2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

ADVANCED CONTROL SYSTEMS			
Course Code	**MLIE201**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:2:0**	**SEE Marks**	**50**
Total Hours ofPedagogy	**40 + 10 = 50**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course Learning Objectives:

1. To define and explain the basic properties of difference equations, Z- transform, inverse Z-transform, Z -Transform Analysis of Sampled Data Control Systems.
2. To acquire the knowledge of state models and solve relevant problems using state equations.
3. To acquire knowledge of state space and state feedback in Modern Control Systems, Pole Placement, designof state observers and output feedback controllers.
4. To explain the concept of Dead beat Control by State Feedback, solving problems using State Variableapproach, State regulator and Output regulator, understanding Concepts of Model Reference AdaptiveControl.
5. To understand the behaviour of nonlinear systems, nonlinearities, Stability Analysis by Describing FunctionMethod, Phase Plane Method.

Module - 1

Digital Control Systems: Review of Difference equations, Z–Transforms and Inverse Z Transforms, The ZTransfer Function(Pulse Transfer Function), The Z–Transform Analysis of Sampled Data Control Systems, The Z and S–domainrelationship, Stability analysis (Jury's Stability Test and Bilinear Transformation).

RBT Levels: L2, L3

Module - 2

State Models & Solution of State equations: State models for Linear Continuous Time and Linear Discrete Time systems, Diagonalization, Solution of State Equations (for both Continuous and Discrete Time systems),Relevant problems.

RBT Levels: L2, L3

Module - 3

State Feedback Systems: Concepts of Controllability and Observability (for both Continuous and Discrete Timesystems),Pole Placement by State Feedback(for both continuous and discrete Time systems), Observer System(Full order and Reduced order observers for both Continuous and Discrete Time systems),Relevant problems.

RBT Levels: L2, L3

Module - 4

Regulators: Dead beat Control by State Feedback, Optimal control problems using State Variable approach,State regulator and Output regulator, Concepts ofModel Reference Adaptive Control(MRAC).

RBT Levels: L2, L3

Module - 5

Nonlinear Control Systems: Behaviour of Nonlinear Systems, Common Physical Nonlinearities, DescribingFunction Method, Stability Analysis by Describing Function Method, Phase Plane Method, Stability Analysis byPhase Plane Method.

RBT Levels: L2, L3

PRACTICAL COMPONENT OF IPCC Using suitable simulation Tool
1. Study and verification of step response of standard second order system (both analog anddigital system), (MATLAB), for the cases of undamped, under damped and criticallydamped cases.
2. To design a Lag-Lead compensator and to obtain the characteristics by simulation using MATLAB. Verify the performance using experiments with the compensator circuit made of passive elements
3. Steady state error analysis for Type-0, Type-1 and Type-2 digital control system using MATLAB by applying standard reference inputs of step, ramp and parabola.
4. Design a digital controller with output feedback to control the speed of a DC motor; simulate the design using Simulink.
5. Design a digital controller with state variable feedback to control the speed of a DC motor; simulate the design using Simulink.
6. Design a digital controller with output feedback to control the position of the metallic ball in Magnetic levitation experiment and simulate the design using Simulink
7. Design a digital controller with state variable feedback to control the position of the metallic ball in Magnetic levitation experiment
8. Implement an on-off temperature controller to control lamp using a temperature sensor and dspace DS1104 hardware interface
9. Design a digital controller with output feedback to control the speed of a DC motor; Control the DC motor using dspace DS1104 hardware interface
10. Design a digital controller with state variable feedback to control the speed of a DC motor; Control the DC motor using dspace DS1104 hardware interface

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50) and for the SEE minimum passing mark is40% of the maximum marks (20 out of 50 marks). The student is declared as a pass in the course if he/ she secures a minimum of 50% (50 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.

CIE for the theory component of the IPCC:

- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 20OMT8.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 50% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC:

- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' writeups are added and scaled down to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 50% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEEfor IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03hours)

1. The question paper will be set for 100 marks and marks scored will be scaled downproportionately to 50marks.
2. The question paper will have ten questions. Each question isset for 20marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mixof topics under that module.
4. The students have toanswer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions fromthe practical component.

<u>Suggested Learning Resources:</u>

Text Books

1. 'Control Systems Engineering', IJ Nagrath& MGopal, New AgeInternational Publishers, Fifth edition,2007.
2. 'Discrete Time Control Systems', K Ogata, 2nd edition, PHI, 2009.

Reference Books

1. 'Modern Control Engineering', K Ogata, PHI, 5th Edition, 2010.
2. 'Modern Control System Theory', M Gopal,New Age International, 2012.
3. 'Digital Control and State Variable methods', M Gopal, Tata McGraw Hill, 4th edition, 2012.
4. 'Advanced Control Theory', A Nagoorkani, RBA publications, 2006.

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO1	Derive the pulse transfer function for various closed loop configurationsandunderstand the stability analysis of sampled data control systems.	L1
CO 2	Apply state space techniques to model linear continuous and discrete timesystems, convert state space (SS) representations to transfer function(TF)representation and vice versa.	L2
CO 3	Apply controllability and observability tests.	L3
CO 4	Solve the optimal control problems using state variable approach andknowledge of adaptive control systems.	L2
CO 5	Understand the types of nonlinearities, characteristics of Nonlinear systemsand the stability analysis of Nonlinear control systems.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

AUTOMATIVE ELECTRONICS			
Course Code	**MLIE202**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand various control requirements in the automotive system.
2. To understand the dashboard electronics and engine system electronics.
3. To understand various physical parameters those are to be sensed and monitored for maintaining the stability of the vehicle under dynamic conditions.
4. To understand and implement the controls and actuator system pertaining to the comfort and safety of commuters.
5. To understand sensor network for mechanical fault diagnostics in anautomotive vehicle.

Module - 1

Automotive Fundamentals, the Systems Approach to Control and Instrumentation: Use of Electronics inthe Automobile, Antilock Brake Systems(ABS), Electronic steering control, Power steering, Traction control,Electronically controlled suspension (Chap.1 and 2 of Text).

RBT Levels: L2, L3

Module - 2

Automotive Instrumentation Control: Operational amplifiers, Digital circuits, Logic circuits, Microcomputer fundamentals, Microcomputer operations, Microprocessor architecture, digital to analog converter, analog todigital converter, Microcomputer applications in automotive systems, Instrumentation applications ofmicrocomputers, Microcomputer in control systems (Chap.3 and4 of Text).

RBT Levels: L2, L3

Module - 3

The basics of Electronic Engine control: Integrated body: Climate controls, Motivation for Electronic Engine Control, Concept of An Electronic Engine Control System, Definition of General Terms, Definition of Engine Performance Terms, Electronic fuel control system, Engine control sequence, Electronic Ignition, Sensors and Actuators, Applications of sensors and actuators, air flow rate sensor, Indirect measurement of mass air flow, Engine crankshaft angular position sensor, Automotive engine control actuators, Digital engine control, Engine speed sensor, Timing sensor for ignition and fuel delivery, Electronic ignition control systems, Safetys ystems, Interior safety, Lighting, Entertainment systems (Chap. 5 and 6 of Text).

RBT Levels: L2, L3

Module - 4

Vehicle Motion Control and Automotive diagnostics: Cruise control system, Digital cruise control, Timing light, Engine analyzer, On-board and off-board diagnostics, Expert systems. Stepper motor-based actuator, Cruise control electronics, Computer-based instrumentation system, Sampling and Input\output signal conversion, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, Trip-Information-Computer, Occupant protection systems (Chap. 8 and 10 of Text).

RBT Levels: L2, L3

Module - 5

Future automotive electronic systems: Alternative Fuel Engines, Collision avoidance Radar Warning Systems, LowTire Pressure Warning System, Radio Navigation, Advance Driver information System. Transmission Control, Speech Synthesis Multiplexing in Automobiles, Control Signal Multiplexing, Navigation Sensors, RadioNavigation, Signpost Navigation, Dead Reckoning Navigation Future Technology, Voice Recognition CellPhone Dialing, Automatic Driving Control (Chap. 11 of Text).

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per theoutcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.

5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. 'Understanding Automotive Electronics', William B.Ribbens,SAMS/Elsevier publishing, 6th Edition, 1997.

Reference Books

1. 'Automotive Electrics and Automotive Electronics-Systems and Components, Networking and Hybrid Drive', Robert Bosch Gmbh, Springer Verlag,5thEdition, 2007.

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Implement various control requirements in the automotive system.	L3
CO 2	Comprehend dashboard electronics and engine system electronics.	L2
CO 3	Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamic conditions.	L2
CO 4	Understand and implement the controls and actuator system pertaining to the comfort and safety of commuters.	L4
CO 5	Design sensor network for mechanical fault diagnostics in an automotive vehicle.	L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

PLC and Industry Automation Control			
Course Code	**MLIE203**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the Programmable Logic Controllers.
2. To understand different types of Devices to which PLC input and output modules are connected.
3. To understand the ladder diagrams from process control descriptions.
4. To understand the PLC timers and counters for the control of industrial processes.
5. To understand the Knowledge of Networking in Industrial automation.

Module - 1

Introduction to PLCs: Technical Definition, Advantages, Characteristic Functions, Chronological Evolution, Types, Unitary PLC, Modular PLC, SMEEl PLC, Medium PLC, Large PLC, Block Diagram Of PLC, Input / Output Section, Processor Section, Power Supply, Memory, Central Processing Unit, Processor Software / Executive Software, Multitasking, Languages, Ladder Language.

Bit Logic Instructions: Introduction, Input and Output Contact Program, Symbols, Numbering System of Inputs and Outputs, Program Format, Introduction to Logic, Equivalent Ladder Diagram of - AND Gate, OR Gate, NOT Gate, XOR Gate, NAND Gate, NOR Gate, Equivalent Ladder Diagram to Demonstrate De Morgan Theorem, Ladder Design.

RBT Levels: L2, L3

Module - 2

PLC Timers and Counters: Timer and its Classification, Characteristics of PLC Timer, Functions in Timer, Resetting – Retentive and Non-Retentive, Classification of PLC Timer, On Delay, and Off Delay Timers, TimerOn Delay, Timer Off Delay, Retentive And Non-Retentive Timers, Format of a Timer Instruction. PLC Counter, Operation of PLC Counter, Counter Parameters, Counter Instructions. Overview, Count Up (CTU), Count Down (CTD).

Advanced Instructions: Comparison Instructions, Addressing Data Files, Format of Logical Address, Addressing Format for Micrologic System, Different Addressing Types. Data Movement Instructions.

RBT Levels: L2, L3

Module - 3

Logical Instructions: Mathematical Instructions and its Features, Special Mathematical Instructions, Scale with Parameters or SCP Instruction. Data Handling Instructions and its Features, Program Flow Control Instructions, Proportional Integral Derivative (PID) Instruction.

PLC I/O Modules and Power Supply: Classification of I/O, I/O System Overview, Practical I/O System and its mapping, Addressing Local and Expansion I/O, Input-Output Systems, Direct I/O Parallel I/O Systems Serial I/O Systems, Sinking and Sourcing, Sourcing and Sinking in PLC Interfacing, Discrete Input Module, Discrete DC Input Module, Discrete AC Input Module, Rectifier with Filter, Threshold Detection, Isolation, Logic Section, Discrete Output Modules, Advantages and Disadvantages of Output Modules, Types of Analog Input Module.

RBT Levels: L2, L3

Module - 4

Industrial Communication: Introduction, Evolution of Industrial Control Process, Types of Communication Interface, Types of Networking Channels, Parallel Communication Interface. Serial Communication Interface, communication mode, Synchronous and Asynchronous Transmissions, Standard interface RS 232C, RS 422, EIA 485, Comparison, Software Protocol, Industrial Network. Network Topology, Media Access Methods.

RBT Levels: L2, L3

Module - 5

Industrial Networking: Open System Interconnection (OSI), Network Model, Network Components, Control Network Issues, Advantage of Standardized Industrial Network, Intelligent Devices, Industrial Network Bus Network, Device Bus Network vs. Process Bus Network, Controller Area Network(CAN), Device net, Control net, Ethernet Protocol, AS-I Interface, FOUNDATION FIELDBUS, Application of Profibus for Real PLC Communication.

Industrial Automation: Introduction, Utility of Automation, General Structure of an Automated Process, Examples of Simple Automated Systems, Selection of PLC.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Programmable LogicControllers and Industrial Automation', Madhuchhanda Mitra and Samarjit Sengupta,Penram International Publishing (India)Pvt. Ltd., 2007. ISBN: 81-87972-17-

Reference Books

1. 'Introduction to Programmable Logic Controllers', Garry Dunning, 2ndEdition, Delmar Thomson Learning, 2001. ISBN: 981-240-625-5.
2. 'Computer Control of Processes',M. Chidambaram, CRC Press, 2002

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain and discuss the Programmable Logic Controllers.	L2
CO 2	Explain different types of Devices to which PLC input and output modules are connected	L2
CO 3	Draw ladder diagrams from process control descriptions.	L3
CO 4	Apply PLC timers and counters for the control of industrial processes.	L4
CO 5	Discuss Networking in Industrial automation.	L2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Hybrid Electric Vehicles			
Course Code	**MLIE204**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. Understand the fundamentals of electric vehicles (EVs) and hybrid electric vehicles (HEVs).
2. Analyze the characteristics and operation of electric motors, power electronics, and energy storage systems.
3. Design and simulate EV and HEV systems using software tools.
4. Evaluate the performance and limitations of different EV and HEV configurations.
5. Apply knowledge of EVs and HEVs to real-world applications and case studies.

Module - 1

Introduction to EV & HEV: Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine.
EV System: EV Configuration: Fixed & variable gearing, single & multiple motor drive, In wheel drives

RBT Levels: L2, L3

Module - 2

EV Parameters: Weight, size, force, energy & performance parameters.
EV Propulsion: Electric Motor: Choice of electric propulsion system, block diagram of EV propulsion system, concept of EV Motors, single motor and multi-motor configurations, fixed & variable geared transmission, In-wheel motor configuration, classification of EV motors, Electric motors used in current vehicle applications, Recent EV Motors, Comparison of Electirc Motors for EV applications Required Power Electronics & Control: Comparison of EV power devices, introduction to power electronics converter, four quadrant DC chopper, three-pase full bridge voltage-fed inverter, soft-switching EV converters, comparison of hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter, Basics of Microcontroller & Control Strategies

RBT Levels: L2, L3

Module - 3

EV Motor Drive: DC Motor: Type of wound-field DC Motor, Torque speed characteristics DC-DC Converter, Two quadrant DC Chopper, two quadrant zero voltage transition converter-fed dc motor drive, speed control of DC Motor Induction Motor Drive: Three Phase Inverter Based Induction Motor Drive, Equal Area PWM, Three Phase Auxiliary resonant snubber (ARS) Inverter Type (ZVC & ZCS), Single Phase ARS Inverter Topology, Speed Control of Induction Motor, FOC, Adaptive Control, Model Reference Adaptive Control (MARS), Sliding mode Control.

RBT Levels: L2, L3

Module - 4

HEV (Hybrid Electric Vehicle): Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system performance.

RBT Levels: L2, L3

Module - 5

Energy Sources & Charging: Different Batteries and Ultra capacitors, Battery characteristics (Discharging &Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Design and analyze EV and HEV systems: Students will be able to design and analyze EV and HEV systems, including electric motors, power electronics, and energy storage systems.	L3
CO 2	Evaluate EV and HEV performance: Students will be able to evaluate the performance and limitations of different EV and HEV configurations.	L2
CO 3	Apply EV and HEV knowledge to real-world applications: Students will be able to apply their knowledge of EVs and HEVs to real-world applications and case studies.	L2
CO 4	Simulate EV and HEV systems: Students will be able to simulate EV and HEV systems using software tools.	L2
CO 5	Communicate EV and HEV concepts effectively: Students will be able to communicate EV and HEV concepts effectively through written reports, presentations, and discussions.	L2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Smart Materials and Sensors			
Course Code	**MLIE215A**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand various smart materials, their physical properties.
2. To understand and working of smart sensors, actuators and transducers.
3. To understand the working of signal conditioning devices, measuring and control techniques in signals processing.
4. To understand the design, analysis, manufacturing and application issues involved in integrating smart materials and devices with the help of case studies.
5. To apply Engineering Smart Structures and Products for automation and precision manufacturing equipment, automotives and consumer products.

Module - 1

Overview of Smart Materials, Structures and Products Technologies. Physical Properties of Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magneto electric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors.

RBT Levels: L2, L3

Module - 2

Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Impact Hammers; MEMS Sensors; Sensor Arrays. Smart Actuators: Displacement Actuators; Force Actuators; Power Actuators; Vibration Dampers; Shakers; Fluidic Pumps; Motors. Smart Transducers: Ultrasonic Transducers; Sonic Transducers; Air Transducers.

RBT Levels: L2, L3

Module - 3

Measurement, Signal Processing, Drive and Control Techniques in Quasi-Static and Dynamic Measurement Methods; Signal-Conditioning Devices; Constant Voltage, Constant Current and Pulse Drive Methods; Calibration Methods; Structural Dynamics and Identification Techniques; Passive, Semi-Active and Active Control; Feedback and Feed forward Control Strategies.

RBT Levels: L2, L3

Module - 4

Design, Analysis, Manufacturing: Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering applications.

RBT Levels: L2, L3

Module - 5

Applications of Engineering Smart Structures and Products. Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, as well as medical and dental tools and equipment.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. M. V. Gandhi and B. So Thompson, Smart Materials and Structures, Chapman & Hall, London; New York, 1992 (ISBN: 0412370107).
2. B. Culshaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN: 0890066817).

Reference Books:

1. A. V. Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

2. A. J. Molson and J. M. Herbert, Electro ceramics: Materials, Properties, Applications, 2nd Edition, John Wiley & Sons, Chichester, West Sussex; New York, 2003 (ISBN: 0471497479).

3. G. Gautschi, Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).

4. K. Uchino, Piezoelectric Actuators and Wtrasonic Motors, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain various smart materials, their physical properties.	L3
CO 2	Explain working of smart sensors, actuators and transducers.	L3
CO 3	Explain the working of signal conditioning devices, measuring and control L3 techniques in signals processing.	L3
CO 4	Design, analysis, manufacturing and application issues involved in L4 integrating smart materials and devices with the help of case studies.	L4
CO 5	Apply Engineering Smart Structures and Products to automation and L4 precision manufacturing equipment, automotives and consumer products.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Nano Electronics and Nano sensors			
Course Code	**MLIE215B**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand basic building blocks of digital electronics.
2. To understand the operations of semiconductor nano-devices.
3. To understand the operation and applications of photonic materials.
4. To understand the operation and applications of nano-sensors.

Module - 1

Fundamentals of Digital Electronics: OP-Amp, RS Flip Flops, J-K Master Slave Flip Flops, Types of registers, D/A and A/D Counters, Bipolar Junction Transistor, FET, MOSFET, Single Electron Tunnelling.

RBT Levels: L2, L3

Module - 2

Semiconductor Nanodevices: Single-Electron Devices, Nano scale MOSFET – Resonant Tunnelling Transistor - SingleElectron Transistors; Single-Electron Dynamics; Nanorobotics and Nanomanipulation; Molecular nanowires-Organic LED, Organic FETs- CNT and Graphene FTE, SiNW FET.

RBT Levels: L2, L3

Module - 3

Electronic and Photonic Materials: Single Electron Tunnelling phenomena- Coulomb blockade-Coulomb staircase - RSD and Resonant tunnelling transistor- Quantum structures based LEDs - OLED and photo detectors Magnetic quantum dots and their applications.

RBT Levels: L2, L3

Module - 4

Nano sensors 1: Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, MEMS and NEMS, Packaging and characterization of sensors, Method of packaging at zero level, dye level and first level.-Thermal energy sensors -temperature sensors, heat sensors Electromagnetic sensors- electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors.

RBT Levels: L2, L3

Module - 5

Nanosensors 2: Mechanical sensors -pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors- Gas Sensor-Bio Sensors- DNA based biosensors-Packaging and method of packaging.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. W. Ranier, "Nano Electronics and Information Technology", 3rd Edition Wiley, (2012).

2. K.E. Drexler, "Nano systems", Wiley, (1992).

Reference Books

1. M.C. Petty, "Introduction to Molecular Electronics". Oxford University Press 1995.

2. Frank J. Owens and Charles P. Poole Jr., The physics and chemistry of nanosolids, Wiley Interscience Publishers, 2008.

3. Kouroush Kalantar – Zadeh, Benjamin Fry, Nanotechnology enabled sensors, Springer Verlag New York, (2008) ISBN-13: 9780387324739

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain the operation and applications of basic building blocks of digital electronics.	L3
CO 2	Explain the operations and applications of semiconductor nano-devices.	L3
CO 3	Explain the operation and applications of photonic materials.	L3
CO 4	Explain the operation and applications of nano-sensors.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Micro Electro Mechanical Systems			
Course Code	**MLIE215C**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the basics of MEMS systems.
2. To understand the operation and design of Microsystems and its components.
3. To understand the engineering mechanics for micro systems design.
4. To understand scaling and laws as applied to miniaturization.
5. To understand the basics of micro-manufacturing and design of Microsystems.

Module - 1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

RBT Levels: L2, L3

Module - 2

Working Principles of Microsystems: Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Micro fluidics. Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.

RBT Levels: L2, L3

Module - 3

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.

Module - 4

Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

RBT Levels: L2, L3

Module - 5

Overview of Micro-manufacturing: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing. Microsystem Design: Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. 'Design and Implementation of Micro Mechatronic Systems' Ren-Jung Chang, IntechOpen, 2017 2. 'Mechatronics: Integrated Mechanical Electronic Systems', M.S.Balasundaram K.P. Ramachandran, G.K. Vijayaraghavan, WILEY, 2008

Reference Books

1. 'Micro Mechatronics' Kenji Uchino, CRC Press, 2nd Edition 2019.
2. 'Mechatronic Systems Analysis, Design and Implementation' , El-Kébir Boukas, Fouad M. AL-Sunni, Springer, 2012.

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain and discuss the basics of MEMS systems.	L2
CO 2	Explain the operation and design of Microsystems and its components.	L2
CO 3	Explain the engineering mechanics for micro systems design.	L2
CO 4	Explain the scaling and its laws as applied to miniaturization.	L2
CO 5	Explain and discuss the basics of micro-manufacturing and design of Microsystems.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Switched mode Power Converters			
Course Code	**MLIE215D**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the operation of various types of switched mode converters.
2. To understand the operation of various types of Cuk converter.
3. To understand the operation of different modes of operation of various types of flyback converter.
4. To understand the operation of various types of Switched Mode DC to AC converter.
5. To understand the operation of Resonant Converters. Module-1

Module - 1

Switched Mode DC-to-DC Converter - buck converters – boost Converter – buck-boost converter - continuous Conduction mode – design of filter inductance & capacitance - boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage – Output voltage ripple.

RBT Levels: L2, L3

Module - 2

Cuk converter – Full-ridge dc-dc Converter – PWM with bipolar voltage and unipolar voltage switching – comparison of dc-dc converters – Linear Power Supply – disadvantages of linear power supply – switched mode power supply – dc-dc converters with electrical isolation –unidirectional core excitation & bidirectional core excitation.

RBT Levels: L2, L3

Module - 3

Fly back converter – continuous & discontinuous conduction mode - double ended fly back converter – forward converters – basic forward converter – practical forward converter – continuous conduction mode only - double ended forward converter – push pull converter – half bridge converter – full bridge converter – continuous conduction mode – current source dc-dc converter.

RBT Levels: L2, L3

Module - 4

Switched Mode DC to AC converter – 1-phase square wave full-bridge inverter – square wave switching scheme - sine PWM switching scheme – PWM with bipolar & unipolar voltage switching - harmonic analysis of output voltage – output control by voltage cancellation - 3-phase voltage source inverter – 3-phase sine PWM inverter – RMS line to line voltage & RMS fundamental line-to-line voltage – square wave operation - Switching utilisation ratio of 1-phase & 3-phase full-bridge inverters.

RBT Levels: L2, L3

Module - 5

Resonant Converters - Basic resonant circuit concepts – series resonant circuit – parallel resonant circuit – load resonant converter - ZCS resonant converter - L type & M type - ZVS resonant converter – comparison of ZCS & ZVS Resonant Converters.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Mohan, Undeland, Robbins, Power Electronics – Converters Application and Design, Wiley-India
2. Muhammad H. Rashid, Power Electronics – Circuits, Devices and Applications, Pearson Education

Reference Books

1. Abraham Pressman, Switching Power supply Design, McGraw Hill

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain the operation of various types of switched mode converters.	L3
CO 2	Explain the operation of various types of Cuk converter.	L3
CO 3	Explain the operation of different modes of operation of various types of flyback converter	L3
CO 4	Explain the operation of various types of Switched Mode DC to AC converter.	L3
CO 5	Explain the operation of Resonant Converters.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Advance Power Electronic Converters			
Course Code	**MLIE216A**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the dynamics of power electronic converters
2. To understand the sustainable energy generation technologies.
3. To model and analysis of power electronic systems and equipment using computational software.
4. To Simulate and analyze resonant converters.
5. To apply the knowledge of mathematics to converter/machine dynamics in Electrical engineering.

Module - 1

Introduction to power electronics: Introduction to Power Processing, Several Applications of Power Electronics, Elements of Power Electronics. Principles of Steady State Converter Analysis: Inductor Volt- Second Balance, Capacitor Charge Balance, and the Small- Ripple Approximation, Boost Converter Example, Cuk Converter Example Estimating the Output voltage ripple and inductor current ripple in converters Containing Two-Pole Low-Pass Filter(Text 1).

RBT Levels: L2, L3

Module - 2

Converter Dynamics and Control: AC Equivalent Circuit Modeling, TheBasic AC Modeling Approach, StateSpace Averaging, Circuit Averaging and Averaged Switch Modeling, The Canonical Circuit Model, Modeling the Pulse-Width Modulator, Analysis of Converter Transfer Functions, Graphical Construction of Impedances and Transfer Functions(Text 1).

RBT Levels: L2, L3

Module - 3

Controller Design: Introduction, Effect of Negative Feedback on the Network Transfer Functions, Construction of the Important Quantities 1/(1 + T) and T/(1+ T) and the Closed-Loop Transfer Functions, Stability, The Phase Margin Test, The Relationship Between Phase Margin and Closed-Loop Damping Factor, Transient Response vs. Damping Factor, Regulator Design, Measurement of Loop Gains (Text 1).

RBT Levels: L2, L3

Module - 4

Modern Rectifiers and Power System Harmonics: Power and Harmonics in Non-sinusoidal Systems, PulseWidth Modulated Rectifiers. Resonant Converters: Sinusoidal Analysis of Resonant Converters with examples (Text 1).

RBT Levels: L2, L3

Module - 5

Power supply applications: Switching DC Power Supplies, Motor drive applications: Introduction to Motor Drives, DC-Motor Drives, Residential and Industrial Applications, Electric Utility Applications (Text 2).

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. 'Fundamentals of Power Electronics', Erickson and Maksimovic, 2ndEdition, Kluwer Academic Publishers, 2001.

2. 'Power Electronics converters, Applications and Design', MNed Mohan, Tore Undeland and William P Robbins, John Wiley and Sons, 3rdEdition, 2002.

Reference Books

1. 'Switching Power Supply Design', Abraham Pressman, McGraw-Hill Publishers, 1998.

2. 'Power Electronics Handbook', Muhammad H.Rashid, 2 ndEdition, Academic Press, 2007.

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Estimate and analyze the dynamics of power electronic converters	L3
CO 2	Explain the sustainable energy generation technologies.	L3
CO 3	Perform Modelling and analysis of power electronic systems and equipment using computational software	L3
CO 4	Simulate and analyze resonant converters.	L3
CO 5	Apply the knowledge of mathematics to converter/machine dynamics in Electrical engineering.	L3

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Internet of Things and Applications			
Course Code	**MLIE216B**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the basic concepts IoT Architecture and devices employed.
2. To understand and analyze the sensor data generated and map it to IoT protocol stack for transport.
3. To understand and apply communication knowledge to facilitate transport of IoT data over various available communications media.
4. To understand a use case for a typical application in real life ranging from sensing devices to analyzing the data available on a server to perform tasks on the device.
5. To understand and apply the knowledge of Information technology to design of IoT applications (Operational Technology).

Module - 1

What is IoT: Genesis, Digitization, Impact, Connected Roadways, Buildings, Challenges IoT Network Architecture and Design Drivers behind new network Architectures, Comparing IoT Architectures, M2M architecture, IoT world forum standard, IoT Reference Model, Simplified IoT Architecture.

RBT Levels: L2, L3

Module - 2

IoT Network Architecture and Design: Core IoT Functional Stack, Layer1 (Sensors and Actuators), Layer 2 (Communications Sublayer), Access network sublayer, Gateways and backhaul sublayer, Network transport sublayer, IoT Network management. Layer 3 (Applications and Analytics) – Analytics vs Control, Data vs Network Analytics, IoT Data Management and Compute Stack.

RBT Levels: L2, L3

Module - 3

Engineering IoT Networks: Things in IoT – Sensors, Actuators, MEMS and smart objects. Sensor networks, WSN, Communication protocols for WSN Communications Criteria, Range, Frequency bands, power consumption, Topology, Constrained Devices, Constrained Node Networks
IoT Access Technologies, IEEE 802.15.4
Competitive Technologies – Overview only of IEEE 802.15.4g, 4e, IEEE1901.2a
Standard Alliances – LTE Cat 0, LTE-M, NB-IoT.

RBT Levels: L2, L3

Module - 4

Engineering IoT Networks: IP as IoT network layer, Key Advantages, Adoption, Optimization, Constrained Nodes, Constrained Networks, IP versions, Optimizing IP for IoT. Application Protocols for IoT – Transport Layer, Application Transport layer, Background only of SCADA, Generic web based protocols, IoT Application Layer Data and Analytics for IoT – Introduction, Structured and Unstructured data, IoT Data Analytics overview and Challenges.

RBT Levels: L2, L3

Module - 5

IoT in Industry (Three Use cases): IoT Strategy for Connected manufacturing, Architecture for Connected Factory Utilities – Power utility, IT/OT divide, Grid blocks reference model, ReferenceArchitecture, Primary substation grid block and automation. Smart and Connected cities –Strategy, Smart city network Architecture, Street layer, city layer, Data center layer, services layer, Smart city security architecture, Smart street lighting.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. 'CISCO, IoT Fundamentals – Networking Technologies, Protocols, Use Cases for IoT', David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, ISBN: 978- 9386873743, First edition, 2017

Reference Books:

1. 'Internet of Things – A Hands on Approach', ArshdeepBahga and Vijay Madisetti, Orient Blackswan Private Limited - New Delhi, First edition,2015

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Explain the basic concepts IoT Architecture and devices employed.	L2
CO 2	Analyze the sensor data generated and map it to IoT protocol stack for transport.	L2
CO 3	Apply communications knowledge to facilitate transport of IoT data over various L3 available communications media.	L3
CO 4	Design a use case for a typical application in real life ranging from sensing devices to analyzing the data available on a server to perform tasks on the device.	L3
CO 5	Apply knowledge of Information technology to design of IoT applications (Operational Technology).	L2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Cyber security			
Course Code	**MLIE216C**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand the cybercrime and laws and computer forensics
2. To explain the phishing and identity theft

Module - 1

Introduction to Cyber crime and Laws

Introduction, Cybercrime: Definition and Origins of the word, Cybercrime and information Security, Who are Cyber criminals? Classifications of Cybercrimes .How Criminals Plan Them

Introduction, How Criminals Plan the Attacks, Cybercafé and Cybercrimes, Botnets, AttackVector,The Indian IT ACT 2000 and amendments.

RBT Levels: L2, L3

Module - 2

Tools and Methods used in Cyber crime

Introduction, Proxy Server and Anonymizers, Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow.

RBT Levels: L2, L3

Module - 3

Phishing and Identity Theft

Introduction, Phishing – Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing. Identity Theft– PII. Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.

RBT Levels: L2, L3

Module - 4

Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics

Investigation, Setting up a Computer Forensics Laboratory : Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics,

Forensics and Social Networking Sites: The Security/PrivacyThreats,Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti forensics.

RBT Levels: L2, L3

Module - 5

Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the IT Act, 2000, Intellectual Property Issues, Overview of Intellectual Property –Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication McGraw Hill.
2. Cyber Security Understanding CyberCrimes, Computer Forensics and Legal Perspectives by

Nina Godbole and Sunit Belpure, Publication Wiley.
3. Introduction to information security and cyberlaws Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla Dreamtech Press 2015
4. MarjieT. Britz- Computer Forensics and Cyber Crime: An Introduction - Pearson
5. Chwan-Hwa(John) Wu, J.David Irwin –Introduction to Computer Networks and Cyber security CRC Press

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Able to understand the cyber crime and cyber laws	L2
CO 2	Able to understand and analyze the tools and methods used in cyber crime	L2
CO 3	Able to understand Computer forensics.	L2
CO 4	Able to understand the cyber security policies.	L2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Medical Electronics			
Course Code	**MLIE216D**	**CIE Marks**	**50**
Teaching Hours/Week (L:P:SDA)	**3:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning Objectives:

1. To understand sources of biomedical signals, medical instrumentation system.
2. To understand biomedical instruments and their working.
3. To learn about patient monitoring systems.
4. To understand medical imaging systems.

Module - 1

Bioelectric Signals and Electrodes: Sources of biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems, Origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrodes – Electrode-tissue interface, Polarization, Skin contact impedance, Motion artifacts, Silver-Silver Chloride electrodes, Electrical conductivity of electrode jellies and creams.

RBT Levels: L2, L3

Module - 2

Acquisition of Bioelectrical signals and Pacemakers: Electrodes for ECG, ECG leads, Effects of artifacts, Multichannel ECG machine, Vectorcardiograph, Phonocardiograph, Electrodes of EMG, Electrodes for EEG, 10-20 electrode systems, computerized analysis of EEG, Pacemakers & Defibrillator: Need for cardiac pacemaker, External pacemaker, Implantable pacemakerstypes, Need for defibrillator, DC defibrillator, Automatic external defibrillator, Implantable defibrillators.

RBT Levels: L2, L3

Module - 3

Diagnosis and Therapeutic Instruments: Spirometry: Basic spirometer, Ultrasonic spirometer, Ventilators, types, Modern ventilators, High frequency ventilators, Nebulizers, Artificial Kidney: Introduction, Dialyzers, Membranes for Hemodialysis, Hemodialysis machine, Oximetry, Blood flow measurement by Doppler imaging, Nuclear Magnetic Resonance& Laser Doppler flow meter.

RBT Levels: L2, L3

Module - 4

Patient Monitoring Systems and Telemedicine: Cardiac monitor, Bedside patient monitoring system, measurement of heart rate-average and instantaneous heart rate meters, Measurement of pulse rate, Blood pressure measurement: Direct method, Indirect method-automatic pressure measurement using Korotkoff's method, Single channel telemetry systems, Multichannel wireless telemetry systems, Multi-patient telemetry, Telemedicine applications, Essential parameters for telemedicine, Telemedicine technology.

RBT Levels: L2, L3

Module - 5

Medical Imaging Systems: Basic components and working principle of X-rays, Ultrasound, Computed Tomography (CT), Magnetic Resonance Imaging (MRI)& Radionuclide Imaging.

RBT Levels: L2, L3

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. Theminimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of themaximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned thecredits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sumtotal of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of 25 Marks
2. Two assignments each of 25 Marks or one Skill Development Activity of 50 marks to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, 2nd Edition, Tata McGraw Hill, 2003.
2. Kirk Shung, Michael Smith and Benjamin M.W Tsui, 'Principles of Medical Imaging' , Academic Press limited, 1992
3. Biomedical Instrumentation and Measurement Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India

Reference Books

1. Guyton & Hall, 'Text Book Of Medical Physiology',11th edition, Saunders/Elsevier
2. ZhongHicho and Manbirsingh, Fundamentals of medical imaging, John Wiley

Web links and Video Lectures (e-Resources): www.nptel.ac.in

Skill Development Activities Suggested

1. Interact with industry (small, medium, and large).
2. Involve in research / testing / projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits / fieldwork.
4. Accustom to the use of standards / codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

Course outcome (Course Skill Set)

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

Sl. No.	Course Outcomes	Blooms Level
CO 1	Discuss the various sources of biomedical signals, medical instrumentation system.	L2
CO 2	Explain the working of biomedical instruments.	L2
CO 3	Discuss patient monitoring systems.	L2
CO 4	Explain medical imaging systems.	L2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO3
4	An ability to create, select, apply appropriate techniques, resources and modern tools to solve complex engineering activities with an understanding of their limitations.	PO4
5	An ability to apply Professional ethics, responsibilities and norms of the engineering.	PO5
6	An ability to recognize the need to engage in independent and life-long learning in Electronics and Communication domain.	PO6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**2**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**3**	**2**	**1**	**1**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

2024 Scheme for M. Tech. in Electronics & Communication Engg.

(Specialisation in Industrial Electronics)

Power Electronics Laboratory			
Course Code	MLIEL207	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	1:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	2	Exam Hours	03

Course Learning objectives:

1. To implement different techniques of message passing.
2. To develop and test programs.
3. To compare DFT and DCT using MatLab.
4. 8. To design digital filters using suitable techniques.

Sl. No.	**Experiments**
1	Analysis of static and dynamic characteristic of MOSFET and IGBT.
2	Performance of single phase fully controlled and semi-controlled converter for RL load for continuous and discontinuous current mode operation.
3	Study of effect of source inductance on the performance of single phase fully controlled converter.
4	Performance analysis of three phase fully controlled and semi-controlled converter for RL load for Continuous and discontinuous current mode operation
5	Performance analysis of single phase bridge inverter for RL load and voltage control by single pulse width modulation.
6	Performance analysis of two quadrant chopper.
7	Performance analysis of Diode clamped multilevel inverter.
8	ZVS operation of a Synchronous buck converter.
9	Simulation study of buck, boost and buck- boost converter (basic topologies) and analysis of wave forms for continuous current mode (CCM).
10	Simulation study of forward converter and fly back converter and performance analysis of various waveforms.
11	Closed loop operation of a buck and boost converter.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for theevaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will beevaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of thesemester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carrya weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks. SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University. All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the characteristics and operation of power electronic devices (MOSFET, IGBT, Thyristors).	L3
CO2	Familiarize yourself with various types of power electronic converters (AC-DC, DC-DC, DC-AC).	L3
CO3	Learn about control techniques for power electronic converters (PWM, resonance).	L3
CO4	Understand the principles of multilevel inverters and their applications	L3
CO5	Develop and simulate power electronic circuits using software tools (e.g., MATLAB, Simulink).	L3