INDIRA

सावित्रीबाई फुले पुणे विद्यापीठ

# Indira College of Engineering and Management

## An Autonomous Institute of

## Savitribai Phule Pune University, Pune

## Maharashtra, India

### National Education Policy (NEP)-2020 Compliant Curriculum

# Second Year B.Tech

# (Electronics and Telecommunication Engineering)

**(With effect from Academic Year 2025-26)**

INDIRA COLLEGE OF ENGINEERING & MANAGEMENT, PUNE-411048 E&TC

**Indira Chanakya Campus (ICC), S.No. 64,65, Gat No. 276 At Post : Parandwadi, Near Somatne phata, Tal. : Maval, Dist. Pune – 410 506**

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# Department of E&TC Engineering

## Semester-III

| Course Code | Name of Course | Course Category (As per NEP) | Teaching Scheme | | | | Credits | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Theory | | | Practical | | Total Marks |
| | | | L | T | P | Total | | TAE | CAE | ESE | INT | EXT | |
| 24UETL301 | Electronic Devices and Circuits | Program Core Course (PCC) | 03 | - | | 03 | 03 | 10 | 15 | 50 | | - | 75 |
| 24UETP301 | Electronic Devices and Circuits Lab | Program Core Course (PCC) | | | 02 | 02 | 01 | | | | | 25 | 25 |
| 24UETL302 | Digital Electronic and logic design | Program Core Course (PCC) | 02 | - | | 02 | 02 | 10 | 15 | 50 | | | 75 |
| 24UETP302 | Digital Electronic and logic design Lab | Program Core Course (PCC) | | | 02 | 02 | 01 | | | | | 25 | 25 |
| 24UETL303 | Control System Design | Program Core Course (PCC) | 02 | | | 02 | 02 | | | 50 | | | 50 |
| 24UETP303 | Control System Design Lab | Program Core Course (PCC) | | | 02 | 02 | 01 | | | | 25 | | 25 |
| 24UETLXXX | Minor-I | M-I | 02 | - | - | 02 | 02 | 10 | 15 | 25 | - | - | 50 |
| 24UETXXXX | Open Elective –I | OE-I (Other Program) | 02 | - | | 02 | 02 | 10 | 15 | 50 | | - | 75 |
| 24UETXXXX | Open Elective –I Lab | OE-I (Other Program) | | | 04 | 04 | 02 | | | | 25 | | 25 |
| 24UESP304 | Entrepreneurship Awareness-I | Entrepreneurship Course | - | - | 04 | 04 | 02 | | | | 25 | - | 25 |
| 24UVEL305 | Understanding India | Value Education (VEC-I) | 02 | - | | 02 | 02 | | | | 25 | - | 25 |
| 24UETP306 | Project Based Learning | Field Project-I | - | - | 04 | 04 | 02 | - | - | - | 25 | - | 25 |
| | Total | | 13 | - | 18 | 31 | 22 | 40 | 60 | 225 | 125 | 50 | 500 |

Prof. D.S. Bhagwate
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# Semester-IV

| Course Code | Name of Course | Course Category (As per NEP) | Teaching Scheme | | | | Credits | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Theory | | | Practical | | Total Marks |
| | | | L | T | P | Total | | TAE | CAE | ESE | INT | EXT | |
| 24UETL401 | Signals and Systems | Program Core Course (PCC) | 03 | - | - | 03 | 03 | 10 | 15 | 50 | - | - | 75 |
| 24UETP401 | Signals and Systems Lab | Program Core Course (PCC) | - | - | 02 | 02 | 01 | - | - | - | 25 | | 25 |
| 24UETL402 | Smart Sensors and IoT | Program Core Course (PCC) | 02 | - | - | 02 | 02 | 10 | 15 | 50 | - | - | 75 |
| 24UETP402 | Smart Sensors and IoT Lab | Program Core Course (PCC) | | | 02 | 02 | 01 | | | | | 25 | 25 |
| 24UETL403 | Mathematical Foundations for Communication | Program Core Course (PCC) | 02 | 1 | | 03 | 03 | 10 | 15 | 50 | | | 75 |
| 24UETLXXX | Minor-II | Minor II | 02 | - | - | 02 | 02 | 10 | 15 | 25 | - | - | 50 |
| 24UETXXXX | Open Elective-II | OE-II (Other Program) | 02 | - | - | 02 | 02 | 10 | 15 | 25 | - | - | 50 |
| 24UETP404 | Electronic Measuring Instruments | Vocational Skill (VSC-III) | - | - | 04 | 04 | 02 | - | - | - | 25 | - | 25 |
| 24UBSP405 | Communication Skills | Ability Enhancement (AEC-I) | - | - | 04 | 04 | 02 | | | | 25 | - | 25 |
| 24UESP406 | Entrepreneurship Awareness-II | Entrepreneurship Course | - | - | 04 | 04 | 02 | | | | 25 | - | 25 |
| 24UVEP407 | Environment Studies | Value Education (VEC-II) | - | - | 04 | 04 | 02 | 10 | 15 | | 25 | - | 50 |
| | **Total** | | **10** | **1** | **22** | **33** | **22** | **60** | **90** | **200** | **100** | **50** | **500** |

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## [24UETL301]: Electronic Devices and Circuits

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 3 Hours/Week | 03 | Teachers Assessment Examination (TAE) | 10 |
| | | Class Assessment Examination (CAE) | 15 |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | 75 |

**Course Prerequisites:** a. Basics of semiconductor Physics
b. Basic Electronics Engineering

| Course Objectives | |
|---|---|
| 1 | To provide students with a broad understanding of the principles underlying electronic devices. |
| 2 | To educate students on modelling techniques, including modelling complex devices like BJT, JFET. |
| 3 | To understand Operational amplifier, Concept, Parameters and applications. |
| 4 | The capability to design and construct circuits, take measurements of circuit behaviour and performance. |
| 5 | The ability of modelling the electronic circuits using simulation tools such as PSPICE, Multisim etc. |
| **Course Outcomes** On successful completion of the course the learner will be able to: | |
| CO1 | Analyse the different application of semiconductor device |
| CO2 | Assimilate the characteristics and parameters of MOSFET towards its application as amplifier. |
| CO3 | Illustrate design and significance of voltage regulators with applications |
| CO4 | To understand Operational amplifier, Concept, Parameters and applications |
| CO5 | Illustrate the concept of feedback and study feedback amplifiers and oscillators. |

| Contents | No. of Session |
|---|---|
| **Unit 1: Applications of Semiconductor Devices** | |
| Diode applications as Rectifier, Bridge rectifier. DC Regulated power supply, and it's performance parameters. Transistor as a switch, Load Line & Modes of operation, Transistor amplifier and configurations CE,CC, CB and their comparisons and applications. Small Signal Amplifier and It's Frequency Response. | 9 |
| **Unit 2: JFET and MOSFET** | |
| JFET: Introduction, Types, Construction of JFET, Characteristics (Transfer and Drain), biasing and DC analysis, JFET as amplifier, CS amplifier analysis. MOSFET types and configurations, Construction of n-channel E- MOSFET, E- MOSFET characteristics & parameters, Common source circuit, Load Line & Modes of operation, Introduction to MOSFET as a basic element in VLSI , Introduction to BiCMOS Technology | 9 |
| **Unit 3: Voltage Regulators** | |

| | |
|---|---|
| Block diagram of linear voltage regulator, Three terminal voltage regulators 78XX, 79XX, IC 317 and IC337, Features and specifications, typical circuits, current boosting, Low Dropout Regulator (LDO). SMPS: Block diagram, Types, features and specifications, typical circuits buck and boost converter. | 9 |
| **Unit4: OP-AMP** | |
| Block diagram of OP-Amp, Symbol and ideal equivalent circuit of OpAmp, DC and AC characteristics of Op-Amp, Inverting and non-inverting amplifier, Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, Practical differentiator, Instrumentation amplifier, Comparator, Schmitt trigger, Square & triangular wave generator. | 9 |
| **Unit 5: Feedback amplifiers and Oscillators** | |
| Four types of amplifiers, Types of Feedback, Feedback topologies and their comparison, Effect of feedback on terminal characteristics of amplifiers, Examples of voltage series and Current series feedback amplifiers and their analysis. Barkhausen criterion, Types of Oscillator, RC Phase Shift oscillator, Hartley Oscillator, Colpitts oscillator .Crystal oscillator | 9 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | Donald Neaman,"Electronic Circuits - Analysis and Design", Mc Graw Hill, 3 rd Edition 2016 |
| 2 | Ramakant Gaikwad, "Op Amps & Linear Integrated Circuits", Pearson Education. |
| 3 | N.P. Deshpande,"Electronic Devices and Circuits Principles and Applications", TMH,1st Edition ,2009 |
| 4 | Floyd,—Electronic Devices, Pearson, 10th Edition,2017 |
| **Reference Books** | |
| 1 | Boylestead & Nashelsky,—Electronic devices and Circuits Theory, PHI, 11th edition, 2022 |
| 2 | S.Salivahanan,—Electronic Devices and Circuits ,Tata McGraw Hill, 2nd Edition, 2014 |
| 3 | David A.Bell,—Electronic Device and Circuitsl, PHI, 5th Edition,2012 |
| **E- Contents / MOOC** | |
| 1 | NPTEL Course "Semiconductor devices" https://nptel.ac.in/courses/117102061 |
| 2 | NPTEL Course on "Analog Electronic Circuits" https://archive.nptel.ac.in/courses/108/105/108105158/ |

## [24UETP30]: Electronic Devices and Circuits Lab [PR]

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | External Practical Exam: | 25 |
| | | **Total** | **25** |

**Course Prerequisites:** Basic Electronics

**Course Objectives:** To familiarize and educate the student with practical knowledge of electronic device & circuit.

**Course Outcomes:** After the completion of course student is able to analyse different application of semiconductor device

| Expt. No. | List of Experiments (Any 08 to be performed) |
|---|---|
| 1. | Plot/Simulate V-I characteristics of MOSFET. |
| 2. | To plot load and line regulation of voltage regulator IC 78XX |
| 3. | To design & implement an adjustable voltage regulator using three terminal voltage regulator IC 317 |
| 4. | To implement current series feedback amplifier & measure Ri, Ro, Av |
| 5. | Single stage CS amplifier, plot frequency response. Calculate Av, Ri , Ro & bandwidth |
| 6. | Simulate frequency response of single stage BJT CE / JFET CS amplifier. (Effect of coupling and bypass capacitors.) |
| 7. | Schmitt trigger and it's transfer characteristics. |
| 8. | MOSFET amplifier-based Wein bridge oscillator. |
| 9. | Simulate Hartley / Colpitt's oscillator |
| 10. | Square and triangular waveform generator using Op-Amp |
| 11. | Study of Instrumentation Amplifier using OPAMP |

## [24UETL302]: Digital Electronics and Logic Design

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 2 Hours/Week | 02 | Teachers Assessment Examination (TAE) | 10 |
| | | Class Assessment Examination (CAE) | 15 |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | **75** |

**Course Prerequisites:** Basic Electronics Engineering

| **Course Objectives** | |
|---|---|
| 1 | To understand and compare the functionalities, properties and applicability of Logic Families |
| 2 | To design and implementation of Combinational and Sequential Circuits. |
| 3 | To understand the concept of programmable logic devices and ASM chart and Design of synchronous state machines |
| 4 | To design and implement digital circuits using VHDL |

| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
|---|---|
| CO1 | Apply knowledge of the digital logic family for the selection of ICs used in applications |
| CO2 | Realize and simplify Boolean expression for designing digital circuits using K-Maps |
| CO3 | Design and implement Sequential and Combinational digital circuits. |
| CO4 | Understand the concept of state machines, PLA, PAL or PLD |
| CO5 | Design simple digital systems using VHDL |

| Contents | No. of Session |
|---|---|
| **Unit 1: Digital Logic Families** | |
| Classification of logic families, Characteristics of digital ICs, Operation of TTL NAND gate,<br>active pull up, wired-AND, open collector output, unconnected inputs. Tri-State logic.<br>CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic,<br>open drain output. Interfacing CMOS and TTL. | 6 |
| **Unit 2: Combinational Logic Circuits-I** | |
| Logic minimization: Representation of truth-table, Sum of Product (SOP) form, Product of Sum (POS) form, Simplification of logical functions, Minimization of SOP and POS forms using KMaps up to 4 variables.<br>Design Examples: Adders and Subtractor, 4-bit Binary Adder, 4-bit BCD adder, look ahead carry, BCD - to – 7 segment decoder, Code converters, Digital Comparator, Parity generators/ checkers,<br>Multiplexers and their use in combinational logic designs, multiplexer trees. De-multiplexers and their use in combinational logic designs, Demultiplexer trees. | 6 |
| **Unit 3: Sequential Logic Design** | |
| 1-Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops, Timing parameters of flip flops. Application of Flip flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), ripple counters, up/down counters, synchronous counters. | 6 |

| | |
|---|---|
| | |
| **Unit 4: State Machines & Programmable Logic Devices** | |
| Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence Generator and detector.<br>Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, designing combinational circuits using PLDs | 6 |
| **Unit 5: Digital Design using VHDL** | |
| VHDL: Introduction to HDL, Data Objects & Data Types, Attributes., VHDL- Library, Design Entity, Architecture, Modeling Styles, Concurrent and Sequential Statements, Design Examples: VHDL for Combinational Circuits-Adder, MUX, VHDL for Sequential Circuits, Synchronous and Asynchronous Counter. | 6 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | R.P. Jain, "Modern digital electronics", 3rd edition, 12th reprint Tata McGraw Hill Publication, 2007. |
| 2 | M. Morris Mano, "Digital Logic and Computer Design", 4th edition, Prentice Hall of India, 2013. |
| 3 | D. L. Perry, "VHDL Programming by Example" 4th Edition, McGraw Hill Publication, 2002. |
| **Reference Books** | |
| 1 | W. H. Gothman, "Digital Electronics-An introduction to theory and practice", Pearson Education,1982 |
| 2 | C.H. Roth, "Digital System Design using VHDL", 3rd Edition, CENGAGE Learning, 2016 |
| 3 | D.P. Leach, A. P. Malvino and G. Saha, " Digital Principles And Application" 7th Edition, Tata McGraw Hill Publication, 2011. |
| 4 | S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design" 3rd Addition, McGraw Hill Publication, 2017 |
| **E- Contents / MOOC** | |
| 1 | Digital Circuits, by Prof. Santanu Chattopadhya, https://onlinecourses.nptel.ac.in/noc19_ee51/preview |
| 2 | https://www.coursera.org/learn/design-of-digital-circuits-with-vhdl-programming |
| 3 | Digital System Design ,By Prof. Neeraj Goel https://onlinecourses.nptel.ac.in/noc21_ee39/preview |

# [24UETP302]: Digital Electronics and Logic Design Lab

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | External Practical Exam: | 25 |
| | | **Total** | **25** |

**Course Prerequisites:** Basic Electronics Engineering

**Course Objectives:**

To introduce Basic Digital ICs and their working principles.
To deliver concepts related to designing basic combinational logic circuits.
To demonstrate designing of basic sequential circuits.
Implementations of Digital circuits using VHDL.

**Course Outcomes:**

After the completion of this course, the students will be able to:
Demonstrate the use of digital ICs in designing combinational circuits.
Demonstrate the use of digital ICs in designing sequential circuits.
Design and Simulate basic combinational and sequential using HDL design flow

| General Guidelines: Any 6 from Part A and all experiments from Part B is compulsory | |
|---|---|
| **Expt.No.** | **Suggested List of Experiments/Tutorials** |
| **Part A: Combinational and Sequential Logic Circuit Implementation** | |
| 1. | Study of IC-74LS153 as a Multiplexer:<br>a. Design and Implement 8:1 MUX using IC-74LS153 & Verify its Truth-Table.<br>Design & Implement the given 4 variable functions using IC74LS153. Verify its Truth-Table. |
| 2. | Study of IC-74LS138 as a Demultiplexer / Decoder:<br>a. Design and Implement full adder / subtractor function using IC-74LS138. |
| 3. | Study of IC-74LS83 as a BCD adder:<br>a. Design and Implement 1 digit BCD adder using IC-74LS83. |
| 4. | Study of IC-74LS85 as a magnitude comparator:<br>a. Design and Implement 5-bit comparator. |
| 5. | Design and Implement MOD-N / MOD-NN using IC-74LS90 and draw a Timing diagram |
| 6. | Design and implement Up and down counter using Flip Flop. |
| 7. | Design & Implement MOD-N Up/down Counter using IC74HC191/ IC74HC193. Draw Timing Diagram |
| 8. | Design and implement sequence detector using Flip flop. |
| **Part B: VHDL based Design and Simulation** | |
| 9. | Design and Simulate adder, subtractor and 3 bit binary to gray converter using VHDL/ Verilog |
| 10. | Design and Simulate 3 bit up/ down counter using VHDL/ Verilog |

| Learning Resources | |
|---|---|
| **Reference Books** | |
| 1 | S. Brown and Z. Vranesic, "Fundamentals of Digital Logic with VHDL Design" 3rd Addition, McGraw Hill Publication, 2017 |
| 2 | D. L. Perry, "VHDL Programming by Example" 4th Edition, McGraw Hill Publication, 2002. |
| **E- Contents / Virtual Labs:** | |
| 1 | https://de-iitr.vlabs.ac.in/ |
| 2 | https://www.mooc-list.com/course/digital-systems-logic-gates-processors-coursera |

## [24UETL303]: Control System Design

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 2 Hours/Week | 03 | Teachers Assessment Examination (TAE) | - |
| | | Class Assessment Examination (CAE) | - |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | **50** |

**Course Prerequisites:** Basic Electronics Engineering

| **Course Objectives** | |
|---|---|
| 1 | To understand the fundamentals and classification of control systems and their applications. |
| 2 | To model physical systems using differential equations, transfer functions, and state-space methods. |
| 3 | To perform time and frequency domain analysis for assessing system behaviour and stability. |
| 4 | To explore root locus, Bode plots, and criteria for control system design and analysis. |
| 5 | To explore digital controllers and PID tuning for real-time control and automation applications |

| **Course Outcomes** On successful completion of the course the learner will be able to: | |
|---|---|
| CO1 | Model physical systems using transfer functions. |
| CO2 | Analyse system response in the time domain and interpret system behaviour. |
| CO3 | Determine system stability using analytical and graphical techniques. |
| CO4 | Perform frequency domain analysis using Bode plots and Root locus Method. |
| CO5 | Evaluate and differentiate control strategies (P, PI, PD, PID) and their application. |

| **Contents** | **No. of Session** |
|---|---|
| **Unit I: Block Diagram Reduction Techniques** | |
| Introduction to control systems, control system terminology and basic structure, feedforward and feedback control theory, open-loop and closed-loop systems, real-world examples and system classifications, real-world applications of control systems, derivation of transfer functions from physical systems, introduction to block diagrams, elements of block diagrams – blocks, summing points, take-off points, modeling of electrical and mechanical systems, block diagram representation of systems, block diagram algebra rules, block diagram simplification techniques for series, parallel, and feedback configurations, block diagram algebra for multiple-input and multiple-output (MIMO) systems, use of critical rules in simplification, moving summing and take-off points, and numerical problems on block diagram reduction. | 6 |
| **Unit 2: Signal Flow Graph** | |
| Introduction to signal flow graphs, basic elements – nodes, branches, and gains, construction of signal flow graphs from system models and block diagrams, conversion of block diagrams to signal flow graphs, forward paths, loops, loop gain, non-touching loops, Mason's Gain Formula, application of Mason's formula to compute overall transfer function, signal flow graphs for multiple-input and multiple-output (MIMO) systems, solving SFGs using Mason's rule, and numerical problems based on signal flow graph analysis. | 6 |

| Unit 3: Stability Analysis and Root Locus | |
|---|---|
| Stability concepts and criteria, Routh-Hurwitz stability test, Pole-zero concept, effect of pole-zero locations, magnitude and angle conditions, Root locus construction, dominant poles, system behaviour with additional poles/zeros. Application of root locus for stability analysis. | 6 |
| **Unit 4: Frequency Domain Analysis** | |
| Frequency response and frequency domain specifications, correlation between time domain and frequency domain specifications. Frequency response and specifications, Bode plot, polar plot, Gain margin, Phase margin graph method, stability analysis using Bode techniques, Time-frequency domain correlation. | 6 |
| **Unit 5: Industrial Controllers** | |
| Control actions: P, I, D, PI, PD, PID controllers, Controller tuning methods (Zeigler-Nichols), Offset and reset actions, Digital controllers and real-time control systems, IoT and Concept of Industrial Automation, Need of IoT based Industrial Automation. | 6 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | N. J. Nagrath and M. Gopal, *Control System Engineering*, New Age International, 5th Edition |
| 2 | K. Ogata, *Modern Control Engineering*, Prentice Hall, 5th Edition |
| **Reference Books** | |
| 1 | Benjamin C. Kuo, *Automatic Control Systems*, PHI, 7th Edition |
| 2 | M. Gopal, *Control Systems – Principles and Design*, McGraw Hill, 4th Edition |
| 3 | Schaum's Outline, *Feedback and Control Systems*, McGraw-Hill |
| 4 | D'Azzo & Houpis, *Linear Control System Analysis and Design*, McGraw-Hill |
| 5 | Dorf & Bishop, *Modern Control Systems*, Pearson |
| **E- Contents / MOOC** | |
| 1 | Control Systems, by Prof. C s Shankar Ram IIT Madras, https://nptel.ac.in/courses/107/106/107106081/ |
| 2 | Control Systems Analysis: Modeling of Dynamic Systems \| Coursera |
| 3 | Modelling and simulation of mechanical systems (Coursera) \| MOOC List |

## [24UETP303]: Control System Design Lab

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | Internal Practical Exam: | 25 |
| | | **Total** | **25** |

**Course Prerequisites:** Basic Electronics Engineering

**Course Objectives:**

To develop the ability to model, simplify, and analyze control systems using block diagrams and signal flow graphs.

To provide hands-on experience with time and frequency domain analysis of dynamic systems.

To simulate and interpret control system behavior using software tools for performance and stability.

To understand the effect of classical controllers (P, PI, PD, PID) on system response and performance.

**Course Outcomes:**

Compute and analyze transfer functions using block diagram reduction and signal flow graph techniques.

Evaluate system time response characteristics and stability using analytical and simulation tools.

Perform frequency domain analysis (Bode plots) and root locus for a given system to assess stability margins.

Analyse and interpret the effect of various controllers (P, PI, PD, PID) on control system performance parameters.

**General Guidelines: All experiments are compulsory and Use software tool like MATLAB/Scilab**

| Expt.No. | Suggested List of Experiments/Tutorials |
|---|---|
| 1. | Computation and analysis of on Black diagram reduction technique (at least 4 numericals) |
| 2. | Numerical on Signal Flow Graphs (at least 4 numericals) |
| 3. | Computation of transfer function of, Mechanical Circuits for concept understanding with their analogy Force-Voltage and Force Current. |
| 4. | Standard input signals and time response analysis of First Order and Second Order Systems for step input. |
| 5. | Stability analysis for any given system with Characteristic Equation given (Software Simulation). |
| 6. | Computation and Software / Simulation of root locus for given G(s)H(s). Comment on time domain specifications and stability of the system. |
| 7. | Computation and analysis of frequency response analysis u Bode Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system. |
| 8. | Observe the effect of P, PI, PD and PID controller on the step response of a feedback control system. Comment on effect of Controller mode Time domain specifications/ analysis. |

| Learning Resources | |
|---|---|
| **Reference Books** | |
| 1 | "Control Systems Engineering" – By I.J. Nagrath and M. Gopal, New Age International Publishers, 6th Edition |
| 2 | "Automatic Control Systems" – By B.C. Kuo and Farid Golnaraghi, Wiley India, 9th Edition |
| 3 | "Modern Control Engineering" – By Katsuhiko Ogata, Pearson Education, 5th Edition |
| 4 | "Feedback Control of Dynamic Systems" – By Gene F. Franklin, J. David Powell, and Abbas Emami-Naeini, Pearson, 7th Edition |
| 5 | "Control Systems: Principles and Design" – By M. Gopal, McGraw-Hill Education, 4th Edition |
| **E- Contents / Virtual Labs:** | |
| 1 | Control Systems Virtual Lab – IIT Roorkee: http://cse10-iitr.vlabs.ac.in/ |
| 2 | Digital Control Systems Laboratory – IIT Guwahati: http://ssl-iitg.vlabs.ac.in/ |
| 3 | NPTEL Online Course on Control Engineering by Prof. S. D. Agashe: https://nptel.ac.in/courses/108/106/108106098/ |
| 4 | Scilab for Control Systems Simulations (Open Source): https://www.scilab.org |

## [24UETLXXX]: Minor-I

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Theory: 2 Hours/Week | 02 | Teachers Assessment Examination (TAE): | 10 |
| | | Class Assessment Examination (CAE): | 15 |
| | | End Semester Examination (ESE): | 25 |
| | | **Total** | **50** |
| | | | |
| **Note:** *Please select the Minor from the Basket of Minors* | | | |

## [24UXXXXXXX]: Open Elective-I

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Theory: 3 Hours/Week | 03 | Teachers Assessment Examination (TAE): | 10 |
| | | Class Assessment Examination (CAE): | 15 |
| | | End Semester Examination (ESE): | 50 |
| | | **Total** | **75** |
| | | | |
| **Note:** *Please select the Open Elective from the Basket of Open Electives* | | | |

## [24UXXXXXXX]: Open Elective-1 Laboratory

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | Internal Practical Exam (OR) | 25 |
| | | | |
| | | **Total** | **25** |
| | | | |
| **Note:** *Please select the Open Elective lab from the Basket of Open Electives* | | | |

# [24UESP304]: Entrepreneurship Awareness - I

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Internal Practical Exam | 25 |
| | | **Total** | **25** |
| | | | |
| **Course Prerequisites:** [24UBSL113] : Professional Communication | | | |

| **Course Objectives** | |
|---|---|
| 1 | To introduce the entrepreneurship skills and the entrepreneurial mind-set. |
| 2 | To familiarize students with tools for identifying business opportunities and managing risks. |
| 3 | To enhance leadership, creativity, and problem-solving capabilities. |
| 4 | To teach students how to develop a comprehensive business plan. |
| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
| CO1 | Understand the skills required by a good Entrepreneur. |
| CO2 | Demonstrate Leadership and Teamwork Skills: Cultivate leadership qualities and work effectively in teams for business success. |
| CO3 | Identify Business Opportunities: Analyze market trends, recognize gaps, and generate innovative business ideas. |
| CO4 | Develop a Business Plan: Create a feasible business plan covering vision, mission, market analysis, financial projections, and strategic planning. |

| List of Laboratory Assignments | |
|---|---|
| 1 | Students should execute the self **SWOC analysis** and Analyze it. |
| 2 | **Importance of Leadership, Teamwork, and Management Skills** and execute an activity. (Leadership Styles and Entrepreneurship, Building and Managing Teams in Startups, Conflict Resolution and Negotiation Skills, Effective Communication for Entrepreneurs, Motivating and Managing Employees) |
| 3 | **Introduction to Entrepreneurship -** Definition of Entrepreneurship, Characteristics and Traits of Successful Entrepreneurs, The Role of Entrepreneurs in Economic Development, Types of Entrepreneurship (small business, scalable startups, large companies, social enterprises), The Entrepreneurial Mindset: Risk-taking, Innovation, Resilience |
| 4 | **Opportunity Identification and Idea Generation** -Techniques for Identifying Business Opportunities, Creativity and Innovation in Entrepreneurship, Evaluating Feasibility and Potential of Business Ideas, Tools for Idea Generation: Brainstorming, Design Thinking |
| 5 | **Business Planning and Strategy Development:** Importance of a Business Plan, Components of a Business Plan: Executive Summary, Market Research, Marketing Strategy, Operational Plan, Developing Financial Projections (Revenue, Cost, Profit), Strategic Planning and Goal Setting, Business Model Design (e.g., B2B, B2C, SaaS). |

| | |
|---|---|
| 6 | **Marketing for Entrepreneurs:** Market Research and Competitive Analysis, Developing a Marketing Plan and Strategy, Brand Positioning and Building a Brand Identity, Customer Acquisition and Retention Strategies |
| 7 | **Financial Management for Entrepreneurs:** Basics of Accounting and Financial Statements (Income Statement, Balance Sheet, Cash Flow), Budgeting and Financial Forecasting, Understanding Capital Requirements and Funding Needs, Financial Ratios and Decision-Making. |
| 8 | **Risk Management and Problem-Solving:** Identifying and Analyzing Business Risks, Risk Management Strategies: Risk Avoidance, Mitigation, and Transfer, Crisis Management and Business Continuity Planning, Decision-Making Models for Entrepreneurs. |
| 9 | Case Studies of an Entrepreneur. |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | *"Start with Why"* by Simon Sinek – Explores the importance of defining the purpose behind a business. |
| 2 | *"The Lean Startup"* by Eric Ries – A guide on how startups can efficiently build products and scale through iterative testing and feedback. |
| 3 | *"Business Model Generation"* by Alexander Osterwalder and Yves Pigneur – A comprehensive guide to creating and analyzing business models. |
| 4 | *"The Innovator's Dilemma"* by Clayton Christensen – A look at how companies can innovate and grow in changing markets. |
| **Journal Articles** | |
| 1 | *"Entrepreneurship as a Career Choice: Implications for Education and Research"* by K. R. Venkataraman and S. S. Sarasvathy, *Academy of Management Learning & Education.* |
| 2 | *"The Role of Entrepreneurship Education in Shaping Entrepreneurial Intentions", Journal of Business Venturing.* |
| **E- Contents** | |
| 1 | *Harvard Business Review (HBR) – Articles on entrepreneurship, leadership, and business strategy.* |
| 2 | *Entrepreneur.com – A website offering advice on various aspects of entrepreneurship.* |
| **Case Studies** | |
| 1 | *Harvard Business School Case Studies* – Real-world business problems for entrepreneurs. |
| 2 | *Case Study: Airbnb's Startup Journey* – From the ground up to global success. |
| 3 | *The Uber Growth Story* – Scaling and disrupting the transportation industry. |

# [24UVEL305]: Understanding India

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: 2 Hours/Week | 02 | Internal Practical Exam (OR) | 25 |
| | | **Total** | **25** |
| | | | |
| **Course Prerequisites:** Basic knowledge about Indian history, geography, culture, society, and polity | | | |

| **Course Objectives** | |
|---|---|
| 1 | To expose the students to our social, economic and cultural heritage |
| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
| CO1 | Contemporary India with its historical perspective |
| CO2 | Constitutional obligations: fundamental rights and duties. |
| CO3 | Indian knowledge systems (IKS) |
| CO4 | India's struggle for freedom |

| Contents | No. of Session |
|---|---|
| **Unit 1: Geography of India** | |
| India on the map of world and its neighbouring countries • Physical features of India including mountain, plateau, plain, coast, island, vegetation, rivers, soils, and climate • Racial diversities, Population, its growth, distribution, Migration • People and Culture of India: Major Festivals, Culinary traditions and Costumes | 4 |
| **Unit 2: History of India** | |
| Harappan civilisation and Vedic age • Religious Tradition of India: Vedic Age, Buddhism, Jainism, Bhakti, Sufi, Social Reform Movement and Revivalism. • Hinduism and its etymological roots • Indian Universities-Taxila, Nalanda, IITs, NITs, IIMs • Accounts of foreign travellers-Huan Tsang, Itsing, Ibn Batuta, Al Baruni • Case study of Vijaynagar Empire, Chola Empire & Maratha Empire • Literary masterpieces of India-Kalidas | 8 |
| **Unit 3: Understanding Indian Economy & polity** | |
| Kautilya's Arthashastra & Mauryan administration • Vidurneeti • Kacchitsarg • Forms of govt in India-16 Mahajanpadas | 6 |
| **Unit4: Indian Constitution** | |
| Preamble, Salient features, Fundamental rights, Fundamental duties • Important Bills | 4 |
| **Unit 5: Nationalists in Indian National Movements** | |
| 1857 revolt • Non-violence, Satyagraha and Social Justice • Leaders of India's freedom struggle: Lokmanya Tilak, V D Savarkar, Mahatma Gandhi, Subhashchandra Bose, Bhagatsingh. | **8** |

| Learning Resources | |
|---|---|
| **Text Book** | |
| 1 | Bipan Chandra (1987). India's Struggle for Independence. Penguin. Delhi |
| 2 | Dhar. P. K. (2000): Growing Dimensions of Indian Economy. Kalyani Publishers. New Delhi. |
| 3 | Dhingra. I. C. (2020): Indian Economy. Sultan Chand & Sons. New Delhi. |
| 4 | Dutt, R. and Sundharam (2018): Indian Economy. S. Chand & Co. Ltd. New Delhi |
| 5 | Gautam A (2009): Advanced Geography of India. Sharda Pustak Bhawan. Allahabad. |
| 6 | Godschalk. D.R. (et.al.) (1999): Natural Hazard Mitigation Recasting Disaster Policy and Planning. Island Press. Washington. D.C. |
| 7 | Gore. M. S. (2002) Unity in Diversity: The Indian Experience in Nation-Building. Rauat Publication. Jaipur. |
| 8 | Government of India, Economic Survey (Annual). Economic Division. Ministry of Finance, New Delhi. |
| 9 | K. Roy, C. Saunders and J. Kincaid (2006) (eds.) 'A Global Dialogue on Federalism'. Volume 3Montreal, Queen's University Press. |
| 10 | Kabir. Humayun (1946). Our Heritage. National Information and Publications Ltd., Mumbai. |
| 11 | L. Rudolph and S. Rudolph. (2008) 'Explaining Indian Institutions: A Fifty-Year Perspective, 1956-2006'. Volume 2. Neu Delhi. Oxford University Press. |
| 12 | M. Singh, and R. Saxena (2011) (eds.), 'Indian Politics: Constitutional Foundations and Institutional Functioning'. Delhi: PHI Learning Private Ltd. |
| 13 | Malik. S. C. (1975). Understanding Indian Civilization: A Framework of Enquiry. Indian Institute of Advanced Study |
| **E- Contents:** | |
| 1 | https://onlinecourses.swayam2.ac.in/ntr25_ed18/preview |

# [24UETP306]: Project Based Learning

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Internal Practical Exam: | 50 |
| | | **Total** | **50** |

**Preamble:**

Traditional engineering education usually relies on classroom teaching where the teacher leads, and students have limited involvement in how they learn. However, with the fast pace of technological progress, there's a growing need to adopt teaching methods that help students gain practical, industry-ready skills and prepare them for future changes in their careers.

Project-Based Learning (PBL) is one such approach used to develop electronic system curricula, making electronics more engaging. Since electronics is a foundation for other fields like computer science, signal processing, and communication, this method encourages multidisciplinary project development. The PBL approach can make electronics more interesting by introducing lab-based projects where students build complete systems using knowledge from different areas.

**Course Objectives:**

- Focus on long-term, interdisciplinary, and student-driven project activities.
- Develop independent and team-based problem-solving using real-life challenges and available resources.
- Build applications grounded in electronics and communication engineering by using previously learned knowledge.
- Gain practical exposure to the full life cycle of electronic system development: specification, design, implementation, and testing.
- Choose appropriate software and hardware tools for system design and analysis.
- Work individually or in groups, improving teamwork and professional behavior.

**Course Outcomes:**

- CO1: Identify real-world (interdisciplinary) problems through detailed literature study and set clear aims and objectives.
- CO2: Provide meaningful solutions that benefit society while following safety norms and professional ethics.
- CO3: Use core knowledge of electronics and communication engineering to suggest suitable solutions.
- CO4: Analyze outcomes effectively and draw proper conclusions.
- CO5: Utilize technology in the project and communicate results in both oral and written form. Build the ability to contribute individually and as part of a team.

**General Guidelines:**

**Group Structure:**
Students will work in small groups (2 to 3 members) under the supervision of a faculty mentor. Each team will plan and complete a task/project that addresses the selected problem.

**Project Selection:**
Students must carry out a survey (via journals, patents, or field visits) to identify a relevant problem. The issue can be theoretical, technical, practical, social, symbolic, scientific, or cultural. Feasibility must be evaluated, followed by problem analysis, system design, and component value determination.
There are no fixed rules for selecting a valid project—it may vary in scope, learning goals, and structure. The problem-oriented learning model is preferred, beginning with a well-defined problem arising from curiosity or need. The problem should be rooted in students' own observations from various disciplines or industries.
Since electronics is a base for many fields, the project can be interdisciplinary. However, electronics and communication engineering principles must be used in solving the problem. At least 40% of the developed system should include electronic components. In exceptional cases, 100% software-based projects may be accepted.

**Ethical Practices, Teamwork, and Project Management:**
Follow IEEE standards in project development, value others' time, attend all reviews, participate in poster presentations and exhibitions, and meet project deadlines. Follow all safety and legal regulations.

**Effective Documentation:**
Students should learn to write clear and detailed project reports. The final PBL report should include:
- Literature Survey
- Problem Statement
- Aim and Objectives
- System Block Diagram
- Implementation Details
- Results Analysis
- Conclusion
- Limitations and Future Work

Students can use tools like Medley (Elsevier), Grammarly, etc., to help with report writing. Mentors should guide students in using valid sources such as research papers, books, or magazines relevant to their topics.

**Evaluation and Continuous Assessment:**
Faculty mentors and department authorities will assess both student performance and the overall effectiveness of the program. Weekly project reviews are mandatory, and both individual and group progress must be recorded.

**Students must maintain a PBL logbook with:**
- Weekly mentor reviews
- Review and evaluation sheets signed by the mentor

**Assessment Parameters and Weightage:**

| Sr. No. | Evaluation Criteria | Weightage |
|---|---|---|
| 1 | Idea generation and initial research (survey) | 10% |
| 2 | Project outcome (publication, copyright, patent, prototype, product) | 50% |
| 3 | Documentation (requirements, design, implementation, technology use, reports) | 15% |
| 4 | Attendance in reviews, poster presentations, model exhibitions | 10% |
| 5 | Project demonstration (poster/model) | 10% |
| 6 | Awareness of environmental, social, ethical, legal, and safety considerations | 5% |

| **Learning Resources** |
|---|
| **Reference Books** |
| 1. John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning". |
| 2. John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences". |
| 3. Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry". M. Krašna, "Project based learning (PBL) in the teachers' education,"39th International Convention on Information and Communication Technology, Electronics and Microelectronics. |
| 4. J. Macias- Guarasa, J.M. Montero, R. San-Segundo, A. Araujo and O. Nieto-Taladriz, "A project based learning approach to design electronic systems curricula", IEEE transactions on Education. |
| **E- Contents:**<br>• Project-Based Learning, Edutopia, March 14, 2016.<br>• What is PBL? Buck Institute for Education.<br>• www.howstuffworks.com<br>• www.wikipedia.org |

# SEMESTER- IV

## [24UETL401]: Signals and Systems

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 3 Hours/Week | 03 | Teachers Assessment Examination (TAE) | 10 |
| | | Class Assessment Examination (CAE) | 15 |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | **75** |
| **Course Prerequisites:** | | | |

| **Course Objectives** | |
|---|---|
| 1 | To mathematically represent and classify continuous-time and discrete-time signals and systems |
| 2 | To analyse linear time-invariant (LTI) systems using convolution, impulse response, and system properties. |
| 3 | To apply Fourier series, Fourier Transform, Laplace Transform, and Z-Transform for signal and system analysis in frequency domain. |
| **Course Outcomes** On successful completion of the course the learner will be able to: | |
| CO1 | Classify and mathematically represent signals and systems based on their properties. |
| CO2 | Perform basic operations on signals and analyze their effect in time domain. |
| CO3 | Determine system response using convolution and evaluate system behavior based on impulse response. |
| CO4 | Analyze signals using Fourier series and Fourier transform for frequency domain characterization. |
| CO5 | Apply Laplace and Z-transforms for system analysis, including stability and causality assessment. |

| **Contents** | **No. of Session** |
|---|---|
| **Unit 1: Introduction to Signals** | |
| Definition of Signals and Systems, Conversion of analog signal to digital signal, Classification of signals: Continuous Time (CT) and Discrete Time (DT), Even, Odd, Periodic and aperiodic, Deterministic and random, Energy and power, Operations on signals: Amplitude scaling, Time scaling, Time shifting and Folding, Precedence rule, Addition, Multiplication, Differentiation, Integration, Elementary signals: Impulse and its properties, Step, Ramp, Exponential, Sine, Rectangular, Triangular, Signum and Sinc | 9 |
| **Unit 2: System Classification** | |

| | |
|---|---|
| System: Definition, Classification: linear and nonlinear, Time variant and invariant, Causal and non-causal, Static and dynamic, Stable and unstable, Invertible and non-invertible, System modelling: Input-output relation, Impulse response, Definition of impulse response, Convolution integral, Convolution sum, Properties of convolution, System interconnection, System properties in terms of impulse response, Step response in terms of impulse response | 9 |
| **Unit 3: Fourier Series and Fourier Transform** | |
| Introduction to Fourier Analysis, Fourier Series for Periodic Signals, Properties of Fourier Series, Fourier transform: Properties of CTFT, FT of standard signals. Inverse Fourier Transform and Application of Fourier Transforms | 9 |
| **Unit 4: Laplace Transform** | |
| Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform, stability considerations in S domain | 9 |
| **Unit 5: Z Transform** | |
| Need of Transform, Definition of unilateral and bilateral Z transform, Properties of Z transform, Inverse Z transform, Analysis of LTI DT System, Stability and Causality considerations of LTI system. | 9 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | A.V. Oppenheim, A.S. Willsky —Signals and Systems, Prentice-Hall signal processing series. 2nd Edition, 2015 |
| 2 | Simon Haykins and Barry Van Veen, "Signals and Systems", Wiley India, (2nd Edition), (2004) |
| 3 | DP. Rameshbabu, R. Anandanatarajan, "Signals and Systems", Scitech Publication, Fourth Edition, (2011). |
| **Reference Books** | |
| 1 | B P Lathi —Linear Systems and Signals, Oxford University Press, Second Edition, 2005 |
| 2 | Charles Phillips, "Signals, Systems and Transforms", Pearson Education, (4thEdition), (2004) |
| 3 | Mrinal Mandal and Amir Asif, "Continuous and Discrete Time Signals and Systems", Cambridge University Press, (1stEdition), (2007) |
| **E- Contents / MOOC** | |
| 1 | NPTEL Course "Principles of Signals and Systems" https://onlinecourses.nptel.ac.in/noc24_ee36/ |

| | |
|---|---|
| 2 | NPTEL Course "Signals and Systems", https://onlinecourses.nptel.ac.in/noc24_ee28/ |

## [24UETP401]: Signals and Systems Lab

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | Internal: | 25 |
| | | **Total** | **25** |

**Course Prerequisites:** Signals and Systems

**Course Objectives:**

1. To provide hands-on experience in generating, visualizing, and analyzing standard signals using MATLAB/Scilab.
2. To simulate and verify signal operations such as convolution, sampling, and aliasing in discrete-time domain.
3. To compute and visualize Laplace and Z-transforms for given signals using computational tools.
4. To relate theoretical signal behavior with practical observations using software tools and audio signals.

**Course Outcomes:**

1. Generate and analyze standard signals in time and frequency domains using MATLAB/Scilab.
2. Perform convolution and verify signal properties through simulations.
3. Demonstrate the effects of sampling and aliasing on real-time audio signals.
4. Compute Laplace and Z-transforms using MATLAB and interpret the results.
5. Develop practical insight into signal behavior through experimentation and visualization.

**General Guidelines: All experiments are compulsory and Use software tool like MATLAB/Scilab**

| Expt.No. | Suggested List of Experiments/Tutorials |
|---|---|
| 9. | Introduction MATLAB/SCILAB/ any other open source software. |
| 10. | Generate and plot the following signals in time domain and sketch its amplitude and phase spectrum. Verify the result:<br>□ Impulse<br>□ Unit Step<br>□ Exponential<br>□ Unit ramp<br>□ Sinc<br>□ Rectangular |
| 11. | Write the codes to plot the following signals also simulate the signals: |
| 12. | Find the convolution integral of Unit step and exponential signals and write a program to sketch the out response of the system. Also verify the commutative property of convolution integral |
| 13. | Sampling & Aliasing Consider various human voice / speech (probably your voice both male and female) or music signals. Try different sampling rates and observe the effect of aliasing. |

| | |
|---|---|
| 14. | Record or use the recorded music samples of different instruments (at least four) and Write a program to record the music signal and sketch it in time domain, its amplitude spectrum and phase spectrum. Also comment on the result. |
| **15.** | Compute the Laplace Transform of standard functions<br>like 1. $e^{-at}$ u(t), 2. sin(bt) u(t), 3. cos(bt)u(t) |
| 16. | Compute the Z-Transform of a basic discrete signal<br>$x[n]=a^n u[n]$ for $a<1$ |

| **Learning Resources** | |
|---|---|
| **Reference Books** | |
| 1 | "Signals and Systems using MATLAB" , *By Luis F. Chaparro* Academic Press, 3rd Edition (2021) |
| 2 | "Signal Processing and Linear Systems" , *By B. P. Lathi* Oxford University Press |
| 3 | "Scilab: A Free Software to MATLAB" *By H Ramchandran and A S Nair* S. Chand Publishing. |
| **E- Contents / Virtual Labs:** | |
| 1 | Signals and Systems Labotratory:<br>http://ssl-iitg.vlabs.ac.in |

# [24UETL402]: Smart Sensors and IOT

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 2 Hours/Week | 03 | Teachers Assessment Examination (TAE) | 10 |
| | | Class Assessment Examination (CAE) | 15 |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | 75 |
| **Course Prerequisites: Control System Design** | | | |

| **Course Objectives** | |
|---|---|
| 1 | To understand the fundamentals of embedded systems and the Arduino platform for sensor-based applications. |
| 2 | To develop the ability to interface and program digital and analog sensors using Arduino. |
| 3 | To comprehend the working principles and selection criteria of smart sensors for physical measurements. |
| 4 | To analyse and apply smart sensors in domains like displacement, motion, pressure, and flow. |
| 5 | To explore IoT integration with sensors in real-world applications such as agriculture, healthcare, and automotive systems. |
| **Course Outcomes:** On successful completion of the course the learner will be able to: | |
| CO1 | Identify and interface various digital and analog sensors with Arduino for data acquisition. |
| CO2 | Write embedded code for sensor control, data display, and serial communication. |
| CO3 | Interpret sensor characteristics and analyze signal conditioning requirements. |
| CO4 | Select appropriate sensors for measuring physical parameters in industrial and commercial systems. |
| CO5 | Apply IoT-based sensor solutions in environment, biomedical, and automotive case studies. |

| Contents | No. of Session |
|---|---|
| **Unit I: Introduction to Arduino and Embedded Systems** | |
| Overview of microcontrollers and microprocessors, Role and applications of embedded systems, Open-source embedded platforms, Introduction to Arduino hardware (Atmega328-based board), Basics of Arduino IDE: features, interface, compiling & uploading code, Programming concepts: variables, functions, conditional statements | 6 |
| **Unit II: GPIO Programming and Digital Interfaces** | |
| Understanding GPIOs in Atmega328-based Arduino, Digital Input/Output operations, Interfacing digital devices: LED (blinking, toggling), Push button (with debounce logic), Buzzer (on/off control), Displaying messages on Serial Monitor and LCD, Serial communication using Arduino IDE (Serial.begin, Serial.print) | 6 |
| **Unit III: Analog Interfaces and Sensor Interfacing** | |
| Concept of ADC in Atmega328, Reading analog values using analogRead(), Interfacing analog sensors: Temperature sensor (LM35), LVDT (displacement measurement – concept and demo), Strain gauge (force/weight measurement – concept and demo), Displaying real-time sensor data on Serial Monitor and/or LCD | 6 |
| **Unit IV: Smart Sensors for Physical Parameters** | |

| | |
|---|---|
| Sensor Fundamentals: Working principles, selection, calibration, signal conditioning, Force, Pressure & Flow Sensors: Unit conversions: Newton, Bar, Pascal, PSI, Strain gauge (Load Cell), Piezoelectric transducers, GY-63, MS5611, Differential pressure sensors (Bernoulli's principle), Orifice, Venturi, Nozzle (conceptual only), Pneumatic sensors: Bellows, Diaphragm, Solid-state flow sensors: YF-S201, E8FC-25D, Fiber-optic, Ultrasonic, Hall Effect sensors, Displacement & Motion Sensors: Potentiometric, capacitive, inductive, and strain-gauged displacement sensors, LVDT, proximity sensors (eddy current, capacitive, inductive), Accelerometers, gyroscopes, magnetometers (e.g., ADXL335/345), Optical encoders, Hall effect, electro-optical sensors | 6 |
| **Unit V: Smart Sensors in Environment, Bio-Medical, and IoT Applications** | |
| Environmental & Bio Sensors: Image Sensors: CCD, CMOS, Biosensors: Resonant mirror, electrochemical, surface plasmon resonance, Gas/air quality sensors: MQ2, MQ3, MQ135, pH sensors, Non-contact temp sensor (MLX90614), LDR, photodiode, photo transistor, RFID sensor (EM18), MEMS and NEMS-based sensors, IoT-Enabled Applications: Basics of Data Acquisition Systems and IoT sensor integration (Block diagram)Case Studies: Agriculture & Greenhouse Monitoring – Dielectric soil moisture, air flow, optical, electrochemical sensors, Healthcare Monitoring Systems – ECG, temperature, humidity, accelerometer, heart rate, $SpO_2$ sensors, Automotive Sector – EMS – Fuel level, ignition, exhaust sensors | 6 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | D. Patranabis, *Sensors and Actuators*, PHI Learning |
| 2 | Massimo Banzi and Michael Shiloh, *Getting Started with Arduino*, Maker Media |
| 3 | Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On-Approach*, Universities Press |
| **Reference Books** | |
| 1 | Randy Frank, *Understanding Smart Sensors*, Artech House |
| 2 | Clarence W. de Silva, *Sensors and Actuators: Engineering System Instrumentation*, CRC Press |
| 3 | John G. Webster, *Measurement, Instrumentation, and Sensors Handbook*, CRC Press |
| 4 | Robert Faludi, *Building Wireless Sensor Networks*, O'Reilly Media |
| 5 | Subhas Chandra Mukhopadhyay (Editor), *Smart Sensors for Real-Time Water Quality Monitoring*, Springer |
| **E- Contents / MOOC** | |
| 1 | **Sensors and Actuators** – Prof. Hardik J. Pandya, IIT Madras https://nptel.ac.in/courses/108105093 |
| 2 | **Introduction to Embedded System Design** – Prof. Dhananjay Gadre, IIT Delhi https://nptel.ac.in/courses/108102045 |
| 3 | **Introduction to Internet of Things** – Prof. Sudip Misra, IIT Kharagpur https://nptel.ac.in/courses/106105166 |
| 4 | **Interfacing with the Arduino** – University of California, Irvine \| Coursera https://www.coursera.org/learn/interface-arduino |

## [24UETP402]: Smart Sensors and IOT Lab

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 2 Hours/Week | 01 | External Practical Exam: | 25 |
| | | **Total** | **25** |

**Course Prerequisites:** Basic Electronics Engineering

**Course Objectives:**

To understand the basics of Arduino boards and how to program them.
To learn how to connect and use different sensors with Arduino.
To collect data from sensors and display it on a screen or computer.
To write simple programs to control LEDs, buzzers, and other devices.
To learn how sensors are used to measure things like temperature, pressure, distance, and motion.

**Course Outcomes:**

Identify and connect different types of sensors to the Arduino board.
Write basic programs to read sensor data and control devices like LEDs and buzzers.
Show sensor readings on the Serial Monitor or LCD screen.
Understand how different sensors work and what they are used for.
Choose the right sensor for measuring temperature, pressure, distance, or motion..

**General Guidelines: All experiments are compulsory** (Any Eight to be Performed)

| Expt.No. | Suggested List of Experiments/Tutorials |
|---|---|
| 1. | To study the architecture, features, and pin configuration of the Arduino Uno board and ATmega328P microcontroller. |
| 2. | To develop a program for controlling one or more LEDs using digital I/O pins (ON/OFF and blinking modes). |
| 3. | To write a program that illuminates the green LED if the counter is less than 100, yellow if between 101–200, and red if greater than 200. |
| 4. | To implement a serial input-based LED control system where: 'b' triggers green LED blinking, 'g' turns green ON, 'y' turns yellow ON, and 'r' turns red ON. |
| 5. | To design a program that controls an RGB LED's color using three potentiometers for red, green, and blue values, and display readings via serial communication. |
| 6. | To interface a temperature sensor and display the readings on both the serial monitor and a connected LCD module. |
| 7. | To develop a program that continuously monitors temperature in Fahrenheit and displays the maximum and minimum recorded values. |
| 8. | To plot real-time temperature data as a graph using the Arduino serial plotter based on sensor inputs. |
| 9. | To interface a strain gauge sensor for measuring physical parameters like force or weight, and display the acquired values on the serial monitor. |
| 10. | To interface an LVDT sensor to measure linear displacement and display the result digitally using Arduino. |

**Learning Resources**

**Reference Books**


| | |
|---|---|
| 1 | **Alan G. Smith**, *Introduction to Arduino: A Piece of Cake*, CreateSpace, 2011, ISBN: 9781463698348 |

| | |
|---|---|
| 2 | **Deshmukh Ajay**, *Microcontrollers: Theory and Applications*, Tata McGraw-Hill |
| 3 | **Massimo Banzi**, *Getting Started with Arduino*, 2nd Edition, Maker Media, Inc. |
| 4 | **Brad Kendall**, *Getting Started With Arduino: A Beginner's Guide*, Edited by Justin Pot and Angela Alcorn |
| **E- Contents / Virtual Labs:** | |
| 1 | Official Arduino website: https://www.arduino.cc/ |
| 2 | Datasheets of components: https://www.alldatasheet.com/ |
| 3 | **Internet of Things: Sensing and Actuation from Devices:** Prof. Rajeshwari M. R., IISc Bangalore Link:https://nptel.ac.in/courses/108/105/108105171/ |
| 4 | **Internet of Things and Applications:** Instructor: Prof. Vijay Kumar, IIT Kharagpur Link:https://nptel.ac.in/courses/106/106/106106179/ |
| 5 | **Sensors and Transducers:** Instructor: Prof. B.V. Sankar Ram, IIT Madras Link:https://nptel.ac.in/courses/108/105/108105066/ |

## [24UCEL301]: MATHEMATICAL FOUNDATION FOR COMMUNICATION

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| TH: - 3 Hours/Week | 03 | Teachers Assessment Examination (TAE) | 10 |
| | | Class Assessment Examination (CAE) | 15 |
| | | End Semester Examination (ESE) | 50 |
| | | **Total** | **75** |
| **Course Prerequisites:** Basic of Linear algebra and univariate calculus,engineering mathematics | | | |

| **Course Objectives** | |
|---|---|
| 1 | To make the students familiarize with concepts and techniques in Ordinary differential equations, Fourier Transform, Z-Transform, Numerical methods, Vector calculus and functions of a Complex variable. |
| 2 | The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their electronic and telecommunication engineering. |
| **Course Outcomes** On successful completion of the course the learner will be able to: | |
| CO1 | Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems. |
| CO2 | Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems. |
| CO3 | Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing |
| CO4 | Perform vector differentiation & integration, analyze the vector fields and apply to electromagnetic fields & wave theory. |
| CO5 | Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing. |

| Contents | No. of Session |
|---|---|
| **Unit 1: Linear Differential Equations (LDE) and Applications** | |
| LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy"s and Legendre"s DE, Simultaneous and Symmetric simultaneous DE. Modelling of Electrical circuits | 9 |
| **Unit 2: Transforms** | |
| Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses. Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations. | 9 |
| **Unit 3 :Numerical Methods** | |

| | |
|---|---|
| Interpolation: Finite Differences, Newton"s and Lagrange"s Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson"s rules, Bound of truncation error, Solution of Ordinary differential equations: Euler"s, Modified Euler"s, Runge-Kutta 4 th order methods and Predictor-Corrector methods. | 9 |
| **Unit 4 : Vector Differential Calculus** | |
| Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities. | 9 |
| **Unit 5: Complex Variables** | |
| Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy"s integral theorem, Cauchy"s integral formula and Residue theorem | 9 |

| **Learning Resources** | |
|---|---|
| **Text Book** | |
| 1 | B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill. |
| 2 | B.S. Grewal, "Higher Engineering Mathematics", Khanna Publication, New Delhi. |
| **Reference Books** | |
| 1 | Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India,10th Edition. |
| 2 | M.D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2nd Edition. |
| 3 | Peter. V and O"Neil, "Advanced Engineering Mathematics", Cengage Learning,7th Edition. |
| 4 | S.L. Ross, "Differential Equations", Wiley India, 3rd Edition. |
| 5 | S. C. Chapra and R. P. Canale, "Numerical Methods for Engineers", McGraw-Hill, 7th Edition. |
| 6 | J. W. Brown and R. V. Churchill, "Complex Variables and Applications", McGraw-Hill Inc, 8th Edition. |
| **E- Contents / MOOC** | |
| 1 | NPTEL Course "Transform Calculus And its applications in differential equations" https://nptel.ac.in/courses/111/105/111105123/ |
| 2 | NPTEL Course on "Numerical Methods" https://nptel.ac.in/courses/111/107/111107105/ |
| 3 | NPTEL Course on "Integral & Vector Calculus" https://nptel.ac.in/courses/111/105/111105122/ |
| 4 | NPTEL Course on "Complex Analysis" https://nptel.ac.in/courses/111/103/111103070/ |

# [24UETLXXX]: Minor-II

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Theory: 2 Hours/Week | 02 | Teachers Assessment Examination (TAE): | 10 |
| | | Class Assessment Examination (CAE): | 15 |
| | | End Semester Examination (ESE): | 25 |
| | | **Total** | **50** |
| | | | |
| **Note:** *Please select the Minor from the Basket of Minors* | | | |

# [24UXXXXXXX]: Open Elective-II

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Theory: 2 Hours/Week | 02 | Teachers Assessment Examination (TAE): | 10 |
| | | Class Assessment Examination (CAE): | 15 |
| | | End Semester Examination (ESE): | 25 |
| | | **Total** | **50** |
| | | | |
| **Note:** *Please select the Open Elective from the Basket of Open Electives* | | | |

# [24UETP404]: Electronic measuring Instruments.

| Teaching Scheme | Credit | Examination Scheme | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Internal Practical Exam: | 25 |
| | | **Total** | **25** |
| **Course Prerequisites: Basic Electronics Engineering** | | | |
| **Course Objectives:** CO1:To understand the working principles of various electronic measuring instruments.<br>CO2:To develop practical skills in the use of electronic test and measurement equipment.<br>CO3:To analyze the characteristics and behavior of electrical signals using instruments.<br>CO4:To apply measurement techniques for testing and troubleshooting circuits. | | | |
| **Course Outcomes:CO1:** Identify and explain the operation of electronic measuring instruments like CRO, DMM, and function generators.<br>**CO2**: Operate and calibrate different electronic instruments accurately.<br>**CO3**: Measure voltage, current, frequency, and waveform parameters using appropriate instruments.<br>**CO4**: Apply measurement techniques for fault detection and circuit analysis. | | | |

| **General Guidelines: Any 6 from Part A and all experiments from Part B is compulsory** | |
|---|---|
| **Expt.No.** | **Suggested List of Experiments/Tutorials** |
| 1. | Measurement of Voltage, Current, and Resistance using DMM (Digital Multimeter). |
| 2. | Use of Analog Multimeter for measuring electrical quantities. |

| | |
|---|---|
| 3. | Verification of Ohm's Law and measurement of unknown resistance using Wheatstone Bridge. |
| 4. | Study and operation of CRO (Cathode Ray Oscilloscope).<br>Measurement of amplitude, time period, frequency. |
| 5. | Use of Function Generator and measurement of waveforms using CRO. |
| 6. | Calibration of voltmeter and ammeter using standard instruments. |
| 7. | Frequency and time period measurement using Digital Storage Oscilloscope (DSO). |
| 8. | Amplitude and frequency response using Spectrum Analyzer (if available) |
| 9. | Study of RTD and Thermocouple characteristics (Temperature measurement) |
| 10. | Measurement errors and uncertainty calculation for resistive circuits. |
| 11. | Study of LVDT (Linear Variable Differential Transformer). |
| | **Reference Books:** |
| | **Virtual Labs:** 1.https://virtual-labs.github.io/exp-electrical-equipments-iitr/index.html<br>2.https://vlab.spit.ac.in/Virtual%20Laboratory.html |

# [24UBSP405]: Communication Skills

| Teaching Scheme: | Credit | Examination Scheme: | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Internal Practical Exam: | 25 |
| | | **Total** | **25** |
| | | | |
| **Course Prerequisites: Basic English Grammar** | | | |

| **Course Objectives** | |
|---|---|
| 1 | Developing Proficiency in English. |
| 2 | Enhancing Writing Skills. |
| 3 | Improving Public Speaking and Presentation Skills. |
| 4 | Developing Listening and Reading Comprehension. |
| 5 | Fostering Interpersonal Communication Skills. |
| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
| CO1 | Demonstrate Effective Written Communication. |
| CO2 | Engage in Clear Oral Communication. |
| CO3 | Improve Listening and Reading Comprehension. |
| CO4 | Showcase Interpersonal and Teamwork Skills. |
| CO5 | Apply English Language Proficiency in Professional Contexts. |

| **List of Laboratory Assignments** | |
|---|---|
| 1 | **Introduction to Communication:**<br>a) **Overview of Communication**: Definition, types, and importance of communication in the engineering field. |

| | |
|---|---|
| | b) **Process of Communication**: Sender, message, receiver, feedback, and noise.<br>c) **Barriers to Communication**: Psychological, cultural, physical, and language barriers.<br>d) **Effective Communication Skills**: Listening, speaking, reading, and writing as components of effective communication.<br>e) **Role of Communication in Engineering**: The need for clear communication in technical and non-technical contexts |
| 2 | **SWOT analysis:**<br>The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, non-verbal skills, achievements. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.<br>The teacher should explain to them on how to set goals and provide template to write their short term and long term goals. |
| 3 | **Writing Skills**<br><br>a) **Paragraph and Essay Writing**: Structure and organization of paragraphs; writing clear and cohesive essays.<br>b) **Formal and Informal Writing**: Difference and usage in emails, memos, and letters/Applications. Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.<br>c) **Technical Writing**: Writing reports, proposals, and manuals. The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal<br>• Structure of technical reports (abstract, introduction, methodology, results, conclusion).<br>• Guidelines for presenting data and information clearly.<br><br>d) **Review and Editing**: Proofreading techniques, identifying and correcting errors.<br>e) **Writing for the Web**: Writing effective content for web pages, blogs, and forums. |
| 4 | **Oral Communication Skills**<br><br>a) **Public Speaking**: Prepared speech (Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.))<br>b) **Presentation Skills**: Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.<br>c) **Group Discussions**: Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedbacks.<br>d) **Interview Skills**: Preparing for job interviews, mock interviews, and communication in an interview setting.<br>e) **Speech Delivery Techniques**: Voice modulation, body language, eye contact, and engaging the audience. |

| | |
|---|---|
| 5 | **Interpersonal and Cross-Cultural Communication**<br><br>a) **Verbal and Non-Verbal Communication**: The role of body language, facial expressions, and tone of voice.<br>b) **Interpersonal Communication**: Communicating effectively in one-on-one or small group settings, building rapport.<br>c) **Cross-Cultural Communication**: Understanding and navigating cultural differences in communication.<br>d) **Conflict Resolution**: Techniques for resolving misunderstandings and disagreements in communication.<br>e) **Teamwork and Collaboration**: Effective communication in team projects and professional settings. |
| 6 | **Reading and Listening skills**<br>The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages asked questions on the article by the readers. Students will get marks on<br>various topics to students for evaluating their reading comprehension |
| 7 | **Resume writing-** Guide students and instruct them to write resume. |

| **Learning Resources:** | |
|---|---|
| **Text Book:** | |
| 1 | Sanjay Kumar, Pushp Lata - "Communication skills ", Oxford university press, ISBN 0-19-945706-9,9780199457069 |
| **Journal Articles:** | |
| 1 | 2. P.D. Chaturvedi, Mukesh Chaturvedi - "Business Communication" ,PEARSON, isbn 978-81-317-1872-8, 9-788131718728 |
| 2 | 3. Andrea J. Rutherfoord - "Basic communication skills for technology", PEARSON Education, ISBN 978-81-7758-407-3, 9-788177-584073 |
| 3 | 2. P.D. Chaturvedi, Mukesh Chaturvedi - "Business Communication" ,PEARSON, isbn 978-81-317-1872-8, 9-788131718728 |
| **E- Contents:** | |
| 1 | https://onlinecourses.swayam2.ac.in/ntr25_ed62/preview |
| 2 | https://www.udemy.com/course/business-english-complete/?couponCode=ST11MT170325G3 |
| 3 | https://www.udemy.com/course/learn-english-grammar-online/?couponCode=ST11MT170325G3 |
| 4 | https://www.coursera.org/learn/verbal-communications-and-presentation-skills |

# [24UESP406]: Entrepreneurship Awareness-II

| Teaching Scheme: | Credit | Examination Scheme: | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Internal Practical Exam: | 25 |
| | | **Total** | **25** |
| | | | |
| **Course Prerequisites:** [24UESL304] : Entrepreneurship I | | | |

| **Course Objectives** | |
|---|---|
| 1 | To provide students with core knowledge of start up, entrepreneurship, and the ecosystem while supporting idea generation and business model creation. |
| 2 | To familiarize students with legal, ethical, and regulatory aspects of starting and managing a business. |
| 3 | To provide insights into product development, prototyping, and the use of emerging technologies in stratus. |
| 4 | To develop an understanding of financial planning, funding sources, and investor pitching techniques |
| 5 | To teach marketing strategies, customer acquisition, and growth hacking for start up success. |
| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
| CO1 | Understand Startups, entrepreneurship, and the ecosystem while identifying opportunities, applying ideation techniques, and developing viable business models. |
| CO2 | Analyse market opportunities and apply ideation techniques to generate innovative business ideas and develop a viable business model. |
| CO3 | Navigate legal, ethical, and regulatory requirements for setting up and managing a startup, including company registration, compliance, and intellectual property protection. |
| CO4 | Apply product development and prototyping techniques, leveraging emerging technologies for start up innovation. |
| CO5 | Develop financial planning strategies by understanding revenue models, funding sources, and investment pitching techniques |

| **List of Laboratory Assignments** | |
|---|---|
| 1 | Introduction to Startups & Entrepreneurship: What is a startup? ,Differences between a startup & traditional business, Startup ecosystem & key players (incubators, accelerators, VCs),Engineering innovation & its role in Startups |
| 2 | Ideation & Business Model Development : Identifying problems & market opportunities, Design Thinking & Ideation Techniques, Business Model Canvas (BMC),Building an MVP (Minimum Viable Product). |
| 3 | Legal, Regulatory & Ethical Considerations: Company Registration: Private Limited, LLP, Sole Proprietorship, Patents, Copyrights & Trademarks for engineering Startups, Compliance, taxation & government schemes for Startups, Ethical issues in technology-based Startups |
| 4 | Product Development & Engineering Prototyping : Product Development Life Cycle (PDLC),Prototyping & Rapid Development Techniques, Using emerging technologies (AI, IoT, Blockchain) in Startups, Software & hardware considerations in tech Startups. |

| | |
|---|---|
| 5 | Financial Planning & Startup Funding: Basics of startup finance: revenue models, cost structures, Funding options: Bootstrapping, Angel Investors, Venture Capital, Financial planning & cash flow management, Pitching a startup idea to investors (Elevator Pitch & Pitch Deck). |
| 6 | Marketing & Growth Hacking: Basics of digital marketing (SEO, SEM, Social Media),Customer segmentation & target market selection, Growth Hacking Strategies for rapid scale-up, Branding & positioning for tech Startups. |
| 7 | Operations & Team Management :Setting up a start-up's operational workflow, Supply Chain & Inventory Management for product-based stratus, Hiring & team building strategies, Managing co-founders, leadership & conflict resolution. |
| 8 | Scaling, Sustainability & Exit Strategies : Scaling up a startup: challenges & strategies, Risk management & handling failures, Sustainable business models, Exit strategies: Mergers, Acquisitions, IPOs. |
| 9 | Project : Real-world case studies of successful & failed Startups, Engineering startup project: students create a prototype & business model, Presentation & evaluation of startup projects. |

| **Learning Resources:** | |
|---|---|
| **Text Book:** | |
| 1 | *"The Lean Startup"* by Eric Ries – A guide on how Startups can efficiently build products and scale through iterative testing and feedback. |
| 2 | *"Zero to One "* by Peter Thiel–Focuses on innovation, creating unique businesses, and avoiding competition |
| 3 | *The Startup Owner's Manual"* by Steve Blank & Bob Dorf -A practical guide covering customer development, business models, and startup methodologies. |
| 4 | *"Disciplined Entrepreneurship "* by Bill Aulet,-Provides a **step-by-step framework** for launching a startup. |
| 5 | *"The Corporate Yodha: Unleashing the Power of Qu in You" by Chetan Waklkar*-Focuses on transformative journey through the multifaceted realms of human excellence. Drawing on nearly three de2ades of experience in education |
| **Journal Articles**: | |
| 1 | *"Prior Knowledge and the Dsiscovery of Entrepreneurial Opportunities"* by Scott Shane, *Organization Science, 11(4), 448-469 (2000).* |
| 2 | **"***The Relational Organization of Entrepreneurial Ecosystems***"** by Ben Spigel , Published. |
| **E- Contents:** | |
| 1 | *Harvard Business Review (HBR) – Articles on entrepreneurship, leadership, and business strategy.* |
| 2 | *Entrepreneur.com – A website offering advice on various aspects of entrepreneurship.* |
| **Case Studies**: | |
| 1 | *Harvard Business School Case Studies* – Case studies on successful and failed Startups. |
| 2 | *Stanford e Corner – Startup Stories- Videos and lectures from successful startup founders and investors.* |
| 3 | *TED Talks on startup - Inspiring talks on startup culture, innovation, and business strategy.* |

# [24UVEP407]: Environment Studies

| Teaching Scheme: | Credit | Examination Scheme: | Marks |
|---|---|---|---|
| Lab: 4 Hours/Week | 02 | Teachers Assessment Examination (TAE): | 10 |
| | | Class Assessment Examination (CAE): | 15 |
| | | Internal Practical Exam: | 25 |
| | | **Total** | **50** |
| | | | |
| **Course Prerequisites:** | | | |

| **Course Objectives** | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| **Course Outcomes**<br>On successful completion of the course the learner will be able to: | |
| CO1 | Associate the role of environment in man-environment relationship and critically analyse the necessity of environment awareness in society. |
| CO2 | Create awareness about the environmental issue and the role of pollution act in the conservation of resources. |

| **List of Laboratory Assignments** | |
|---|---|
| 1 | Environment and Ecosystem:<br>a) Environment –Meaning of Environment, Types of Environment, Components of Environment,<br>b) Man- Environment relationship, importance of environment,<br>c) Need for Public Awareness<br>d) Ecosystem-Meaning, Major Components of Ecosystem<br>e) Case studies of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem<br>f) Stability of Ecosystem in Sustainable Environment |
| 2 | Environment Pollution<br>a) Definition of Pollution, Types of Pollution<br>b) Air Pollution-Meaning, Sources, effects of air pollution, Air Pollution Act<br>c) Water Pollution – Meaning, Sources, Effects of Water pollution, Water Pollution Act<br>d) Noise Pollution – Meaning, Sources, Effect of Noise Pollution<br>e) Solid Waste Pollution – Meaning, sources, Effect of Waste Pollution<br>f) Environment Protection Act – Air (Prevention and control of Pollution)Act, Water Act (Prevention and control of Pollution) Act , Solid waste Pollution Act in India |

| Learning Resources: | |
|---|---|
| **Text Book:** | |
| 1 | Agarwal, D.P. (1992): Man and Environment in India through Ages, Books & Books, New Delhi |
| 2 | Arthur N. Strahler and Alan H. Strahler (1973 1st Ed): "Environmental Geoscience Interaction between natural systems and man", Wiley International Ed. |
| 3 | Balakrishnan, M., 1998: Environmental Problems and Prospects in India, Oxford & IBH Pub., New Delhi. |
| 4 | |
| 5 | |
| **Journal Articles**: | |
| 1 | Barrow, C. J. (2003): Environmental Change and Human Development. Arnold Publication. |
| 2 | Bhaduri, S., and Basu, R. (2006):Society Development and Environment. Progressive Publishers. |
| **E- Contents:** | |
| 1 | |
| 2 | |
| **Case Studies**: | |
| 1 | |
| 2 | |
| 3 | |

## Basket: Minor Subjects

| | Set-1 | | Set-2 | | Set-3 | |
|---|---|---|---|---|---|---|
| Semester | Data Science | | Internet of Things | | AR/VR | |
| III | 24UCEL1M1 | Probability and Statistics | 24UCEL1M2 | Internet of Things | 24UCEL1M3 | Virtual Reality |
| IV | 24UCEL2M1 | Big data Analytics | 24UCEL2M2 | Embedded Systems | 24UCEL2M3 | Augmented Reality |
| V | 24UCEL3M1 | Data Analysis and Visualization | 24UCEL3M2 | Sensors and Wireless Sensor Networks | 24UCEL3M3 | Extended Reality |
| VI | 24UCEL4M1 | Machine Learning | 24UCEL4M2 | Cloud Computing for IoT | 24UCEL4M3 | Game Development |
| VII | 24UCEL5M1 | Advanced Machine Learning | 24UCEL5M2 | AI and Machine Learning for IoT | 24UCEL5M3 | Mixed Reality |
| VIII | 24UCEL6M1 | Capstone Project | 24UCEL6M2 | Capstone Project | 24UCEL6M3 | Capstone Project |

| | Set-4 | | Set-5 | |
|---|---|---|---|---|
| Semester | Cyber Security | | Human Computer Interactions | |
| III | 24UCEL1M4 | Network security & cryptography | 24UCEL1M5 | Human-Computer Interaction |
| IV | 24UCEL2M4 | Cyber security | 24UCEL2M5 | Cognitive Psychology and User Behaviour |
| V | 24UCEL3M4 | Digital Forensics | 24UCEL3M5 | User Interface (UI) and User Experience (UX) Design |
| VI | 24UCEL4M4 | Infrastructure & Cloud security | 24UCEL4M5 | HCI in Emerging Technologies |
| VII | 24UCEL5M4 | Cyber law & Ethical Hacking | 24UCEL5M5 | HCI Evaluation and Research Methods |
| VIII | 24UCEL6M4 | Capstone Project | 24UCEL6M5 | Capstone Project |

Dr. Soumitra Das
HoD Computer

Dr. Saurabh Gupta
Dean Academics

Dr. Nilesh Uke
Director

ESTC

Principal Office

# Indira College of Engineering and Management

## Department of Computer Engineering

### List of Multidisciplinary Minor (MDM)

### S.Y. B.Tech A.Y. 2025-2026

| S.No. | Name of the Company | MDM No. | Course Code | Course Name | Credit | Sem | Paid/Free | Conducted ONLINE/OFFLINE |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 1 | DADB, German Academy of Digital Education | Emerging Technologies (MDM-03) | MDM31 | Internet of Things (IoT) | 2 | 3 | Paid ( Approx Rs. 5000/-) per student per course | Online |
| | | | MDM32 | 5G Technology | 2 | 4 | | |
| | | | MDM33 | Hydrogen Technology | 2 | 5 | | |
| | | | MDM34 | Solar Technology | 2 | 6 | | |
| | | | MDM35 | Capstone Project | 2 | 7 | | |
| | | | MDM36 | | 2 | 8 | | |
| | | | | | | | | |
| 2 | ICEM (MBA) | Management | MDM51 | Fundamentals of Entrepreneurship development | 2 | 3 | Free | Offline / Online |
| | | | MDM52 | Basics of Marketing | 2 | 4 | | |
| | | | MDM53 | Basics of Accounting | 2 | 5 | | |
| | | | MDM54 | Fiundamnetals of Financial Management | 2 | 6 | | |
| | | | MDM55 | Capstone Project | 2 | 7 | | |
| | | | MDM56 | | 2 | 8 | | |
| | | | | | | | | |
| 3 | ICEM (Mech) | Electric Vehicles | MDM61 | Introduction to Electric Vehicle | 2 | 3 | Free | Offline / Online |
| | | | MDM62 | Vehicle | 2 | 4 | | |
| | | | MDM63 | Battery technology and Management system | 4 | 5 | | |
| | | | MDM64 | Electrical Machines and Drives | 2 | 6 | | |
| | | | MDM65 | Vehicle Dynamics and Control | 2 | 7 | | |
| | | | MDM66 | E-Mobility: Standards, Charging, and Safety | 2 | 8 | | |

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E&TC

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|---|---|---|---|---|---|---|---|---|
| 4 | ICEM (AI&DS) | Robotics Process Automation | MDM91 | Fundamentals of RPA | 2 | 3 | Free | Offline / Online |
| | | | MDM92 | RPA Business Analysis Fundamentals | 2 | 4 | | |
| | | | MDM93 | Crisper Learning for RPA | 4 | 5 | | |
| | | | MDM94 | Automation Techniques in RPA | 2 | 6 | | |
| | | | MDM95 | Future of RPA with business automation | 2 | 7 | | |
| | | | MDM96 | Application Areas of User Interface RPA Tool | 2 | 8 | | |
| 5 | ICEM (E&TC) | Agriculture Electronics | MDM110 | Introduction to AgriTech and Agricultural | 2 | 3 | Free | Offline / Online |
| | | | MDM111 | Green Energy Technologies for Sustainable Agriculture | 2 | 4 | | |
| | | | MDM112 | IoT and Smart Sensors for Precision Agriculture | 2 | 5 | | |
| | | | MDM113 | Automation Systems and Robotics in Agriculture | 2 | 6 | | |
| | | | MDM114 | Telecommunication Systems for Real-Time Agricultural Data | 2 | 7 | | |
| | | | MDM115 | Case Studies and Industry Projects in Smart Agriculture Electronics | 2 | 8 | | |
| 6 | ICEM (I-MBA) | Business Management | MDM116 | Principles of Management | 2 | 3 | Free | Offline |
| | | | MDM117 | Business Communication I | 2 | 3 | | |
| | | | MDM118 | Principles of Marketing | 2 | 3 | | |
| | | | MDM119 | Organizational Behaviour | 2 | 4 | | |
| | | | MDM120 | Business Communication II | 2 | 4 | | |
| | | | MDM121 | Business Accounting | 2 | 4 | | |

# Basket: Open Elective (OE)

| Department of AI & DS | | |
|---|---|---|
| **OE-1** | **OE-2** | **OE-3** |
| 24UAIL304 /24UAIP304 A: DMS administration | 24UAIL405 A: Data Security & Privacy | 24UAIL506 A: AI & ML |
| 24UAIL304/24UAIP304 B: Analytics using Data Science | 24UAIL405 B: Design Thinking | 24UAIL506 B: AR & VR applications in Industry |
| 24UAIL304 /24UAIP304 C: Gen AI | 24UAIL405 C: Social Network analysis | 24UAIL506 C: Deep Neural Network |
| 24UAIL301/ 24UAIP301: Data Engineering | | |

| Department of Information Technology | | |
|---|---|---|
| **OE-1** | **OE-2** | **OE-3** |
| 24UIT304A Software engineering and development | 24UIT405A Design and Analysis of Algorithms | 24UIT505A Big data analytics and R Programming |
| 24UIT304B Data Structures | 24UIT405B Deep Learning | 24UIT505B Internet of Things |
| 24UIT304C Statistics for Engineers | 24UIT405C Android and IOS app development | 24UIT505CCryptocurrency and block chain |

| Department of Mechanical Engineering | | |
|---|---|---|
| **OE-1** | **OE-2** | **OE-3** |
| 24UAI304 A Non-conventional Energy System | 24UME405A Mathematical Modelling | 24UME505A Technology and Financial Management |
| 24UAI304 B Solar Energy | 24UME405B Advance Excel | 24UME505B Product Design and Development |
| 24UAI304 C Product Development | 24UME405C Power BI | 24UME505C Process Planning & Management |

| Department of Computer Engineering | | |
|---|---|---|
| **OE-1** | **OE-2** | **OE-3** |
| 24UCEL302/24UCEP302 Object Oriented Programming | 24UCEL401 /24UCEP401 Advance Data Structure | 24UCEL501 /24UCEP50I Database Management System |
| 24UCEL303 Software Engineering | 24UCEL402 / 24UCEP402 Operating System | 24UCEL502 / 24UCEP502 Computer Networks |
| 24UCEL1M2 Internet of Things | 24UCEL2M4 Cyber Security | 24UCEL3MI Data Analysis and Visualization |
| 24UCEL1M3 Virtual Reality | 24UCEL2M5 Cognitive Psychology and User Behavior | 24UCEL3M5 User Interface (UI) and User Experience (UX) Design |

| Task Force for Curriculum Design and Development |
|---|
| |
| **Team Members for Course Design** |
| Prof. Dhiraj Bhagwate<br>Prof. Meenakshi Patil<br>Prof. Rupali Salunke<br>Prof. Sudhir Sawarkar<br>Prof. Priyanka Patil<br>Prof. Balu Tandale<br>Prof. Raghunandan Kale |
| |
| **BoS Chairman** |
| Prof. Dhiraj Bhagwate |