



INSTITUTE OF ENGINEERING & MANAGEMENT

a school of UEM, Kolkata

DEPARTMENT OF ELECTRICAL ENGINEERING

SEMESTER WISE CURRICULAM

3rd YEAR- 6th SEMESTER

Syllabus for B. Tech Admission Batch 2023

Semester VI [Third year]
Branch/Course: Electrical Engineering

Sl No	Type of Course	Course Code	Course Name	L	T	P	Total Contact Hours	Credit Points
1	Professional Core Courses	PCC-EE 601	Power System-II (Operation and Control)	3	1	0	4	3
2	Professional Core Courses	PCC-EE 602	Microprocessor & Microcontroller	3	0	0	3	3
3	Professional Elective Courses	PEC-EE 601	A. Wind and Solar Power Energy System B. Electric and Hybrid Vehicles	3	0	0	3	3
4	Professional Elective Courses	PEC-EE 602	A. Measurement and Instrumentation B. Semiconductor Design and Simulation	2	0	0	2	2
5	Open Elective Courses	OEC-EE 601	A. IoT B. AI & ML C. Industrial Automation- II	2	0	0	2	2
6	Humanities and social sciences including Management	HSMCEE 671	Principles of Management	2	0	0	2	2
7	Humanities and social sciences including Management	ESP(EE) 601	ESSENTIAL STUDIES FOR PROFESSIONAL- VI	2	0	0	2	0.5
8	Professional Core Courses	PCC-EE 691	Power System Laboratory - II	0	0	3	3	1
9	Professional Core Courses	PCC-EE 692	Microprocessor & Microcontroller Laboratory	0	0	3	3	1
10	Professional Elective Courses	PEC-EE 691	A. Wind and Solar Power Energy System Laboratory B. Electric and Hybrid Vehicles	0	0	3	3	1
11	Professional Core Courses	PEC-EE 692	A. Measurement and Instrumentation Laboratory	0	0	3	3	1

			B. Semiconductor Design and Simulation Laboratory					
12	Humanities and social sciences including Management	SDP 681	Skill Development for Professionals VI				2	0.5
13	Project. Seminar and Industrial Training	PWEE681	Mini Project IV				1	1
14	Massive Open Online Courses (MOOCs)	MOOCs	Massive Open Online Courses (MOOCs)					
15	Industry and Foreign Certification (IFC)	IFC	Industry and Foreign Certification (IFC)					
16	Mandatory Additional Requirements (MAR)	MAR681	Mandatory Additional Requirements (MAR)					
Total Credit Points of Semester				17	0	8	33	21



University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
University of Engineering & Management, Jaipur



Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Power Systems – II (Operation and Control) Credit: 3

Lecture Hours: 40

Subject Code: PCCEE601

Study Mateial	NPTEL	Lesson Plan PCCEE6 01
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Pre-requisite: Basic Electrical Engineering, Power System-I

Course Objective:

1. To utilize numerical methods for analyzing a power system using load flow study.
2. To understand power system stability and to utilize numerical methods.
3. To realize methods to control the voltage and frequency.
4. To understand the monitoring, control and basic economics of a power system.

Course Outcome:

- CO 1:** Understand the numerical methods for analyzing a power system using power flow study.
- CO 2:** Analyze power system stability and application of numerical techniques.
- CO 3:** Realize the methods to control the voltage and frequency of a power system.
- CO 4:** Understand the modern technologies for monitoring and controlling of power system operation, system security and basic economics for power dispatch, power market and demand side management.

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	<p>Power Flow Analysis: Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.</p>	<p>Industry Mapping: MATLAB, ETAP</p> <p>International Academia: https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/</p>	10	<p>1. Study on DC load flow using MATLAB 2. Study on AC load flow using Gauss-seidel method using MATLAB/ETAP 3. Study on AC load flow using Newton Raphson method etc. using MATLAB/ETAP</p>	<p>D. P.Kothari and I. J.Nagrath, “Power System Engineering”, 3e, McGraw Hill Education.</p>	6
2	<p>Power System stability analysis: Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single machine infinite bus system following a disturbance like a three-phase fault. Analysis using numerical integration of swing equations (Point by Point, Modified Euler’s , Runge Kutta or other evolutionary methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.</p>	<p>Industry Mapping: MATLAB,ETAP</p> <p>International Academia: https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/</p>	12	<p>1. Study and analysis of Swing equation using MATLAB</p>	<p>D. P.Kothari and I. J.Nagrath, “Power System Engineering”, 3e, McGraw Hill Education.</p>	13

3	<p>Control of Frequency and Voltage: Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters.</p>	<p>Industry Mapping: MATLAB</p> <p>International Academia: https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/</p>	10	<p>1. Modelling of SVC and analysis using MATLAB. 2. Study of SVC Using Thyristor-Switched Capacitor and Thyristor-Controlled Reactor in hardware setup. 3. Control of active and reactive power in hardware setup.</p>	<p>D. P.Kothari and I. J.Nagrath, “Power System Engineering”, 3e, McGraw Hill Education.</p>	9, 27
4	<p>Generation Economics and Monitoring/Control: Power System Economics and Management: Basic Pricing Principles: Generator Cost curves, Utility Functions, Power Exchanges and economic dispatch, Lambda iteration method, penalty factor. Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Transmission and Distributions charges, Ancillary Services. Demand Side-management (DSM). AI modelling practices in electricity markets and DSM. Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units (PMU) and Wide-Area Measurement Systems (WAMS), Techniques and integration of AI for PMU data analysis, state-estimation, security Assessment. Contingency Analysis. Preventive Control and Emergency Control.</p>	<p>Industry Mapping: MATLAB</p> <p>International Academia: https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/</p>	8	<p>1.Study of ELD problems in MATLAB</p>	<p>D. P.Kothari and I. J.Nagrath, “Power System Engineering”, 3e, McGraw Hill Education.</p>	7,29

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3	0	0	0	0	0	1
CO2	3	3	3	3	3	0	0	0	0	0	1
CO3	3	2	2	3	2	0	0	0	0	0	1
CO4	3	3	3	3	3	1	0	0	0	0	1

Text Books:

1. D. P.Kothari and I. J.Nagrath, "Power System Engineering", 3rd edition, McGraw Hill Education.. (Chapter: 2,5,6,10,13)

Reference Books:

1. J.Grainger and W.D.Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O.I.Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. B.M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G.Strbac, "Electric Power Systems", Wiley, 2012.1

Syllabus for B.Tech Admission Batch 2023

Subject Name: Microprocessors and Microcontrollers

Lecture Hours: 40

Pre-requisite: Digital Electronics, Basic concept of programming.

Credit: 3

Subject Code: PCCEE602

[Study Material](#)

[Coursera](#)

[Nptel](#)

[LinkedIn Learning](#)

[LessonPlan_PCCEE602](#)

Course Objective:

1. To understand the architecture of 8-bit and 16-bit microprocessor.
2. To study the architecture of 8-bit microcontroller
3. To learn the design aspects of I/O and Memory Interfacing circuits.
4. To design a microcontroller-based system
5. To get a brief idea of advanced processors

Course Outcome:

At the end of the course, the students will be able to

- CO1. Understand processor microarchitecture, design and performance evaluation concepts.
- CO2. Understand the architecture and instruction set of 8086 and 8051.
- CO3. Develop simple programs in 8086 and 8051
- CO4. Build microcontroller-based applications

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	<p>Fundamentals of 8-bit microprocessor architecture. Comparison between 8-bit and 16-bit architecture.</p> <p>The 8086 Microprocessor: Introduction to 8086- Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation. 8086 System bus structure: 8086 signals – Basic configurations – System bus timing – System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations</p>	<p>Industry Mapping: home appliances, process control, motor control, and robotic operations.</p> <p>International Academia: https://ocw.mit.edu/courses/2-996-biomedical-devices-design-laboratory-fall-2007/resources/lec5_microprsr_1/</p>	10	<p>1. Programming using 8086 to implement the concept of Look Up table.</p> <p>2. Programming using 8086 to implement the concept of Binary to ASCII conversion</p>	Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.	Chapter 1 - 4,8
2	<p>I/O INTERFACING: Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller –DMA controller – Programming and applications</p> <p>Case studies: Traffic Light control, LED display, LCD display, Keyboard interface and Alarm Controller. Case Study: Virtual Testing of 8086-Based Traffic Light Controller Using AI Simulation Prompts</p>	<p>Industry Mapping: conveyor systems, robotic arms, temperature and pressure monitoring systems, smart home devices, Traffic light controllers.</p> <p>International Academia: https://ocw.mit.edu/courses/2-996-biomedical-devices-design-laboratory-fall-2007/resources/lec6_microprsr2/</p>	8	Design a traffic light controlling system using 8086.	Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.	Chapter 5,6,7

3	<p>Microcontroller: Architecture of 8051 – Structure of internal memory - Special Function Registers (SFRs) – I/O Ports – Instruction set – Addressing modes – Assembly language programming.</p>	<p>Industry Mapping: Consumer Electronics and Home Automation, Industrial Automation and Robotics, Medical and Healthcare Devices</p> <p>International Academia: https://ocw.mit.edu/courses/res-3-002-collaborative-design-and-creative-expression-with-arduino-microcontrollers-january-iap-2017/</p>	8	<ol style="list-style-type: none"> 1. Design a circuit using 8051/Arduino/Raspberry Pi to measure the room temperature 2. Design a circuit to control the speed of a stepper motor using 8051/Arduino/Raspberry Pi 3. Design a virtual keyboard using 8051/Arduino/Raspberry Pi 4. Design a circuit using 8051/Arduino/Raspberry Pi to display digits 0 to 9 in a 7 segment display 5. Design a circuit to measure air pressure of a particular room using 8051/Arduino/Raspberry Pi 	<p>The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.</p>	<p>Chapter 1 - 6</p>
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4	<p>Interfacing Microcontroller: Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation. Case Study: Design an AI-Assisted home automation system using 8051 to control lights, fans, and alarms based on sensor input.</p>	<p>Industry Mapping: Consumer Electronics and Home Automation, Industrial Automation and Robotics, Medical and Healthcare Devices</p> <p>International Academia: https://ocw.mit.edu/courses/res-3-002-collaborative-design-and-creative-expression-with-arduino-microcontrollers-january-iap-2017/</p>	8	<p>1. Design Analog to Digital converter using 8051/Arduino/Raspberry Pi. 2. Design a digital Tachometer using 8051/Arduino/Raspberry Pi. 3. Design a strain gauge based weighing machine using 8051/Arduino/Raspberry Pi. 4. Design an Arduino based Smoke detector. 5. Design an Arduino based obstacle measurement system using Ultrasonic sensor.</p>	<p>The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.</p> <p>Chapter 9 - 14</p>
5	<p>Advanced Processor: Introduction to DSP processor and its architecture, ARM processor: Introduction to ARM processor and its architecture, RISC processor: Introduction to RISC processor and its architecture</p>	<p>Industry Mapping: Radar systems, biomedical signal analysis, and telecommunications, Smartphones, IoT devices.</p> <p>International Academia: https://ocw.mit.edu/courses/2-996-biomedical-devices-design-laboratory-fall-2007/resources/lec5_microprsr_1/</p>	6	<p>1. Familiarization with DSP processor architecture. Familiarization with process of storing and viewing the contents. 2. Familiarization with ARM processor architecture. Familiarization with process of storing and viewing the contents.</p> <p>Study material</p>	<p>NA</p>

Suggested sources of learning:**TEXT BOOK:**

1. Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.
2. Microprocessor & Interfacing, D.V. Hall, Mc Graw Hill.
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.

REFERENCE BOOKS:

1. Advanced Microprocessors, Y. Rajasree, New Age international Publishers.
2. An introduction to the Intel family of Microprocessors, James L. Antonakos, Pearson Education.
3. The 8051 Microcontroller, Ayala, Thomson.
4. The 8086 Microprocessors: Programming & Interfacing the PC, K.J.Ayala, Thomson.
5. Microprocessor & Peripherals, S.P. Chowdhury & S. Chowdhury, Scitech.
6. Microchip technology data sheet, www.microchip.comerence books

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	1	-	-	-	-	2
CO2	3	3	2	2	3	1	-	-	-	-	2
CO3	3	3	3	3	3	2	-	-	-	-	2
CO4	3	3	3	3	3	3	-	1	1	1	3



University of Engineering and Management
Institute of Engineering & Management, Salt Lake Campus
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Syllabus for B.Tech Admission Batch 2023

Subject Name: Wind and Solar Power Energy System

Credit: 3

Lecture Hours: 40

Subject Code: PEC-EE 601A

Relevant Links

[Study Material](#) [Coursera](#) [NPTEL](#)

Course Objective(s):

The purpose of learning this course is-

1. To understand the difference between Renewable and non-renewable energy sources
2. To understand methods of conversion of wind energy to other form of energy.
3. To understand methods of conversion of wind energy to other form of energy.
4. To solve numerical problems of Renewable and non-renewable energy sources

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Detailed Syllabus

Module No	Description	Mapping with Industry and international academia	Lecture Hours	Corresponding Lab assignment	Text Book	Mapped Chapter
1	Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions	AICTE Syllabus: Aicte Syllabus International Academia: MIT Syllabus Mapping	5	No Lab	B.H. Khan, Non-Conventional Energy Resources, McGraw Hill, 3 rd Ed	Unit- 7
2	Wind generator topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, BDFRM, Power electronics converters. Generator-Converter configurations, Converter Control. Using AI to analyze historical wind data to predict future wind patterns.	AICTE Syllabus: Aicte Syllabus International Academia: MIT Syllabus Mapping	12	Exp- 7	B.H. Khan, Non-Conventional Energy Resources, McGraw Hill, 3 rd Ed	Unit-7
3	The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	AICTE Syllabus: Aicte Syllabus International Academia: MIT Syllabus Mapping	3	Exp- 1, 2, 3	B.H. Khan, Non-Conventional Energy Resources, McGraw Hill, 3 rd Ed	Unit- 4
4	Solar photovoltaic: Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT)	AICTE Syllabus: Aicte Syllabus	8	Exp- 1, 2, 3, 4, 5, 6, 10	B.H. Khan, Non-Conventional Energy Resources,	Unit- 6

	algorithms. Converter Control. Using AI to optimize MPPT algorithms for maximum power extraction.	International Academia: MIT Syllabus Mapping			McGraw Hill,3rd Ed	
5	Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms-real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. Using AI to optimize the operation of hybrid power systems.	AICTE Syllabus: Aicte Syllabus International Academia: MIT Syllabus Mapping	8	Exp- 8	T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005	Unit-19
6	Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.	AICTE Syllabus: Aicte Syllabus International Academia: MIT Syllabus Mapping	3	No experiment	B.H. Khan, Non-Conventional Energy Resources, McGraw Hill,3 rd Ed	Unit- 5

Suggested Learning Resources:

Text Books

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. B.H. Khan, Non-Conventional Energy Resources, McGraw Hill,3rd Ed.

Reference Books

1. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
2. G.N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

3. J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley&Sons,1991.
4. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill,1984

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	1	-	-	-	-	2
CO2	3	3	2	2	3	1	-	-	-	-	2
CO3	3	3	3	3	3	2	-	-	-	-	2
CO4	3	3	3	3	3	3	-	1	1	1	3



University of Engineering and Management
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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Electric and Hybrid Vehicles

Lecture Hours: 40

Pre-requisite: Electrical Machines, Power Electronics.

Credit: 3

Subject Code: PEC-EE 601B

Relevant Links

[Study Material](#)

[Coursera](#)

[NPTEL](#)

[Linkedin Learning](#)

[Infosys Springboard](#)

Lesson Plan

Course Objectives:

The purpose of learning this course is-

1. To understand the basic difference between conventional and Hybrid vehicles.
2. To understand different configuration and control of Electric drives.
3. To understand energy storage system and charging technology in Hybrid vehicles.
4. To understand different energy management strategies and vehicle connectivity for ADAS.
5. To solve numerical problems on the topics studied

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- CO1. Understand the models to describe electric vehicles and their cutting edge technologies.
- CO2. Understand the basic concept of EV Drivetrains and fault detection.

CO3. Understand the different possible ways of energy storage and charging technology.

CO4. Understand the different EV energy management strategies, connectivity and ADAS.

Detailed Syllabus

Module No	Description	Mapping with Industry & International Academia	Lecture Hours	Text Book	Mapped Chapter
1	<p>Introduction: Introduction to Electric & Hybrid Electric Vehicles: History of hybrid and electric vehicles, efficiencies of electric & ICEs, classifications of hybrid vehicle powertrains, advantages & disadvantages of EVs and HEVs, social and environmental importance of hybrid and electric vehicles.</p> <p>Recent cutting edge EV technology: AI Based Cyber-Security for EV Technology, Threat management and risk assesment, Core Concepts of Embedded Technology</p>	<p><i>International Academia:</i> MIT Syllabus Mapping</p> <p><i>AICTE prescribed syllabus:</i> Aicte Syllabus</p> <p><i>Industry Mapping:</i> JSW-MG MOTORS INDIA, mgmotors.skill-lync.com</p> <p><i>AI mapping:</i> Introduction to Automotive Cybersecurity & Vehicle Networks / Coursera</p>	8	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 2, 3 & 4
2	<p>EV & HEV Drive-trains: Electric Drive-trains: fundamentals of electric vehicle architecture, components, and energy flow.</p> <p>Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, DC Motor, Induction Motor control, Permanent Magnet Motor drives (BLDC, PMSM), Understand traction motors, power electronics, and fault diagnostics in EVs.</p>	<p><i>International Academia:</i> MIT Syllabus Mapping</p> <p><i>AICTE prescribed syllabus:</i> Aicte Syllabus</p>	10	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 11

		<i>Industry Mapping:</i> JSW-MG MOTORS INDIA, mgmotors.skill-lync.com			
3	<p>Energy Storage & Charging Technology: EV battery chemistry, design, performance, and safety basics, Fuel Cell based energy storage and its analysis, low & high voltage batteries, different types of batteries (Li-ion, Ni-metal hybrid), battery management system (BMS), regenerative braking. EV & PHEV Charging: different levels of charging, EV charging equipment, wireless charging, selecting the energy storage technology.</p>	<i>International Academia:</i> MIT Syllabus Mapping <i>AICTE prescribed syllabus:</i> Aicte Syllabus <i>Industry Mapping:</i> JSW-MG MOTORS INDIA, mgmotors.skill-lync.com	10	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 9, 10, 12 & 13, 14, 19
4	<p>Energy Management Strategies and vehicle connectivity Introduction to energy management strategies used in hybrid and electric vehicles, different intelligent energy management strategies using AI, implementation issues of energy management strategies, CAN Network, AI based fault detection using CAN Network, Case Studies and best practices, ADAS SYSTEM: Understanding vehicle connectivity, essential principals of ADAS</p>	<i>International Academia:</i> MIT Syllabus Mapping <i>AICTE prescribed syllabus:</i> Aicte Syllabus <i>Industry Mapping:</i> JSW-MG MOTORS INDIA, mgmotors.skill-lync.com	6	J.D. Halderman & C. Ward, “Electric & Hybrid Electric vencies”, Pearson, 2023.	Chapter 3: Energy Management Problem in HEVs
Total			40		

Suggested Learning Resources:

Text Books

1. J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

Reference Books

1. M. Ehsani, Y. Gao, S. E. Gayand A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

CO-PO MAPPING:

COs \ POs	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
C01	3	2	1	0	0	3	1	0	1	0	2
C02	3	3	3	2	3	0	0	1	0	0	2
C03	3	2	2	3	3	2	0	0	1	0	2
C04	2	3	3	3	2	3	1	0	2	1	3



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Measurement and Instrumentation

Credit: 2

Lecture Hours: 30

Subject Code: PEC-EE 602A

Pre-requisite: Basic Electronics

Relevant Links

[Study Material](#)

[Coursera](#)

[NPTEL](#)

Course Objectives:

1. To provide students a brief knowledge of measurements and measuring instruments related to engineering.
2. To introduce students how different types of electrical and electronic meters work and their construction.
3. To provide students a knowledge to use modern tools necessary for instrumentation projects.
4. To provide students a knowledge of sensors and transducers and its industrial application.

Course Outcome:

1. To provide students a brief knowledge of measurements and measuring instruments related to engineering.
2. To introduce students how different types of electrical and electronic meters work and their construction.
3. To provide students a knowledge to use modern tools necessary for instrumentation projects.
4. To provide students a knowledge of sensors and transducers and its industrial application.

Module No	Description	Mapping with Industry and international academia	Lecture Hours	Corresponding Lab assignment	Text Book	Mapped Chapter
1	<p>Measurement and Electromechanical indicating Instruments: Generalized block diagram of Measurement System, Industrial Standards of measurement. Measurement of current & Voltage using PMMC, MI and Electro dynamometer type instruments. Extension of range of instruments- shunts & multipliers-Current transformers- Potential Transformers.</p>	<p>AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf</p> <p>International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future</p>	4	No Lab	A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; DhanpatRai.	Chapter 2
2	<p>Power, Energy and Power Factor Measurements: Definition of power, types, Measurement of power with different methods, construction and working of Electro dynamometer type Wattmeter, Errors in power measurements. Measurement of Energy using Induction type energy meter. Electro dynamometer type P.F. meter.</p>	<p>AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf</p> <p>International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future</p>	6	Exp- 7	A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; DhanpatRai.	Chapter 9
3	<p>DC and AC Bridges: Concept of Bridges, Measurement of low resistance by Kelvin Double Bridge Method, A.C. bridges - Maxwell's inductance bridge, Anderson bridge, D-Sauty Bridge, Schering Bridge, Wien</p>	<p>AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf</p>	7	Exp- 1, 2, 3	A.K.Sawhney, Electrical & Electronics Measurements and	Chapter 13

	bridge- Circuit diagram, phasor diagram, derivations of equations for unknown parameter, Q-factor, dissipation factor, advantages and disadvantages for all the bridges.	International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future			Instrumentation; DhanpatRai.	
4	Analogue Electronic Instruments: Q- Meter circuit and its operation, errors in Q- Meter circuits, Voltmeters with IC Operational Amplifiers, Peak Response and rectifying type AC Voltmeters, True rms Voltmeter, Electronic Ohmmeters, Current measurement with Analogue Electronic Instruments -Current-to-voltage converter type Electronic Ammeters. Digital Instruments: Introduction, Digital voltmeters, Digital Frequency Meter, Errors in frequency measurement – possible remedies, Time and Ratio measurement. Frequency Divider Generator, Signal Generator, Digital Multimeter.	AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future	8	Exp- 1, 2, 3, 4, 5, 6, 10	A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; DhanpatRai.	Chapter 4
5	Introduction to Sensors, Definition, significance of measurement and instruments, General concepts and terminology of measurement systems, Static & dynamic characteristics of instruments, Different types of instruments, Types of errors, Limiting error with examples. Principle of sensing & transduction, transducer classification, emerging fields of sensor technologies.	AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future	7	Exp- 8	A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; DhanpatRai.	Chapter 18

6	<p>Resistive transducers: Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.</p> <p>Inductive transducers: Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics.</p> <p>Optical Sensors: LDR, Photo Diode, Stroboscope, IR Sensor.</p> <p>Thermal sensors: Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple,</p>	<p>AICTE Syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf</p> <p>International Academia: https://online.stanford.edu/courses/xeiet100-clean-renewable-energy-storage-sustainable-future</p>	8	No experiment	A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; DhanpatRai.	Chapter 18
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CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3	0	0	0	0	0	1
CO2	3	2	3	3	3	0	0	0	0	0	1
CO3	3	2	2	3	2	0	0	0	0	0	1
CO4	3	3	3	3	3	1	0	0	0	0	1

Learning Resources

Text Books:

1. A.K.Sawhney, Electrical & Electronics Measurements and Instrumentation; Dhanpat Rai.
2. E.W Golding, Electrical Measurement and Measuring Instruments; Wheeler Publication
3. Electronic Measurement & Instrumentation By H. Cooper – PHI.

Reference Books:

1. Electronics Instruments & Measurement by David A. Bell – PHI.
2. J.B.Gupta, Electrical & Electronics Measurements and Instrumentation; S.K. Kataria and Sons.



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Semiconductor Design and Simulation

Credit: 2

Lecture Hours: 30

Subject Code: PECEE602B

Pre-requisite: Basic Electronics

Relevant Links:

<u>STUDY MATERIAL</u>	<u>COURSERA</u>	<u>NPTTEL</u>	<u>LinkedIn Learning</u>	Infosys Springboard
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Lesson Plan PCCEE602B

Course Objective:

The purpose of learning this course is to

1. Provide fundamental knowledge and understand the ecosystem of semiconductor manufacturing from design to product.
2. Explore advanced semiconductor devices including MOSFETs, FINFETs, scaling effects, and their impact on device design.
3. Gain working knowledge of process simulation using SEMulator3D.
4. Apply statistical tools for process control and optimization in semiconductor fabrication.

Course Outcome:

After completion of this course, the learners will be able to

CO1: Distinguish between design, fab, packaging, and system/product levels.

CO2: Explain key microfabrication processes and scaling benefits.

CO3: Analyze FinFET process integration challenges across multiple modules.

CO4: Analyze the different characterization techniques required to

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	<p>Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams, Types of materials, metals, insulators and semiconductors, Band gap, Miller indices, Crystal Structure of Silicon, Intrinsic Semiconductors, Extrinsic semiconductors, Fermi level, Thermal Equilibrium, Law of mass action, mobility, generation recombination, Transport Equations, Continuity Equations</p>	<p>International Standards: (Solid-State Circuits Electrical Engineering and Computer Science MIT OpenCourseWare)</p> <p>AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final%20Minor%20VLSI.pdf</p> <p>Industry Mapping: LAM Research, IISc Bangalore, Intel, Samsung, Texas Instruments, STMicroelectronics</p>	4	Familiarization of the SEMulator3D software and basic GUI navigation.	G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th edition	1

2	<p>Review of PN Junction Diode BJT: BJT- I-V relation and gain, Ebers-Moll model, Non-idealities in BJT, Gummel Poon Model, HBT, BJT Transient and small signal behavior, and capacitance characteristics, Thermionic emission current flow and fermi-level pinning; Field Effect Transistors: Field Effect Transistors (JFET, MESFET, HEMT), MOS Band diagram and C-V characteristics, Threshold voltage and Interface charges, MOSFET I-V, gradual channel approximation and frequency response, non-idealities and CMOS</p>	<p>International Standards: (Solid-State Circuits Electrical Engineering and Computer Science MIT OpenCourseWare) AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final%20Minor%20VLSI.pdf Industry Mapping: LAM Research, IISc Bangalore, , Intel, Samsung, Texas Instruments, STMicroelectronics</p>	7	ID-VD characteristics of junction field effect transistors	G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th edition	
3	<p>FINFET Process Integration: MOSFET, Isolation: STI vs LOCOS, Device Architecture: Planar to FinFET, strain, SiGe; Gate Stack: High-k dielectrics, metal gates, gate-first vs gate-last; Junction and Implantation: Well, source-drain, LDD; Contact: Metal-silicon contact, silicides (Ti/Co/Ni), salicidation; Interconnect: Cu vs Al, RC delay, electromigration, Damascene; ILD: Low-k dielectrics, integration challenges</p>	<p>International Standards: (Solid-State Circuits Electrical Engineering and Computer Science MIT OpenCourseWare) AICTE prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final%20Minor%20VLSI.pdf Industry Mapping: LAM Research, IISc Bangalore, Intel, Samsung, Texas Instruments, STMicroelectronics</p>	7	1. Replacement of metal gate 2. Implement the process of Implantation & Silicidation	Study Material	Study Material

4	<p>Elements of Fabrication Technology: Wafer Cleaning, Epitaxial Growth, Oxidation, Diffusion, Ion Implantation, Metallization, Photolithography, Wet Chemical Etching, Dry or Plasma Etching, Steps of Chip Assembly, Die Bonding, Wire Bonding, Packaging</p> <p>Deposition techniques: CVD-APCVD, LPCVD, MOCVD, PECVD, ALD, PVD, electroplating</p>	<p>International Standards: (Solid-State Circuits Electrical Engineering and Computer Science MIT OpenCourseWare)</p> <p>AICTE prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final%20Minor%20VLSI.pdf)</p> <p>Industry Mapping: LAM Research, IISc Bangalore, Intel, Samsung, Texas Instruments, STMicroelectronics</p>	5	<p>1. Introduction to process simulation steps (material properties, basic crystal growth/wafer prep simulation, thermal oxidation).</p> <p>2. Introduction to Process Simulators and Simulating Crystal growth.</p>	<p>G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th edition</p>	5
5	<p>Characterization Techniques (brief overview): SEM, AFM, XRD, XPS, FTIR, RAMAN, DTA, TGA, DSC, Ellipsometry, Electrical probing. Emerging trends:</p> <p>Packaging : Wafer dicing to chip assembly, Heterogeneous integration, 3D ICs, flexible electronics, quantum computing</p>	<p>International Standards: (Solid-State Circuits Electrical Engineering and Computer Science MIT OpenCourseWare)</p> <p>AICTE prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final%20Minor%20VLSI.pdf)</p> <p>Industry Mapping: (Intel, Samsung, Texas Instruments, STMicroelectronics)</p>	7	<p>1. Understanding the difference between Damascene and Dual-Damascene</p> <p>2. Designing of PlanarFET and FinFET inverter</p>	<p>Study Material</p>	<p>Study Material</p>

TEXT BOOK:

1. G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th edition, Pearson, 2014.

REFERENCE BOOKS:

1. Donald Neamen , Dhruves Biswas "Semiconductor Physics and Devices" McGraw-Hill Education
2. S. M. Sze & Kwok K. Ng, Physics of Semiconductor Devices, 3rd Edition, Wiley.
3. Marc Madou, Fundamentals of Microfabrication and Nanotechnology, 3rd Edition, CRC Press.
4. Stephen D. Senturia, Microsystem Design, Springer.
5. Chang Liu, Foundations of MEMS, 2nd Edition, Pearson.
6. James D. Plummer, Michael D. Deal, Peter B. Griffin, Silicon VLSI Technology: Fundamentals, Practice and Modeling, Pearson.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	2	-	-	-	-	-	-

Syllabus for B.Tech Admission Batch 2023

Subject Name: IoT
Lecture Hours: 40

Credit: 3
Subject Code: OEC-EE-601A

<u>Study Material</u>	<u>Coursera</u>	<u>Nptel</u>	<u>LinkedIn Learning</u>	<u>Infosys Springboard</u>
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Lesson Plan OECEE601A

Course Objective:

1. To learn fundamentals of IoT and how to build hardware and software for IoT based systems
2. Emphasize on Industrial IoT development

Course Outcome:

- CO1. To be well versed with the design flow of IoT based systems.
 CO2. Able to build IoT nodes using different sensors, microcontrollers and processors.
 CO3. Able to understand different communication protocols like GPRS and WiFi for connecting IoT nodes to server.
 CO4. Able to understand the internet communications like IP, TCP.UDP, the server application and user interface software

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Basics of Networking and Network Security Introduction, Network Types, Layered Network Model, Addressing, TCP/IP Transport Layer, Security, Network Confidentiality, Cryptography, Internet Security	Industry: https://aws.amazon.com/iot/ Academia https://tinycloud.com/3eshksfw	7	NA	Introduction To IOT By Sudip Misra, Anandarup Mukherjee, Arijit Roy Cambridge University Press	1,2

2	Sensor, Transducer and Its Characteristics: Primary Sensing element, Secondary Sensing Element, Selection of Sensors for Practical Applications, Resistive Transducer, Strain Gauges, Temperature Transducer, Differential Output Transducer, Load Cell, Piezo-electric Transducer, Magnetic Flowmeter, Turbine Flowmeter, Introduction to Signal Conditioning System, Use of Op-Amp in Signal Conditioning	Industry: https://aws.amazon.com/iot/ Academia https://tinyurl.com/3eshksfw	9	NA	A Course in Electrical , Electronics Measurement and Instrumentation By A.K. Shawney Dhanpat Rai & Sons Publishing, 2022	5
3	IOT Actuation and Data Acquisition System: Actuator Characteristics, Actuator types: Hydraulic Actuator, Pneumatic Actuators, Electric Actuator, Mechanical Actuator, Objective of DAS, Single Channel DAS, Multi-Channel DAS, Computer Based DAS	Industry: https://aws.amazon.com/iot/ Academia https://tinyurl.com/3eshksfw	8	NA	Introduction To IOT By Sudip Misra, Anandarup Mukherjee, Arijit Roy Cambridge University Press	5
4	Introduction to Smart Sensor and Its Architecture: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel, Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	Industry: https://aws.amazon.com/iot/ Academia https://tinyurl.com/3eshksfw	9	NA	INTERNET OF THINGS Architecture and Design Principles by Raj Kamal, McGraw Hill Education (India) Private Limited	4
5	IOT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA 100.11A, Wireless HART, RFID, NFC, LoRa, WI-fi, Bluetooth, Sigfox, NB-IoT	Industry: https://aws.amazon.com/iot/ Academia https://tinyurl.com/3eshksfw	7	NA	Introduction To IOT By Sudip Misra, Anandarup Mukherjee, Arijit Roy Cambridge University Press	7

Suggested sources of learning:

TEXT BOOK:

1. Introduction To IOT By Sudip Misra, Anandarup Mukherjee, Arijit Roy Cambridge University Press, 2024
2. Raj Kamal, "INTERNET OF THINGS Architecture and Design Principles", McGraw Hill Education (India) Private Limited, 2017.
3. A Course in Electrical , Electronics Measurement and Instrumentation By A.K. Shawney Dhanpat Rai & Sons Publishing, 2022

REFERENCE BOOKS:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley, 2012.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3	0	0	0	0	0	1
CO2	3	3	3	3	3	0	0	0	0	0	1
CO3	3	2	2	3	2	0	0	0	0	0	1
CO4	3	3	3	3	3	1	0	0	0	0	1



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: AI & ML

Credit: 2

Lecture Hours: 30

Subject Code: OEC-EE601B

Relevant Links

[Study Material](#)

[Coursera](#)

[NPTEL](#)

[Linkedin Learning](#)

[Infosys Springboard](#)

Module Number	Topic	Sub- Topic	Mapping with Industry and International Academia	Lecture Hour	Chapter Mapping	Corresponding Lab Assignment
1	Introduction to AI	Introduction Artificial Intelligence and its applications, Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents. AI Techniques, advantages, and limitations of AI, Impact and Examples of AI, Application domains of AI. The AI Ladder - The Journey for	<i>AICTE-prescribed syllabus:</i> aicte syllabus <i>International Academia:</i> MIT Syllabus Mapping	4	Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010	Basic Programs using Python From https://onlineco.urs.es.swayam2.ac.in/ai

		Adopting AI Successfully, Advice for a career in AI, Hotbeds of AI Innovation.	<i>Industry Mapping:</i> Python		Chapter 1 and 2	c20_sp33/previ ew
2	Problem solving techniques	State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, Constraint satisfaction problem, Mean- end analysis, Min-Max Search, Alpha-Beta Pruning, Additional refinements, Iterative Deepening.	<i>AICTE-prescribed syllabus:</i> aicte syllabus <i>International Academia:</i> MIT Syllabus Mapping <i>Industry Mapping:</i> Python	8	Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010 Chapter 3 and 6	1. Python programming, symbolic algebra. 2. Implementation of Depth first search, Breadth first search 3. Implementation of A* search 4. Implementation of bi-directional search Implementation of Decision Tree Classifier.
3	Introduction to ML	What Is Machine Learning, How Do We Define Learning; what are datasets and how to handle them, Feature sets, Dataset division: test, train and validation sets, Holdout, cross validation, k Cross validation, random sampling LOOCV, Bootstrap sampling; Fitting of data; Evaluation Measures: SSE, MME, R2, confusion matrix, precision, recall, F-Score, Kappa, ROC- Curve, Cross-Entropy Loss.	<i>AICTE-prescribed syllabus:</i> aicte syllabus <i>International Academia:</i> MIT Syllabus Mapping <i>Industry Mapping:</i> Python	6	Machine Learning for Dummies, By John Paul Mueller and Luca Massaron Chapter 9 and 12	1. Implementation of Splitting real life data using a. Holdout, b. K Fold, c. Stratified K Fold, d. Leave-One-Out (LOO), e. Leave-P-Out (LPO), f. Shuffle Split.

						<p>2. Compare them.</p> <p>3. Bootstrap Sampling.</p> <p>4. WAP to construct</p> <p>a. AUC-ROC curve</p> <p>b. Confusion matrix WAP</p> <p>Scale features in a given dataset</p>
4	Supervised & Unsupervised learning techniques	<p>Supervised: Classification and Regression: Binary, Multilevel, Multiclass, Imbalance; K- Nearest Neighbour, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Decision Tree.</p> <p>Unsupervised: Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitioned Clustering - K-means clustering, Association Analysis(Ginni)</p>	<p><i>AICTE-prescribed syllabus:</i> aicte syllabus</p> <p><i>International Academia:</i> MIT Syllabus Mapping</p> <p><i>Industry Mapping:</i> Python</p>	5	<p>Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education , 2010</p> <p>Chapter 12 and 13</p>	<p>1. Implementation on real life data</p> <p>Multi-class Classification</p> <p>2. Multi-label Classifications</p> <p>3. Implementation on real life data KNN</p> <p>4. Implementation on real life data Linear regression</p> <p>5. Implementation on real life data Naïve Base, Gaussian Naive Bayes</p>

												6. Implementation on real life data SVM 7. Implementation on real life data with Decision Tree 8. Implementation on real life data Association Rule Mining 9. Implementation on real life data with Ginni
5	Introduction to Deep Learning	Introduction to CNNs: Architecture, Convolution/Pooling, Applications (AlexNet, VGGNet, ResNet), Introduction to Generative Artificial Intelligence	<i>AICTE-prescribed syllabus: aicte syllabus</i> <i>International Academia: MIT Syllabus Mapping</i> <i>Industry Mapping: Python</i>			3	Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010 Chapter 22					Introduction to TensorFlow Keras, PyTorch

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3	0	0	0	0	0	1
CO2	3	2	3	3	3	0	0	0	0	0	1
CO3	3	2	2	3	2	0	0	0	0	0	1
CO4	3	3	3	3	3	1	0	0	0	0	1

Text Book:

1. Artificial Intelligence: A modern approach by Stuart Russel, Pearson Education, 2010
2. Machine Learning for Dummies, By John Paul Mueller and Luca Massaron, For Dummies, 2016

Reference book:

3. Artificial Intelligence & Generative AI for Beginners, The Complete Guide, David M. Patel, Independently published 2023
4. Machine Learning, Tom M. Mitchell, McGraw Hill Education, 2017.
5. Artificial Intelligence by Rich and Knight, The McGraw Hill, 2017
6. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning, the MIT press, 2016

Online resources:

1. <https://nptel.ac.in/courses/106102220>
2. <https://nptel.ac.in/courses/106105077>
3. <https://nptel.ac.in/courses/106106139>
4. https://onlinecourses.nptel.ac.in/noc20_cs49/preview
5. <https://www.coursera.org/learn/machine-learning-duke>
6. https://www.linkedin.com/learning/artificial-intelligence-foundations-machine-learning-22345868?trk=course_title&upsellOrderOrigin=default_guest_learning
7. <https://www.mooc-list.com/course/transformer-models-and-bert-model-coursera>
8. <https://www.coursera.org/learn/nlp-sequence-models>



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023



Subject Name: Industrial Automation II

Credit: 2

Lecture Hours: 30

Subject Code: OEC-EE601C

Sl. No.	Topics	No. of Lectures	Remarks
	TOTAL	30	1 hr duration for each session
1	PLC/DCS HARDWARE	1	
1.1	Controller	1	
1.2	Signal Modules		
1.3	Technological Modules		
2	PLC PROGRAMMING	8	
2.1	Recapitulation of PLC Programming	1	
2.2	Hardware Configuration	1	Theory + Practical
2.3	Programming in Statement List (STL)	6	1 Theory + 3 Practical Sessions
2.4	Programming in Structured Control Language (SCL)		
2.5	Programming in Sequential Function Chart (SFC)		
3	CONTROL MODES	3	
3.1	ON-OFF control	1	
3.2	Feedback Control	1	
3.3	Feed-forward Control		
3.4	Cascade Control		
3.5	Ratio Control	1	
3.6	Adaptive Control		
3.7	Split Range Control		
4	PID CONTROL	2	
4.1	Basics of PID Control	2	Theory + Practical
4.2	PID Control Tuning		
5	HUMAN MACHINE INTERFACE	11	
5.1	Introduction to HMI	1	
5.2	HMI Hardware	1	
5.3	Types of Operator Interfaces		
5.4	Connection Wiring of HMI		
5.5	Data Handling with HMI	1	
5.6	HMI Screen	3	1 Theory + 2 Practical Sessions
5.7	Configuration & Interfacing to PLC & Other Systems	1	Theory + Practical
5.8	Reports	4	2 Theory + 2 Practical Sessions
5.9	Trends		
5.10	Messages – Alarm, Warning, Event		
5.11	User Administration		
6	NETWORKS OF INDUSTRIAL AUTOMATION	2	
6.1	Types of Networks	2	
6.2	Network Topologies		
6.3	Passive & Active Network Components		
7	COMMUNICATION	3	
7.1	Communication between PLC & Drives	1	
7.2	Communication between two PLCs/PLC & other systems	2	1 Theory + 1 Practical Sessions



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Principles of Management

Credit: 3

Lecture Hours: 40

Subject Code: HSMCEE 671

Relevant Links:

[Study Material](#)

[Coursera](#)

[NPTEL](#)

[Linkedin Learning](#)

Course Objectives:

1. Relate, discuss, understand, and present management principles, processes and procedures in consideration of their effort on individual actions.
2. Participate, summarize and/or lead class discussions, case problems and situations from both the text and student experience that relate to the text material.
3. Knowledge and understanding of the Principles of Management will enable the student manager and/ or employee and gain valuable insight into the workings of business and other organizations.

Course Outcome:

- CO1: Recognize the basic concept of Management.
- CO2: Appreciate the relation of Management and Society, People Management and Managerial competencies.
- CO3: Understand the Decision making process and concept of Financial analysis
- CO4: Have acquaintance with Operation and Technology management.

Detailed Syllabus

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	<p>Basic concepts of management: Definition – Essence, Functions, Roles, Level.</p> <p>Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organization Structure –Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organizational Effectiveness.</p>	IIT, Kgp & Roorkey	5	-	Principles of Management by Anil Bhat & Arya Kumar: Oxford	1,6,7
2	<p>Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.</p> <p>People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.</p> <p>Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship</p>		5	-	Principles of Management by Anil Bhat & Arya Kumar: Oxford	3,16,17,18,20,21,22,23
3	<p>Leadership: Concept, Nature, Styles.</p> <p>Decision making: Concept, Nature, Process, Tools & techniques.</p> <p>Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.</p>		5	-	Principles of Management by Anil Bhat & Arya Kumar: Oxford	9,11,12,13,14,25,

4	Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.		5	-	Principles of Management by Anil Bhat & Arya Kumar: Oxford	30,31, 41,42
	Total:		20			

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	0	0	0	1	2	0	0	0	0	1
CO2	0	0	3	2	1	3	0	0	0	0	2
CO3	1	1	3	2	2	3	0	0	0	0	1
CO4	1	1	3	2	0	3	0	0	0	1	1

Suggested Learning Resources:

1. Drucker. F. Peter- Management – Tasks, Responsibilities & Practice
2. Principles of Management by Anil Bhat & Arya Kumar: Oxford

Reference Books

1. Drucker, F. Peter - The Practice of Management.
2. Terry and Franklin - Principles of Management
3. Stoner - Principles of Management
4. William H. Newman and - The Process of Management. E. Kirby Wassen



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Power System Laboratory II

Credit: 1

Lecture Hours: 30

Subject Code: PCC-EE 691

Course Outcomes:

After completion of this course, the learners will be able to

CO1	PCC EE691.1	Identify appropriate equipment and instruments for the particular experiments.
CO2	PCC EE691.2	Perform experiments on transformers and various types of relays, and validate the measured results by constructing the circuits with appropriate instruments and following safety precautions.
CO3	PCC EE691.3	Design of experiments and analyze the experimental results obtained from simulations of problems related to stability, faults, and power flow using appropriate IT tools such as ETAP, MATLAB, etc.
CO4	PCC EE691.4	Data interpretation, proper communication with report writing, and building effective teamwork and leadership.

Detailed Syllabus

Module No	Description	Hrs.
1	Performance analysis and trip characteristic testing of a Numerical Overcurrent Relay for fault detection and mitigation. Hands-on hardware design and simulation of a numerical relay- performance and accuracy testing of the numerical overcurrent relay under various fault conditions, including normal load, overcurrent, and short-circuit scenarios and to determine its trip characteristics and response time.	2
2	Testing of time-dependent characteristics of on-time delay relay and off-time delay relay for application of load management. Design of simulation model for activation or deactivation of heavy electrical loads to reduce peak demand using on-time delay relay and off-time delay relay.	2
3	Performance analysis and testing of polarity, ratio and magnetization characteristics of CT and PT for proper transformer connection in a system. Design and simulation of connection diagram by CT-PT for protection of a distribution system using MATLAB/ETAP.	2
4	Testing of IDMT characteristics of under voltage relay and MATLAB based design for application in transmission line faults analysis.	2
5	Simulation of different IEEE distribution bus systems framework and assessment of voltage, current and load profile using AC load flow analysis implementing Gauss-Seidel method in ETAP/MATLAB platform.	2
6	Simulation of different IEEE distribution bus systems framework and assessment of voltage, current and load profile using AC load flow analysis implementing Newton Raphson method in ETAP/MATLAB platform.	2
7	Design and simulation of DC and AC distribution system with protection arrangements for assessment of current and voltage profile using MATLAB. Design of hands-on app-based hardware for Ring Main system.	2
8	Design and simulation of different transformer and generator protection schemes for an electrical network using ETAP/ MATLAB simulation.	2
9	Design and simulation of transient stability of a multi-machine system in a power network for reliable power supply using MATLAB	2
10	Testing of time-dependent voltage current characteristics of over current relay for application to generator protection, transformer protection and motor protection. Design of op-amp based overcurrent fault protection.	2
11.	Design of protection scheme of distribution substation using earth fault relay and testing of its IDMT characteristics.	2
12.	Development of bus admittance matrix of an interconnected power network for load flow analysis following IEEE standard using MATLAB. Design and AI based simulation of a microgrid system using renewable and non-renewable micro-sources for demand side management (DSM).	2

13.	Simulation and analysis of different types of unsymmetrical and symmetrical faults exists in distribution system network using MATLAB	2
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CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	0	0	0	0	1	0	0	0	0	0
CO2	3	3	0	0	1	0	0	2	0	0	1
CO3	0	0	3	2	2	0	0	1	1	0	0
CO4	2	1	0	0	0	1	1	1	2	2	1



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Syllabus for B.Tech Admission Batch 2023

Subject Name: Microprocessor & Microcontroller Laboratory

Credit: 1

Lecture Hours: 30

Subject Code: PCC-EE 692

Course Objective(s):

1. To understand the architecture of 8-bit and 16-bit microprocessor.
2. To study the architecture of 8-bit microcontroller
3. To learn the design aspects of I/O and Memory Interfacing circuits.
4. To design a microcontroller-based system
5. To get a brief idea of advanced processors

Course Outcomes:

At the end of the course, the students will be able to

CO1: Understand processor microarchitecture, design and performance evaluation concepts.

CO2: Understand the architecture and instruction set of 8086 and 8051.

CO3: Develop simple programs in 8086 and 8051

CO4: Build microcontroller-based applications

Detailed Syllabus

Module No.	Description	No of period
1	Design a circuit using 8051/Arduino/Raspberry Pi to measure the room temperature.	2
2	Design an Arduino based obstacle measurement system using Ultrasonic sensor.	2
3	Design an Arduino based Smoke detector.	2
4	Design a digital Tachometer using 8051/Arduino/Raspberry Pi.	2
5	Design a circuit using 8051/Arduino/Raspberry Pi to display digit 0 to 9 in a seven segment display.	2
6	Design an Analog to Digital converter using 8051/ Arduino /Raspberry Pi.	2
7	Design a traffic light controlling system using Arduino	2
8	Programming using 8086 to implement the concept of Binary to ASCII conversion	2
9	Programming using 8086 to implement the concept of Look Up table	2
10	Design a circuit to measure air pressure of a particular room using 8051/Arduino/Raspberry Pi	2
11	Design a strain gauge based weighing machine using 8051/Arduino/Raspberry Pi.	2
12	Design a circuit to control the speed of a stepper motor using 8051/Arduino/Raspberry Pi.	2
13	Design a circuit using 8051/Arduino/Raspberry Pi to measure the moisture using moisture sensor.	2
14	Familiarization with ARM processor architecture. Familiarization with process of storing and viewing the contents.	2
15	Familiarization with DSP processor architecture. Familiarization with process of storing and viewing the contents.	2

Suggested Learning Resources:

1. Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.
2. Microprocessor & Interfacing, D.V. Hall, Mc Graw Hill.
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.

CO-PO mapping

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
C01	3	2	2	2	3	1	-	-	-	-	-
C02	3	3	2	2	3	1	-	-	-	-	-
C03	3	3	3	3	3	2	-	-	-	-	-
C04	3	3	3	3	3	3	2	-	1	1	1



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Syllabus for B.Tech Admission Batch 2023

Subject Name: Wind and Solar Power Energy System Laboratory

Credit: 1

Lecture Hours: 30

Subject Code: PEC-EE-691A

Course objectives:

The purpose of learning this course is

1. To understand the different concepts of renewable sources like wind and solar
2. To understand the different operational behavior changes with different controlling parameters of renewable sources.
3. To understand the different controlling parameters for battery storage systems.
4. To understand the concept of developing a simulation model for renewable sources.

Course Outcomes:

After completion of this course, the learners will be able to

CO1	Remember the working principle of solar cell and wind turbine.
CO2	Apply the concept of charging and discharging to monitor the health of EV battery system.
CO3	Evaluate the effect of different loads in a solar and grid-tie inverter system.
CO4	Create a MATLAB simulation to draw the I-V and P-V characteristics of the PV module.

Detailed Syllabus:

Experiment No	Experiment Name	No of period
1	Performance Evaluation of Solar PV Panel using I-V and P-V Characteristics for PV Module Testing under Standard Test Conditions (STC) to ensure quality and compliance with international standards (Hardware and MATLAB simulation)	2
2	Optimizing the Maximum Power Point (MPP) to achieve maximum efficiency for supplying industrial loads by utilizing series and parallel combinations of solar PV panels, ensuring reliable and cost-effective renewable energy solutions in industrial applications (Hardware and MATLAB simulation).	2
3	Design a solar plant yielding maximum energy considering the variation of solar irradiance throughout the day for supplying the variable load (Hardware and MATLAB simulation).	2
4	Design a solar plant yielding maximum energy considering proper placement and orientation of solar PV module for supplying the variable load (Hardware and MATLAB simulation).	2
5	Analyze the effect of the bypass diode on the PV module so that stable voltage and current levels is maintained in grid-tied systems by minimizing power disruptions caused by partial shading	2
6	Analyze the behavior of PV module by varying radiation and intensity for catering the load demand (Hardware and MATLAB simulation).	2
7	Performance evaluation of a wind plant to analyze the impact of wind speed and ensure efficient power generation (Hardware and MATLAB simulation).	2
8	Analyzing the impact of varying loads on the performance of a solar and grid-tied inverter system to ensure efficient power delivery, optimal load management, and seamless grid integration in real-world applications (Hardware and MATLAB simulation).	2
9	Monitoring the health and performance of electric vehicle (EV) battery systems to ensure optimal operation, extend battery life, and support efficient energy management in automotive and fleet management applications (Hardware and MATLAB simulation).	2
10	Design a single phase grid tied inverter for solar PV application in MATLAB Simulink.	2

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	0	0	0	1	2	0	0	0	0	1
CO2	0	0	3	2	1	3	0	0	0	0	2
CO3	1	1	3	2	2	3	0	0	0	0	1
CO4	1	1	3	2	0	3	0	0	0	1	1



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Syllabus for B.Tech Admission Batch 2023

Subject Name: Electric and Hybrid Electric Vehicles LAB

Lecture Hours: 30

Credit: 1

Subject Code: PEC-EE 691B

Course Objective(s):

The purpose of learning this course is to-

1. To understand the concepts of Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) operations.
2. To design and simulate net energy consumption of EV through smart charging scheduling
3. To create realistic driving scenarios for ADAS validation in MATLAB.
4. To configure and place virtual sensors (Ultrasonic, LiDAR, Radar, Camera) for object detection
5. To generate synthetic sensor detections for algorithm testing and performance evaluation.
6. To integrate Distributed Energy Resources (DER) with conventional grids.
7. To designing intelligent control techniques for BLDC motors using AI is to optimize performance, improve efficiency.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Identify appropriate equipment and instruments for the experiment.

CO2. Test the instrument for application to the experiment.

CO3. Construct battery pack and ADAS System.

CO4. Validate different characteristics of BLDC machine, methods of speed control of BLDC motor and operation of the Electric Vehicle.

List of Experiment:

Sl. No	Hardware Experiment
1.	Development of Solution Tools for Noise Reduction and Efficiency Enhancement in BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles
2.	Analysis of Charging and Discharging Characteristics of Lithium-Ion Battery Used in Electric Vehicles
3.	Design and Implementation of Cell Balancing Techniques for Lithium-Ion Battery Packs in EV Applications
4.	Performance Evaluation of Electric Vehicle under Power Lock Condition and without Power Lock Condition
5.	Development of Prototype for EV using EV drivetrain and power train components.
6.	Design and Analysis of Electric Vehicle Performance under Various Fault Conditions
Software Experiment	
7.	Modeling various EV driving cycle attributes and essential parameter calculation Using MATLAB Simulation
8.	Designing Driving scenario generation for ADAS through the appropriate placement of various sensors like ultrasonic, LIDAR to generate synthetic object detection.
9.	Designing Intelligent Charging Scheduling Techniques Using MATLAB SIMULATION Incorporating G2V and V2G Mode of Operation
10.	Development of Intelligent Energy Management Strategies for EV Charging in Distributed Energy Resources (DER), Integrated with Conventional Grids
11.	Design of Intelligent Control Techniques of BLDC Motor Using Artificial Intelligence (AI)
12.	Design of Battery cell using digital twin in MATLAB

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	0	0	0	1	0	0	0	1
CO2	3	2	2	2	1	0	1	0	0	0	1
CO3	3	3	3	3	1	0	1	0	0	0	1
CO4	3	2	2	3	2	0	1	0	0	0	1



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Syllabus for B.Tech Admission Batch 2023

Subject Name: Measurement and Instrumentation Lab
Lecture Hours: 30

Credit: 1
Subject Code: PEC-EE692A

Course Objective(s):

The purpose of learning this course is to:

1. Develop a clear understanding of various electrical and electronic measurement techniques and their practical applications.
2. Familiarize students with different types of transducers and their use in measuring physical quantities such as temperature, displacement, and speed.
3. Provide hands-on experience in designing, calibrating, and testing measuring instruments and bridges for accurate data acquisition.
4. Introduce compensating circuits and digital techniques used in measurement systems for enhancing precision and reliability.
5. Enable students to understand the construction, working, and assembly of conventional and digital measuring instruments.

Course outcome(s):

At the end of the course, the students will be able to-

CO1: Design and analyze compensating circuits and evaluate their role in improving measurement accuracy.

CO2: Develop and calibrate different transducer based measurement systems (e.g., thermocouple, LVDT, strain gauge, capacitive transducer) for physical parameter measurement.

CO3: Examine and interpret characteristics of electrical and electronic instruments through experimental setups involving instrument transformers and bridges.

CO4: Illustrate the functioning and internal construction of different types of measuring instruments.

Experiment No.	Description	Hours
1	Design a model short transmission system and determine its efficiency by applying Instrument Transformers.	2
2	Design and calibrate a power and energy measurement system using Digital energy meter.	2
3	Design an unknown temperature measurement system of a Furnace using Thermocouple.	2
4	Core displacement measurement using LVDT through Digital Storage Oscilloscope.	2
5	Measurement of unknown capacitance of a low pass filter circuit using De Sauty Bridge and its condition monitoring using Schering Bridge	2
6	Calibration of Strain Gauge.	2
7	Rotational speed measurement system using Photo Magnetic pick up.	2
8	Water level measurement system by using capacitive transducer.	
9	Design of an Angular Displacement Measurement system using Capacitive transducer.	2
10	Dismantle and assemble different parts of PMMC, Dynamometer, Electro thermal and Rectifier type of instruments, Digital multimeter and various other instruments to get familiarized with their constructions.	2

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	2	0	0	0	1	0	2
CO2	3	2	3	3	2	0	0	0	1	0	2
CO3	3	3	2	3	2	0	0	0	1	0	2
CO4	2	2	2	2	1	0	0	0	1	0	1



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Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Semiconductor Design and Simulation Lab

Credit: 1

Lecture Hours: 30

Subject Code: PEC-EE 692B

Software: SEMulator 3D

Course Objective:

The purpose of learning this course is to-

1. Provide fundamental knowledge and understand the SEMulator 3D software
2. Explore advanced semiconductor devices including MOSFETs, FINFETs, scaling effects, and their impact on device design.
3. Gain working knowledge of process simulation using SEMulator3D.
4. Use SEMulator3D to simulate FinFET processes and extract layout parameters.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

Design and validate CMOS using SEMulator 3D software.

Learn about different isolation techniques, gate stack deposition and multiple patterning.

Analyze the electrical characteristics for different fabricated models

Understand and compare the planarFET and FinFET inverter design .

Detailed Syllabus

Experiment No	Description	Class Hours
1	SEMulator3D Software Familiarization Objective- Explore the SEMulator3D interface and understand basic GUI navigation, toolbars, and simulation workflow setup.	1
2	Introduction to Process Simulation Objective- Simulate basic process steps including material property definition, crystal growth, wafer preparation, and thermal oxidation.	1
3	Crystal Growth Simulation Objective- Use process simulators to model crystal growth and analyze the impact of initial wafer conditions on subsequent fabrication steps.	2
4	CMOS Inverter Layout Design Objective- Design and simulate a CMOS inverter layout using SEMulator3D, including active, poly, and metal layers.	2
5	Isolation Techniques in CMOS Fabrication Objective- Compare LOCOS and Shallow Trench Isolation (STI) techniques through simulation and evaluate their impact on device performance.	2
6	Gate Stack Deposition Strategies Objective- Simulate Gate-First and Gate-Last deposition processes and analyze differences in structural and electrical characteristics.	2
7	Spacer Formation and Multiple Patterning Objective- Implement spacer formation and multiple patterning techniques to achieve sub-lithographic feature sizes.	2
8	Metal Gate Replacement Process Objective- Simulate the replacement of polysilicon gate with metal gate and study its effect on device scaling and performance.	2
9	Implantation and Silicidation Objective- Model ion implantation and silicidation steps and evaluate junction formation and contact resistance.	2

10	Damascene vs Dual-Damascene Metallization Objective- Simulate both Damascene and Dual-Damascene processes and compare their structural and process integration aspects.	2
11	PlanarFET and FinFET Inverter Design Objective- Design and simulate both PlanarFET and FinFET-based inverter circuits and compare their layout and performance metrics.	2

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	2	-	-	-	-	-	-