

**SEMESTER S3**  
**DIGITAL ELECTRONICS AND LOGIC DESIGN**

(Common to Group A)

|                                       |                 |                    |                |
|---------------------------------------|-----------------|--------------------|----------------|
| <b>Course Code</b>                    | <b>GAEST305</b> | <b>CIE Marks</b>   | 40             |
| <b>Teaching Hours/Week (L:T:P: R)</b> | 3:1:0:0         | <b>ESE Marks</b>   | 60             |
| <b>Credits</b>                        | 4               | <b>Exam Hours</b>  | 2 Hrs. 30 Min. |
| <b>Prerequisites (if any)</b>         | None            | <b>Course Type</b> | Theory         |

**Course Objectives:**

1. To familiarize the basic concepts of Boolean algebra and digital systems.
2. To enable the learner to design simple combinational and sequential logic circuits which is essential in understanding organization & design of computer systems.

**SYLLABUS**

| <b>Module No.</b> | <b>Syllabus Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Contact Hours</b> |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>1</b>          | <p><b>Introduction to digital Systems :-</b> Digital abstraction<br/> Number Systems – Binary, Hexadecimal, grouping bits, Base conversion;<br/> Binary Arithmetic – Addition and subtraction, Unsigned and Signed numbers;<br/> Fixed-Point Number Systems; Floating-Point Number Systems<br/> Basic gates- Operation of a Logic circuit; Buffer; Gates - Inverter, AND gate, OR gate, NOR gate, NAND gate, XOR gate, XNOR gate; Digital circuit operation - logic levels, output dc specifications, input dc specifications, noise margins, power supplies; Driving loads - driving other gates, resistive loads and LEDs.</p> <p><b>Verilog (Part 1) :-</b><br/> HDL Abstraction; Modern digital design flow - Verilog constructs: data types, the module, Verilog operators.</p> | 11                   |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 2 | <p><b>Combinational Logic Design: –</b><br/> Boolean Algebra - Operations, Axioms, Theorems; Combinational logic analysis - Canonical SOP and POS, Minterm and Maxterm equivalence; Logic minimization - Algebraic minimization, K-map minimization, Dont cares, Code convertors.</p> <p><b>Modeling concurrent functionality in Verilog:-</b><br/> Continuous assignment - Continuous Assignment with logical operators, Continuous assignment with conditional operators, Continuous assignment with delay.</p>                                                                                                                                                                                                    | 11 |
| 3 | <p><b>MSI Logic and Digital Building Blocks</b><br/> MSI logic - Decoders (One-Hot decoder, 7 segment display decoder), Encoders, Multiplexers, Demultiplexers; Digital Building Blocks - Arithmetic Circuits - Half adder, Full adder, half subtractor, full subtractor; Comparators.</p> <p>Structural design and hierarchy - lower level module instantiation, gate level primitives, user defined primitives, adding delay to primitives.</p>                                                                                                                                                                                                                                                                    | 8  |
| 4 | <p><b>Sequential Logic Design :-</b> Latches and Flip-Flops- SR latch, SR latch with enable, JK flipflop, D flipflop, Register Enabled Flip-Flop, Resettable Flip-Flop. Sequential logic timing considerations; Common circuits based on sequential storage devices - toggle flop clock divider, asynchronous ripple counter, shift register.</p> <p><b>Finite State Machines :-</b><br/> Finite State Machines - logic synthesis for an FSM, FSM design process and design examples; Synchronous Sequential Circuits - Counters;</p> <p><b>Verilog (Part 2) : -</b><br/> Procedural assignment; Conditional Programming constructs; Test benches; Modeling a D flipflop in Verilog; Modeling an FSM in Verilog.</p> | 14 |

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

| Attendance | Assignment/<br>Microproject | Internal<br>Examination-1<br>(Written) | Internal<br>Examination- 2<br>(Written ) | Total |
|------------|-----------------------------|----------------------------------------|------------------------------------------|-------|
| 5          | 15                          | 10                                     | 10                                       | 40    |

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

| Part A                                                                                                                                                              | Part B                                                                                                                                                                                                                                                                          | Total     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <ul style="list-style-type: none"> <li>2 Questions from each module.</li> <li>Total of 8 Questions, each carrying 3 marks.</li> </ul> <p><b>(8x3 =24 marks)</b></p> | <ul style="list-style-type: none"> <li>Each question carries 9 marks.</li> <li>Two questions will be given from each module, out of which 1 question should be answered.</li> <li>Each question can have a maximum of 3 subdivisions.</li> </ul> <p><b>(4x9 = 36 marks)</b></p> | <b>60</b> |

**Course Outcomes (COs)**

At the end of the course students should be able to:

| Course Outcome |                                                                                                                                                                                                                 | Bloom's<br>Knowledge<br>Level (KL) |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>CO1</b>     | Summarize the basic concept of different number systems and perform conversion and arithmetic operations between different bases.                                                                               | <b>K2</b>                          |
| <b>CO2</b>     | Interpret a combinational logic circuit to determine its logic expression, truth table, and timing information and to synthesize a minimal logic circuit through algebraic manipulation or with a Karnaugh map. | <b>K2</b>                          |
| <b>CO3</b>     | Illustrate the fundamental role of hardware description languages in modern digital design and be able to develop the hardware models for different digital circuits.                                           | <b>K3</b>                          |
| <b>CO4</b>     | Develop MSI logic circuits using both the classical digital design approach and the modern HDL-based approach.                                                                                                  | <b>K3</b>                          |
| <b>CO5</b>     | Develop common circuits based on sequential storage devices including counter, shift registers and a finite state machine using the classical digital design approach and an HDL-based structural approach.     | <b>K3</b>                          |

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

**CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)**

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 3   | 3   | 3   |     |     |     |     |     |     |      |      | 3    |
| <b>CO2</b> | 3   | 3   | 3   | 3   |     |     |     |     |     |      |      | 3    |
| <b>CO3</b> | 3   | 3   | 3   | 3   | 3   |     |     |     |     |      |      | 3    |
| <b>CO4</b> | 3   | 3   | 3   | 3   | 3   |     |     |     |     |      |      | 3    |
| <b>CO5</b> | 3   | 3   | 3   | 3   | 3   |     |     |     |     |      |      | 3    |

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

#### Text Books

| Sl. No | Title of the Book                                          | Name of the Author/s             | Name of the Publisher             | Edition and Year |
|--------|------------------------------------------------------------|----------------------------------|-----------------------------------|------------------|
| 1      | Introduction to Logic Circuits & Logic Design with Verilog | Brock J. LaMeres                 | Springer International Publishing | 2/e, 2017        |
| 2      | Digital Design and Computer Architecture - RISC-V Edition  | Sarah L. Harris,<br>David Harris | Morgan Kaufmann                   | 1/e, 2022        |

#### Reference Books

| Sl. No | Title of the Book                                                                | Name of the Author/s                | Name of the Publisher      | Edition and Year |
|--------|----------------------------------------------------------------------------------|-------------------------------------|----------------------------|------------------|
| 1      | Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog | M Morris Mano,<br>Michael D Ciletti | Pearson                    | 6/e, 2018        |
| 2      | Digital Fundamentals                                                             | Thomas Floyd                        | Pearson                    | 11/e, 2015       |
| 3      | Fundamentals of Digital Logic with Verilog Design                                | Stephen Brown,<br>Zvonko Vranesic   | McGrawHill                 | 3/e, 2014        |
| 4      | Switching and Finite Automata Theory                                             | Zvi Kohavi<br>Niraj K. Jha          | Cambridge University Press | 3/e, 2010        |

| Video Links (NPTEL, SWAYAM...) |                                                                                                           |
|--------------------------------|-----------------------------------------------------------------------------------------------------------|
| No.                            | Link ID                                                                                                   |
| 1                              | <a href="https://nptel.ac.in/courses/117105080">https://nptel.ac.in/courses/117105080</a>                 |
| 2                              | <a href="https://onlinecourses.nptel.ac.in/noc21_ee39/">https://onlinecourses.nptel.ac.in/noc21_ee39/</a> |
| 3                              | <a href="https://onlinecourses.nptel.ac.in/noc24_cs61/">https://onlinecourses.nptel.ac.in/noc24_cs61/</a> |

## SEMESTER S3/S4

### ECONOMICS FOR ENGINEERS

|                                            |                 |                    |                |
|--------------------------------------------|-----------------|--------------------|----------------|
| <b>Course Code</b>                         | <b>UCHUT346</b> | <b>CIE Marks</b>   | 50             |
| <b>Teaching Hours/Week<br/>(L: T:P: R)</b> | 2:0:0:0         | <b>ESE Marks</b>   | 50             |
| <b>Credits</b>                             | 2               | <b>Exam Hours</b>  | 2 Hrs. 30 Min. |
| <b>Prerequisites (if any)</b>              | None            | <b>Course Type</b> | Theory         |

#### Course Objectives:

1. To provide students with an understanding of fundamental economic principles essential for effective decision-making in engineering contexts.
2. To enable students to apply economic analysis to production decisions, cost management, and market strategies in engineering practice.
3. To equip students with the ability to evaluate macroeconomic scenarios, financial methods, and investment decisions relevant to engineering projects.

### SYLLABUS

| <b>Module No.</b> | <b>Syllabus Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Contact Hours</b> |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>1</b>          | Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility –Demand: Factors determining demand – Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Law of supply – Supply curve- Equilibrium price determination- Changes in demand and supply and its effects on equilibrium price and quantity<br><br>Production: Production function - Law of variable proportion –Returns to scale- Cobb-Douglas Production Function | <b>6</b>             |
| <b>2</b>          | Cost: Cost concepts – Private cost and social cost – Sunk cost – Opportunity cost -Explicit and implicit cost –Short run cost curves –Long run average cost curve -Revenue concepts – Break-even point<br><br>Market: Perfect Competition – Monopoly - Monopolistic Competition (features and equilibrium of a firm) - Oligopoly – Features – Kinked demand model                                                                                                                                                                                                        | <b>6</b>             |

|          |                                                                                                                                                                                                                                                                                                                                                             |          |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>3</b> | <p>National income: Concepts (GDP, GNP and NNP)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method-- Difficulties in the measurement of national income.</p> <p>Inflation: Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Repo and reverse repo rate</p>                  | <b>6</b> |
| <b>4</b> | <p>Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure</p> <p>Capital Budgeting: Time value of money - Net Present Value Method - Benefit Cost Ratio – Internal Rate of Return – Payback – Accounting Rate of Return.</p> | <b>6</b> |

**Course Assessment Method**  
(CIE: 50 marks, ESE: 50 marks)

**Continuous Internal Evaluation Marks (CIE):**

| <b>Attendance</b> | <b>Assignment/Case Study/<br/>Microproject</b> | <b>Internal Examination-1<br/>(Written)</b> | <b>Internal Examination- 2<br/>(Written )</b> | <b>Total</b> |
|-------------------|------------------------------------------------|---------------------------------------------|-----------------------------------------------|--------------|
| <b>10</b>         | <b>15</b>                                      | <b>12.5</b>                                 | <b>12.5</b>                                   | <b>50</b>    |

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

| <b>Part A</b>                                                                                                                                                                  | <b>Part B</b>                                                                                                                                                                                                                         | <b>Total</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <ul style="list-style-type: none"> <li>• Minimum 1 and Maximum 2 Questions from each module.</li> <li>• Total of 6 Questions, each carrying 3 marks (6x3 =18 marks)</li> </ul> | <p>2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks.</p> <p style="text-align: right;">(4x8 = 32 marks)</p> | <b>50</b>    |

### Course Outcomes (COs)

At the end of the course students should be able to:

| Course Outcome |                                                                                                                                                                                 | Bloom's Knowledge Level (KL) |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>CO1</b>     | Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.                                 | <b>K2</b>                    |
| <b>CO2</b>     | Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations. | <b>K3</b>                    |
| <b>CO3</b>     | Outline the macroeconomic principles of monetary and fiscal systems and national income.                                                                                        | <b>K2</b>                    |
| <b>CO4</b>     | Make use of the possibilities of value analysis and engineering, and take investment decisions through capital budgeting techniques.                                            | <b>K3</b>                    |

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table:

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | -   | -   | -   | -   | -   | 1   | -   | -   | -   | -    | 1    | -    |
| <b>CO2</b> | -   | -   | -   | -   | -   | 1   | 1   | -   | -   | -    | 1    | -    |
| <b>CO3</b> | -   | -   | -   | -   | 1   | -   | -   | -   | -   | -    | 2    | -    |
| <b>CO4</b> | -   | -   | -   | -   | 1   | 1   | -   | -   | -   | -    | 2    | -    |

| Text Books |                       |                                    |                        |                  |
|------------|-----------------------|------------------------------------|------------------------|------------------|
| Sl. No     | Title of the Book     | Name of the Author/s               | Name of the Publisher  | Edition and Year |
| <b>1</b>   | Managerial Economics  | Geetika, Piyali Ghosh and Chodhury | Tata McGraw Hill,      | 2015             |
| <b>2</b>   | Engineering Economy   | H. G. Thuesen, W. J. Fabrycky      | PHI                    | 1966             |
| <b>3</b>   | Engineering Economics | R. Paneerselvam                    | PHI                    | 2012             |
| <b>4</b>   | Financial Management  | I M Pandey                         | Vikas Publishing House | 2015             |

| Reference Books |                                           |                                            |                            |                         |
|-----------------|-------------------------------------------|--------------------------------------------|----------------------------|-------------------------|
| Sl. No          | Title of the Book                         | Name of the Author/s                       | Name of the Publisher      | Edition and Year        |
| 1               | Engineering Economy                       | Leland Blank P.E,<br>Anthony Tarquin P. E. | Mc Graw Hill               | 7 <sup>TH</sup> Edition |
| 2               | Indian Financial System                   | Khan M. Y.                                 | Tata McGraw Hill           | 2011                    |
| 3               | Engineering Economics and analysis        | Donald G. Newman,<br>Jerome P. Lavelle     | Engg. Press, Texas         | 2002                    |
| 4               | Contemporary Engineering Economics        | Chan S. Park                               | Prentice Hall of India Ltd | 2001                    |
| 5               | Financial Management: Theory and Practice | Prasanna Chandra                           | Mc Graw Hill               | 2007                    |

| MODEL QUESTION PAPER                                                         |        |                                                                                                                                                                                                     |                              |       |
|------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------|
| APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY                                     |        |                                                                                                                                                                                                     |                              |       |
| THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR                    |        |                                                                                                                                                                                                     |                              |       |
| Course Code: UCHUT346                                                        |        |                                                                                                                                                                                                     |                              |       |
| Course Name: Economics for Engineers                                         |        |                                                                                                                                                                                                     |                              |       |
| Max. Marks: 50                                                               |        |                                                                                                                                                                                                     | Duration: 2 hours 30 minutes |       |
|                                                                              | PART A |                                                                                                                                                                                                     |                              |       |
|                                                                              |        | Answer all questions. Each question carries 3 marks                                                                                                                                                 | CO                           | Marks |
| 1                                                                            |        | What are the central problems of an economy?                                                                                                                                                        | CO1                          | (3)   |
| 2                                                                            |        | Point out any three applications of price elasticity of demand.                                                                                                                                     | CO1                          | (3)   |
| 3                                                                            |        | What is the social cost of production?                                                                                                                                                              | CO2                          | (3)   |
| 4                                                                            |        | What is repo rate?                                                                                                                                                                                  | CO3                          | (3)   |
| 5                                                                            |        | What is esteem value?                                                                                                                                                                               | CO4                          | (3)   |
| 6                                                                            |        | Write a short note on time value of money.                                                                                                                                                          | CO4                          | (3)   |
| PART B                                                                       |        |                                                                                                                                                                                                     |                              |       |
| Answer any one full question from each module. Each question carries 8 marks |        |                                                                                                                                                                                                     |                              |       |
| Module 1                                                                     |        |                                                                                                                                                                                                     |                              |       |
| 9                                                                            | a)     | Suppose a country is producing at a point inside the production possibility curve. Draw a PPC and examine this situation.                                                                           | CO1                          | (5)   |
|                                                                              | b)     | State the law of demand. Point out any two exceptions of this law.                                                                                                                                  | CO1                          | (3)   |
| 10                                                                           | a)     | A consumer purchases 10 units of a commodity when its price is Rs.100. Later when its price falls to Rs.90, he purchases 8 units only. Estimate price elasticity. What type of a commodity is this? | CO1                          | (5)   |
|                                                                              | b)     | State the law of variable proportion.                                                                                                                                                               | CO1                          | (3)   |

| Module 2 |    |                                                                                                                                                                                                                                                                                      |     |     |
|----------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 11       | a) | What is oligopoly? Why price is rigid under oligopoly?                                                                                                                                                                                                                               | CO2 | (5) |
|          | b) | The cost function of a firm is given as $TC=1000+10Q-6Q^2+Q^3$ . Calculate fixed cost, variable cost and marginal cost when output is 10 units.                                                                                                                                      | CO2 | (3) |
| 12       | a) | Suppose a firm is earning super normal profit under monopolistic market condition. Explain this situation by drawing a diagram.                                                                                                                                                      | CO2 | (5) |
|          | b) | Suppose a firm sells its product at a price of Rs.10 per unit and its average variable cost is Rs.6. If the firm spend Ra.10000 as rent and pay Rs. 6000 as interest every month, estimate its break-even level of output.                                                           | CO2 | (3) |
| Module 3 |    |                                                                                                                                                                                                                                                                                      |     |     |
| 13       | a) | What is inflation? How does inflation affect investment and production.                                                                                                                                                                                                              | CO3 | (5) |
|          | b) | How will you obtain NNP <sub>fc</sub> from GDP <sub>mp</sub> .                                                                                                                                                                                                                       | CO3 | (3) |
| 14       | a) | From the data given below (In Rs. Crores) estimate GDP <sub>mp</sub> and national income.<br><br>Private final consumption expenditure = 1000, Government expenditure = 500, Invest expenditure = 700, Net exports = 300, Depreciation = 200, NFIA=(-200) and Net indirect tax = 100 | CO3 | (5) |
|          | b) | What is bank rate? Examine the bank rate policy of the government during inflation.                                                                                                                                                                                                  | CO3 | (3) |
| Module 4 |    |                                                                                                                                                                                                                                                                                      |     |     |
| 15       | a) | Examine the procedures of value engineering.                                                                                                                                                                                                                                         | CO4 | (5) |
|          | b) | Examine the application areas of value engineering                                                                                                                                                                                                                                   | CO4 | (3) |

|       |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |
|-------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 16    | a) | 1. Suppose the initial investment of a project is Rs. 3000 (Crores) and the cost of capital or the opportunity cost of capital is 10 percent. Calculate NPV of the project based on the cash flows given below.<br><br>Year                      1                      2                      3                      4                      5<br><br>Cash flow                1000                900                800                700                600<br><br>(In Crores) | CO4 | (5) |
|       | b) | Point out any three merits of NPV method.                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO4 | (3) |
| ***** |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |

## SEMESTER S3/S4

### ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

|                                            |                 |                    |                |
|--------------------------------------------|-----------------|--------------------|----------------|
| <b>Course Code</b>                         | <b>UCHUT347</b> | <b>CIE Marks</b>   | 50             |
| <b>Teaching Hours/Week<br/>(L: T:P: R)</b> | 2:0:0:0         | <b>ESE Marks</b>   | 50             |
| <b>Credits</b>                             | 2               | <b>Exam Hours</b>  | 2 Hrs. 30 Min. |
| <b>Prerequisites (if any)</b>              | None            | <b>Course Type</b> | Theory         |

#### Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

### SYLLABUS

| <b>Module No.</b> | <b>Syllabus Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Contact Hours</b> |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>1</b>          | <b>Fundamentals of ethics</b> - Personal vs. professional ethics, Civic Virtue, Respect for others, <b>Profession and Professionalism</b> , Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, <b>Technology and digital revolution</b> -Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, <b>High technologies: connecting people and places</b> -accessibility and social impacts, <b>Managing conflict</b> , Collective bargaining, <b>Confidentiality</b> , Role of confidentiality in moral integrity, <b>Codes of Ethics</b> .<br><b>Basic concepts in Gender Studies</b> - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, <b>Gender disparity and discrimination in education</b> , | <b>6</b>             |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|          | employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, <b>Ethical values and practices in connection with gender</b> - equity, diversity & gender justice, <b>Gender policy and women/transgender empowerment initiatives.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |
| <b>2</b> | <p><b>Introduction to Environmental Ethics:</b> Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). <b>Sustainable Engineering Principles:</b> Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics.</p> <p><b>Ecosystems and Biodiversity:</b> Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. <b>Landscape and Urban Ecology:</b> Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.</p>                                                                                                                                                       | <b>6</b> |
| <b>3</b> | <p><b>Hydrology and Water Management:</b> Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. <b>Zero Waste Concepts and Practices:</b> Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. <b>Circular Economy and Degrowth:</b> Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. <b>Mobility and Sustainable Transportation:</b> Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.</p> | <b>6</b> |
| <b>4</b> | <p><b>Renewable Energy and Sustainable Technologies:</b> Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. <b>Climate Change and Engineering Solutions:</b> Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. <b>Environmental</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>6</b> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p><b>Policies and Regulations:</b> Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. <b>Case Studies and Future Directions:</b> Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.</p> |  |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Course Assessment Method  
(CIE: 50 marks , ESE: 50)**

**Continuous Internal Evaluation Marks (CIE):**

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

| Sl. No.     | Item                                                                                                             | Particulars                                                                                                                                                                               | Group/Individual (G/I) | Marks     |
|-------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|
| 1           | Reflective Journal                                                                                               | Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.                                                                            | I                      | 5         |
| 2           | Micro project<br><br>(Detailed documentation of the project, including methodologies, findings, and reflections) | 1 a) Perform an Engineering Ethics Case Study analysis and prepare a report<br><br>1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics | G                      | 8         |
|             |                                                                                                                  | 2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context       | G                      | 5         |
|             |                                                                                                                  | 3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV                                                                        | G                      | 12        |
| 3           | Activities                                                                                                       | 2. One activity* each from Module II, Module III & Module IV                                                                                                                              | G                      | 15        |
| 4           | Final Presentation                                                                                               | A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.                                     | G                      | 5         |
| Total Marks |                                                                                                                  |                                                                                                                                                                                           |                        | <b>50</b> |

\*Can be taken from the given sample activities/projects

#### Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

### Course Outcomes (COs)

At the end of the course students should be able to:

| Course Outcome |                                                                                                                                              | Bloom's Knowledge Level (KL) |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>CO1</b>     | Develop the ability to apply the principles of engineering ethics in their professional life.                                                | <b>K3</b>                    |
| <b>CO2</b>     | Develop the ability to exercise gender-sensitive practices in their professional lives                                                       | <b>K4</b>                    |
| <b>CO3</b>     | Develop the ability to explore contemporary environmental issues and sustainable practices.                                                  | <b>K5</b>                    |
| <b>CO4</b>     | Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.                                     | <b>K4</b>                    |
| <b>CO5</b>     | Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach. | <b>K3</b>                    |

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table:

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> |     |     |     |     |     | 3   | 2   | 3   | 3   | 2    |      | 2    |
| <b>CO2</b> |     | 1   |     |     |     | 3   | 2   | 3   | 3   | 2    |      | 2    |
| <b>CO3</b> |     |     |     |     |     | 3   | 3   | 2   | 3   | 2    |      | 2    |
| <b>CO4</b> |     | 1   |     |     |     | 3   | 3   | 2   | 3   | 2    |      | 2    |
| <b>CO5</b> |     |     |     |     |     | 3   | 3   | 2   | 3   | 2    |      | 2    |

| Reference Books |                                                 |                                                   |                                                        |                             |
|-----------------|-------------------------------------------------|---------------------------------------------------|--------------------------------------------------------|-----------------------------|
| Sl. No          | Title of the Book                               | Name of the Author/s                              | Name of the Publisher                                  | Edition and Year            |
| 1               | Ethics in Engineering Practice and Research     | Caroline Whitbeck                                 | Cambridge University Press & Assessment                | 2nd edition & August 2011   |
| 2               | Virtue Ethics and Professional Roles            | Justin Oakley                                     | Cambridge University Press & Assessment                | November 2006               |
| 3               | Sustainability Science                          | Bert J. M. de Vries                               | Cambridge University Press & Assessment                | 2nd edition & December 2023 |
| 4               | Sustainable Engineering Principles and Practice | Bhavik R. Bakshi,                                 | Cambridge University Press & Assessment                | 2019                        |
| 5               | Engineering Ethics                              | M Govindarajan, S Natarajan and V S Senthil Kumar | PHI Learning Private Ltd, New Delhi                    | 2012                        |
| 6               | Professional ethics and human values            | RS Naagarazan                                     | New age international (P) limited New Delhi            | 2006.                       |
| 7               | Ethics in Engineering                           | Mike W Martin and Roland Schinzinger,             | Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi | 4" edition, 2014            |

### Suggested Activities/Projects:

#### Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

### **Module-III**

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

### **Module-IV**

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).