University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

Institute of Engineering & Management, New Town Campus

University of Engineering & Management, Jaipur

4th Semester Syllabus for B.Tech (Admission Batch 2023)

Index:

Electrical & Electronics Engineering

B.Tech. 2nd Year Course Structure

4th Semester

Sl No	Type of Course	Subject Code	Subject Name	L	T	P	S	Total Conta	Credit Points
Theory									
1	Basic Science Course	BSM401	Mathematics IV	3	0	0		3	3
2	Professional Core Courses	PCC-EEE 401	Electric Machine-I	3	1	0		4	3
3	Professional Core Courses	PCC-EEE 402	Digital Electronic	3	0	0		3	3
4	Professional Core Courses	PCC-EEE 403	Electrical & Electronic Measurement	3	0	0		3	3
5	Professional Core Courses	PCC-EEE 404	CMOS Design	3	0	0		3	3
6	Mandatory Courses	MC 401	Environmental Science	2	0	0		2	0
7	Humanities and social sciences including Management	ESP401	Essential Studies For Professionals IV	2	0	0		2	0.5
PRACTICAL									
8	Professional Core Courses	PCC-EEE 491	Electric Machine-I Laboratory	0	0	2		2	1
9	Professional Core Courses	PCC-EEE 492	Digital Electronic Lab	0	0	2		2	1
10	Professional Core Courses	PCC-EEE 493	Electrical & Electronic Measurement	0	0	2		2	1
SESSIONAL									
11	Open Elective Courses	OEC-EEE481	A: Object Oriented Programming & Java Lab B: Programming using Python Lab	0	0	0	2	2	1
12	Humanities and social sciences including Management	SDP481	Skill Development For Professionals IV				2	2	0.5
13	Project. Seminar and Industrial Training	PW-EEE 02	Mini Project II				1	1	1
Value Added Courses									
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)	MAR481	Mandatory Additional Requirements (MAR)						
Total Credit Points of Semester				**19**	**1**	**6**	**5**	**31**	**21**

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4th Semester Syllabus for B.Tech in ECE Batch 2023-2027

Subject Name: Mathematics-IV **Credit: 3** **Lecture Hours: 36**

Subject Code: BSM401

Relevant Links:

Study-material-BSM401 NPTEL
Coursera

COURSE OBJECTIVES:

1. To learn about Calculus of Complex functions.
2. To learn about Fourier series and Fourier Transform.
3. To learn about Laplace transform.
4. To learn about Z-transform.
5. To develop a basic understanding of Data analysis using Python.

COURSE OUTCOMES:

CO 1: Identify different tools for differentiation and integration of functions of a complex variable that are used with various other techniques for solving engineering problems.

CO 2: Appraise the notions of Fourier series and Transform to solve advanced engineering problems.

CO 3: Apprehend the concept of Laplace Transform together with its applications in evaluating integrals and solving ordinary differential equations.

CO 4: Relate the use of Z-Transform for discrete functions and solve difference equations using Z-Transform technique.

CO 5: Acquire an understanding of handling and analyzing datasets, creating data visualizations, solving linear equations.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Text Book Mapping	Corresponding Lab Assignment
1.	**Calculus of Complex Functions**	Complex function, Limit, Continuity and Differentiation; Analytic functions, Cauchy-Riemann equations (statement only); Harmonic functions, Harmonic Conjugate; construction of Analytic functions; elementary Analytic functions (exponential, trigonometric, logarithmic) and their properties. Statement for Cauchy's	***International Academia:*** ● https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/ ***AICTE-prescribed syllabus:*** ● https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf ***Industry Mapping:***	**8**	Text book 1: Chapter **19** & Chapter **20**	❖ Evaluation of contour integrals using **MATLAB**.

		Integral formula for evaluation of $\int_C f(z)dz$ where C is a circle.	To analyze the frequency response of filters by evaluating the behavior of complex functions that represent signals or system responses along a contour. https://in.mathworks.com/help/matlab/math/complex-line-integrals.html			
2.	**Fourier Series & Transform**	*Fourier Series*: Even function, Odd function. Periodic function, Euler's formula, Dirichlet's conditions; Sum of the Fourier series at the point of discontinuity and end points of an interval; Half Range Sine and Cosine Series; Parseval's Theorem (statement only). *Fourier Transforms*: Fourier Transform and its properties; Fourier Sine and Cosine Transforms, Fourier Transform of derivatives (statement only); Inverse Fourier Transform (statement only); Convolution theorem (statement only), related problems.	***International Academia:*** ● https://see.stanford.edu/Course/EE261 ***AICTE-prescribed syllabus:*** ● https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf ***Industry Mapping:*** To analyze periodic signals and transform them into frequency components. https://in.mathworks.com/help/matlab/math/fourier-transforms.html	**10**	*Fourier Series:* Textbook 1: Chapter **10** *Fourier Transform:* Textbook 1: Chapter **22**	❖ Perform Fourier sine and cosine transforms using **MATLAB**. ❖ Write Fourier series for some elementary functions using **MATLAB**. ❖ Compare Fourier Transform results with Spectrum Analyzer outputs in real-world signal frequency analysis.

3.	**Laplace Transform**	Laplace Transform and its properties; First and Second Shifting theorems; Laplace Transform of Periodic functions; Inversion of Laplace Transform by different methods, Convolution theorem; evaluation of integrals by Laplace Transform; solving boundary value problems by Laplace Transform method.	***International Academia:*** ● https://ocw.mit.edu/courses/6-003-signals-and-systems-fall-2011/resources/mit6_003f11_lec06/ ● https://web.stanford.edu/~boyd/ee102/ ***AICTE-prescribed syllabus:*** ● https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf ***Industry Mapping:*** To analyze system dynamics, stability, and control in electrical circuits and automation. https://in.mathworks.com/help/symbolic/sym.laplace.html	**8**	Textbook 1: Chapter **21**	❖ Perform Laplace transform of some elementary functions using **MATLAB**. ❖ Perform inverse Laplace transform using **MATLAB**. ❖ Analyze system stability using Laplace Transform and verify results through control lab experiments with real-world systems.
4.	**Z-Transform**	Sequence, representation of sequence, Z-Transform and its properties, Shifting theorems, Inverse Z-transform, Convolution theorem, region of convergence, concept of difference equation and their solution by Z-Transform method.	***International Academia:*** ● https://ocw.mit.edu/courses/6-003-signals-and-systems-fall-2011/64490a008c1c5c25c86044351465abf7_MIT6_003F11_lec05.pdf ***AICTE-prescribed syllabus:*** ● https://www.aicte-	**6**	Textbook 1: Chapter **23**	❖ Compute Z-transform of some elementary of some functions using **MATLAB.** ❖ Solve linear difference equations with constant coefficients using **MATLAB.**

			india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf ***Industry Mapping:*** To analyze discrete-time systems, especially in control systems and digital signal processing (DSP). https://in.mathworks.com/help/symbolic/sym.ztrans.html			
5.	**Data Analysis using Python**	Arithmetic, logical operations; List, tuple, dictionary, set; Managing arrays and matrices; Solving linear equations; Data handling: Import, clean, sort, filter, summarize, handle missing data; Calculating central tendency, standard deviation of dataset; Data visualization: Line plot, Bar plot, Histogram.	***International Academia:*** ● https://ocw.mit.edu/courses/15-075j-statistical-thinking-and-data-analysis-fall-2011/pages/lecture-notes/ ● https://ocw.mit.edu/courses/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/pages/readings/ ***Industry Mapping:*** 1. To handle datasets and visualize for real-time insights. 2. To solve systems of equations for applications like signal processing.	**4**	Textbook 2:	❖ Handling of data using Panda Library. ❖ Plot data using Matplotlib. ❖ Compute Matrix operations using Numpy library. ❖ Calculate central tendencies, standard deviation of a dataset.

TEXT BOOKS:

1. **B. S. Grewal**, "Higher Engineering Mathematics", 44th Edition (2021), Khanna Publishers. (Chapter No.s: 10, 19, 20, 21, 22, 23)

2. **Wes Mckinney**, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", 2nd Edition (2017), United States: O'Reilly Media.

REFERENCE BOOKS:

1. **Biswadip Basu Mallik & Krishanu Deyasi,** "Engineering Mathematics" – Vol. 2B, 1st Edition (2020), Cengage Learning.

2. **B. K. Pal & K. Das,** "Engineering Mathematics" - Vol. IIB, 13th Edition (2019), Vol. IIIB, 8th Edition (2019), U. N. Dhur& Sons.

3. **Erwin Kreyszig,** "Advanced Engineering Mathematics", 10th Edition (2017), John Wiley & Sons.

4. **R. K. Jain and S. R. K. Iyengar,** "Advanced Engineering Mathematics", 5th Edition (2016), Narosa Publication House.

5. **B. V. Ramana,** "Higher Engineering Mathematics", 11th Reprint (2017), Tata McGraw Hill.

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Syllabus for B.Tech Admission Batch 2023

Subject Name: Electric Machine-I **Credit: 3**
Lecture Hours: 38 **Subject Code: PCCEEE401**

List of Faculty Members handling the Subject –

1. Prof. Rajat Subhra Pal
2. Prof. Nirban Chakraborty
3.

Pre-requisite: Basic Electrical Engineering, Electromagnetic Field Theory.

Study Material	Coursera	Nptel	LinkedIn Learning	Infosys Springboard

Course Objective:

- Provide a strong foundation in the principles of magnetic fields and magnetic circuits.
- Explore the relationship between magnetic materials, circuits, and energy conversion.
- Develop students' ability to analyse and interpret the magnetic field patterns and performance characteristics of DC machines.
- Analyse the performance of DC motors and generators under different operating conditions.
- Learn about transformer testing, cooling methods, and applications.

Course Outcome:

CO1: To equip students with a solid foundation in the concept of magnetic field, electromagnetic force and torque and the ability to apply this knowledge effectively in understanding the operations of electrical machines.

CO2: To equip students with a comprehensive understanding of DC machines, enabling them to apply this knowledge effectively in various engineering fields and contribute to the design, operation, and maintenance of DC machine systems.

CO3: To equip students with a comprehensive understanding of transformers, enabling them to apply this knowledge effectively in various engineering fields and contribute to the design, operation, and maintenance of transformer systems.

CO4: To equip students with a comprehensive understanding of some special electrical machines which are currently used in various industrial and house-hold applications and enabling them to apply this knowledge effectively in various engineering fields.

Detail Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Textbook	Mapped Chapter
1	**Review of Magnetic Field systems and toque production:** Magnetic fields, Energy density and magnetic circuits; Electromagnetic force, torque and General theory of Rotating Electrical Machines	**International Academia:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ **AICTE-prescribed syllabus**: https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf **Industry Mapping:** IS/ IEC Specification t/files/Vol.%20I_UG. pdf	2	NA	I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010	2,4,5

2	**Construction & Working principle of a DC machine:** *Magnetic structure* - stator yoke, stator poles, pole-faces or shoes, air gap and armature core. Visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. *Armature winding and commutation* - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction. Numerical Problems.	**International Academia:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf **Industry Mapping:** IS Specification No. 9320: 1979 regarding Guide for testing of DC Machines **Simulation Software:** MATLAB	7	1. Design and Simulation of DC Machine using MATLAB SIMULINK	I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010	7
3	**DC machine – Operation, Control and Efficiency** Armature circuit equation for motoring and generation, Types of field excitations –, separately excited, shunt and series, Concept of Field Flashing, Open circuit characteristic of separately excited DC generator, internal and external characteristics of DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. Speed Current, Torque Current, and Torque-speed characteristics of separately excited, shunt and series motors. Three Point starter for starting of DC Motor, Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.	**International Academia:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf **Industry Mapping:** IS Specification No. 9320: 1979 regarding Guide for testing of DC Machines **Simulation Software:** MATLAB	8	1. Speed control of DC traction motor for a locomotive-based system using power electronics drives (Hardware/MATLAB). 2. Speed Control of DC motors for air compressor-based application (Hardware/MATLAB)	I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010	7

4	**Transformers – Working principle, Construction, Operation, Control and Testing :** **(**Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses, Efficiency and all-day efficiency, efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses. *Three-phase transformer* - construction, types of connection and their comparative features, Vector Group and connections, Parallel operation of single-phase and three-phase transformers, *Autotransformers* - construction, principle, applications and comparison with two winding transformers, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Open delta connection, Scott connection. Traction Transformer. Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers, Dry type transformer,	**International Academia:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf · **Industry Mapping:** IS Specification No2026: 1981 (Part 1) for Power Transformer and IS Specification No. 11171: 1985 for Dry type transformer **Simulation Software:** MATLAB	**17**	1. Design and assembling of a single a phase 220/12V, 20-30VA shell type transformer for EV changing. 2. Acceptance tests of dry type transformer as per BIS11172 by undertaking a) voltage ratio test b) open circuit test c) Short Circuit test d) insulation test 3. Load Sharing and flexible load management by paralleling multiple single-phase transformers. 4. Type test of Singer Phase transformer at different load and temperature rise tests. 5. Vector grouping of three-phase transformer as per BIS 2026.	Prithwiraj Purkait & Indrayudh Bandopadhyay, “Electrical Machines” Oxford University Press	6,7
5	**Special Machines:** Permanent Magnet DC (PMDC) motor, Brushless DC (BLDC) Motors, Universal Motor, Stepper Motor, Tacho	**Simulation Software:** MATLAB	**4**	1. Design and Construction of a BLDC motor winding. 2. IOT Based control of Brushless DC Motor (BLDC) for ceiling fan application	Prithwiraj Purkait & Indrayudh Bandopadhyay, “Electrical Machines” Oxford University Press	15

Lesson Plan:

Module 1: Review of Magnetic Field systems and toque production: 2nd Year, Sec A (Faculty: Prof. Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction to the subject, Concept of Magnetic fields
Day 2	Energy density and magnetic circuits
Day 3	Electromagnetic force and torque
Day 4	General theory of Rotating Electrical Machines

Module 2: Construction & Working principle of a DC machine: 2nd Year, Sec A (Faculty: Prof. Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 5	Construction: stator yoke, stator poles, pole-faces or shoes, air gap and armature core.
Day 6	Visualization of magnetic field produced by the field winding excitation with armature winding open
Day 7	Air gap flux density distribution, flux per pole, induced EMF in an armature coil.
Day 8	Elementary armature coil and commutator, lap and wave windings,
Day 9	Construction of commutator, linear commutation
Day 10	Derivation of back EMF equation, armature MMF wave, derivation of torque equation,
Day 11	armature reaction, air gap flux density distribution with armature reaction.

Module 3: DC machine – Operation, Control and Efficiency: 2nd Year, Sec A (Faculty: Prof. Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 12	Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series,
Day 13	Concept of Field Flashing, Open circuit characteristic of separately excited DC generator
Day 14	Internal and external characteristics of DC generator, back EMF with armature reaction,
Day 15	voltage build-up in a shunt generator, critical field resistance and critical speed.
Day 16	Speed Current, Torque Current, and Torque-speed characteristics of separately excited, shunt and series motors.
Day 17	Three Point starter for starting of DC Motor,
Day 18	Speed control through armature voltage. Losses,
Day 19	Load testing and back-to-back testing of DC machines.

Module 4: Transformers – Working principle, Construction, Operation, Control and Testing: 2nd Year, Sec A (Faculty: Prof. Nirban Chakraborty)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Syllabus discussion
Day 2	Principle, construction and operation of single-phase transformers.
Day 3	Equivalent circuit, phasor diagram, voltage regulation.
Day 4	Losses, Efficiency and all-day efficiency, efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses.
Day 5	Three-phase transformer: - construction, types of connection and their comparative features.
Day 6	Vector Group and connections.
Day 7	Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Open delta connection.
Day 8	Scott connection.
Day 9	Scott connection continued & Traction Transformer
Day 10	No-load and on-load tap-changing of transformers.
Day 11	Three-winding transformers.
Day 12	Cooling of transformers, Dry type transformer.
Day 13	Parallel operation of single-phase and three-phase transformers.
Day 14	Parallel operation of single-phase and three-phase transformers continued.
Day 15	Autotransformers - construction, principle, applications.
Day 16	Autotransformer comparison with two winding transformers
Day 17	Numerical problem solution.

Module 5: Special Machines: 2nd Year, Sec A (Faculty: Prof. Nirban Chakraborty)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 18	Permanent Magnet DC (PMDC) motor.
Day 19	Brushless DC (BLDC) Motors.
Day 20	Universal Motor.
Day 21	Stepper Motor and Tacho

Suggested sources of learning:

Text Books

1. I.J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2. Prithwiraj Purkait & Indrayudh Bandopadhyay, “Electrical Machines” Oxford University Press

Reference Books

1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2021
2. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
4. Kirtley Jr., James L. Electric Power Principles: Sources, Conversion, Distribution and Use. Wiley, 2010.

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

Examination Rules & Regulations: https://iemcollege-my.sharepoint.com/:b:/g/personal/iemcoe_office_iem_edu_in/EXrcoe3d6oxIogHKO074XeUBC9qm3XNaf_qUeSiVTNh5OQ?e=MMQn40s

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Syllabus for B.Tech Admission Batch 2023-2027

Subject Name: Digital Electronics **Credit: 3** **Lecture Hours: 36**

Subject Code: PCCEEE402

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Pretik De Sarkar
2. Prof. Neeta Sahay

Study Material	Coursera	Nptel:	LinkedIn Learning:	Infosys Springboard:

Course Objectives:

1. To introduce basic postulates of Boolean algebra and to introduce the methods for simplifying Boolean expressions.
2. To study formal procedures for the analysis and design of combinational and sequential circuits.
3. To introduce the concept of logic families, semiconductor memories and implementation of digital circuits using programmable logic devices.
4. To illustrate the concept of synchronous and asynchronous sequential circuits.

Course Outcome(s) (COs):

CO1. Describe the function of different building blocks of digital electronics, semiconductor memories and programmable logic devices.
CO2. Explain the principle of operation of combinational and sequential digital circuits.
CO3. Solve numerical problems of Boolean algebra, number system, combinational & sequential digital circuits and A/D and D/A converter.
CO4. Specify applications of combinational and sequential digital circuits.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Number System and Logic Families** **Text Books: Anand Kumar (Chapter 2, 3, 4)**	Introduction to number systems, Binary, Octal and Hexadecimal representation and their conversions; BCD, ASCII, gray codes and their conversions, thermometric codes, Signed binary number representation with 1's and 2's complement methods ,basic logic functions Standard forms of logic expressions, and simplification of logic expressions using K Map. Review of TTL and CMOS families, their operations and specifications. Overview of Verilog	***International Academia:*** (https://web.stanford.edu/class/archive/ee/ee108a/ee108a.1082/schedule.html) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***Industry Mapping:*** SPICE software, Verilog	5	1. Simulation of MOS Inverter with different loads using SPICE software. 2. Simulation of CMOS Inverter for different parameters Kn, Kp as a design variable in SPICE software. 3. Introduction to programming using Verilog
2	**Introduction to Boolean Algebra and K-map:** **Text Books: Salivahanan and Arivazhagan: (Chapter 2)**	Basic Definitions and Axiomatic Definition of Boolean Algebra, Boolean Functions, Canonical and Standard Forms. The Map Method - K-map, Product of Sums and Sum of Products Simplification, NAND and NOR Implementation.	**International Standards** :(https://web.stanford.edu/class/archive/ee/ee108a/ee108a.1082/schedule.html) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***Industry Mapping:*** Hardware Chipsets (IC 7408, 7432,7404), Software-TinkerCad	5	1. Design of BCD-Excess 3 code and vice-versa using basic gates (IC 7408, 7432,7404) 2. Design of basic digital circuits using Tinkercad.
3	**Designing Combinational Logic Circuits:** **Text Book:**	Arithmetic circuits (ADDER and SUBTRACTOR), multiplier, comparators, decoders, encoders, multiplexers, de- multiplexers, parity generator and checker and their use in logic synthesis; Potential hazards in combinational circuits.	***International Standards*** : (https://web.stanford.edu/class/archive/ee/ee108a/ee108a.1082/schedule.html) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/	6	1. Design of Adder and Subtractor using basic gates (IC 7408, 7432,7404) and use of IC 74LS83 as BCD adder.

	Salivahanan and Arivazhagan: (Chapter 5,6)		Model_Curriculum/Final_ECE.pdf) ***Industry Mapping:*** Hardware Chipset (IC 7408, 7432,7404, 74153, 74155, 74180) Software: LogiSim and VHDL		2. Design of MUX and DEMUX using basic gates (IC 74153, 74155) and also study the available ICS of MUX and DEMUX. Implement logic functions using these ICs. 3. Design and implementation of 16-bit odd/even parity checker/ generator using IC 74180. 4. Implementation of combinational circuits using LogiSim and VHDL
4	**Designing Sequential Logic Circuits:** **Text Book: Anand Kumar (Chapter 8,9,10, 11,12)**	Basic memory element-S-R, J-K, D and T Flip Flops, various types of Registers and counters and their design, Design of Synchronous Sequential Circuits- State Table and State Diagrams, Design of Mealy and Moore FSM -Sequence Detection.	***International Standards:*** (https://web.stanford.edu/class/archive/ee/ee108a/ee108a.1082/schedule.html) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***Industry Mapping:*** Hardware Chipset (IC 7476, 7474) Software: LogiSim and VHDL	6	5. Design of R-S, J-K, D and T Flip flops using universal gates and also study master slave J-K flip flop IC 7476. 6. Design of synchronous and asynchronous counter using Flip Flop IC 7476. 7. Design of 4-bit shift register (shift right) IC 7476/7474 8. Implementation of sequential circuits using Logisim and VHDL
5	**Introduction to Digital Logic Devices, ADC and DAC:**	Introduction of ROM and RAM, PLA, PAL and FPGA. IC iCE40 FPGA family	***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf)	4	9. Design of PLA and PAL using basic logic gates (IC 7408, 7432,7404) 10. Design and testing of half/full adder and multiplexer by burning FPGA Kit.

	Text Book: Salivahanan and Arivazhagan: (Chapter 10, 13)	D/A converter -specifications - weighted resistor type, R-2R Ladder type. A/D Converters specifications - Flash type-Successive Approximation type, Pipeline ADC AFEx8201 16-Bit and 14-Bit Digital-to-Analog Converters (DACs) With Voltage Reference and Diagnostic ADC for Low-Power Applications	***Industry Mapping:*** Hardware Chipset AFEx8201 ADC AD570, DAC 0808 Software TinkerCad (https://www.ti.com/lit/ds/symlink/afe88201.pdf?ts=1700473002665&ref_url=https%253A%252F%252Fwww.ti.com%252Fdata-converters%252Fintegrated-special-function%252Fprecision-adcs-and-dacs%252Fproducts.html)		11. Design of ADC and DAC using IC ADC AD570, DAC 0808 12. Design of ADC and DAC using TinkerCad
6	**GEN AI for Digital Circuits** **Research papers and study material**	Introduction of GEN AI Use of GEN AI for Designing Digital Circuits Use of GEN AI for optimizing power and delay of Digital Circuits			

Lesson Plan:

Module 1: Number System and Logic Families: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
1	Syllabus discussion
2	Introduction to number systems, Binary, Octal and Hexadecimal representation and their conversions; BCD, ASCII, gray codes and their conversions
3	Thermometric codes, Signed binary number representation with 1's and 2's complement methods ,basic logic functions
4	Standard forms of logic expressions, and simplification of logic expressions using K Map: Part 1
5	Standard forms of logic expressions, and simplification of logic expressions using K Map: Part 2
6	Review of TTL families, their operations and specifications.
7	Review of CMOS families, their operations and specifications.
8	Overview of Verilog

Module 2: Introduction to Boolean Algebra and K-map: 2nd Year, (Faculty : Prof. Neeta Sahay)

DAY	LESSON PLAN – DESCRIPTION
9	Syllabus discussion
10	Basic Definitions and Axiomatic Definition of Boolean Algebra, Boolean Functions
11	Canonical and Standard Forms.
12	The Map Method - K-map,
13	Product of Sums and Sum of Products Simplification
14	NAND and NOR Implementation.

Module 3: Designing Combinational Logic Circuits: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
15	Arithmetic circuits (ADDER and SUBTRACTOR)
16	Multiplier,comparators, decoders, encoders
17	Multiplexers
18	De- multiplexers
19	Parity generator and checker and their use in logic synthesis
20	Potential hazards in combinational circuits.

Module 4: Designing Sequential Logic Circuits: 2nd Year, (Faculty : Prof. Neeta Sahay)

DAY	LESSON PLAN – DESCRIPTION
21	Basic memory element-S-R, J-K, D and T Flip Flops,
22	Various types of Registers
23	Counters and their design
24	Design of Synchronous Sequential Circuits- State Table and State Diagrams Part 1
25	Design of Synchronous Sequential Circuits- State Table and State Diagrams Part 2
26	Design of Mealy and Moore FSM -Sequence Detection.

Module 5: Introduction to Digital Logic Devices, ADC and DAC: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
27	Introduction of ROM and RAM, PLA, PAL and FPGA.
28	IC iCE40 FPGA family D/A converter -specifications - weighted resistor type, R-2R Ladder type.
29	A/D Converters specifications - Flash type-Successive Approximation type,
30	Pipeline ADC AFEx8201 16-Bit and 14-Bit Digital-to-Analog Converters (DACs) With Voltage Reference and Diagnostic ADC for Low-Power Applications

Module 6: GEN AI for Digital Circuits: 2nd Year, (Faculty : Prof. Neeta Sahay)

DAY	LESSON PLAN – DESCRIPTION
31	Introduction of GEN AI
32	Use of GEN AI for Designing Digital Circuits Part 1
33	Use of GEN AI for Designing Digital Circuits Part 2
34	Use of GEN AI for optimizing power and delay of Digital Circuits Part 1
35	Use of GEN AI for optimizing power and delay of Digital Circuits Part 2

Text Books:

1. Digital Circuits and Design, by S. Salivahanan, S. Arivazhagan, 5th Edition, Oxford University Press India. (Chapter: 2,5,6,10,13)
2. Fundamentals of Digital Circuits; Anand Kumar; PHI Publication (Chapter:2,3,4,8,9,10,11,12)
3. Digital Logic and Computer Design; M Morris Mano, Pearson Publication

Reference Books:

1. Digital Design, M. Morris. Mano & Michael D. Ciletti, PEARSON Publication
2. Digital Electronics; Tokheim; TMH Publication

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

Examination Rules & Regulations:

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University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Electrical and Electronics Measurement Credit: 3 Lecture Hours: 36

Subject Code: PCCEEE403

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Arijita Das
2. Prof. Manas Mukherjee

Pre-requisite: Basic Electrical Engineering, Electromagnetic Field Theory, Network Theory

Course Objective:

1. To learn techniques involved in analyzing measurement data and the errors associated with the measurement system used.
2. To learn the principle of operation of analog and digital meters.
3. To learn the basic principle of operation of instrument transformers
4. To learn the principle of operation of cathode ray oscilloscope and different sensors and transducers.
5. To learn the principle of measurement of power, energy and different electrical parameters.
6. To acquire problem solving skills to solve problems on the topics studied.

Course Outcome:

CO1. Understand the terms accuracy, precision, resolution, speed of response, errors in measurement loading effect, methods of measurement of power, energy by instruments and resistance, capacitance and inductance by bridges and potentiometer.

CO2. Understand the principle of operation of analog meters, instrument transformer, digital multimeter, digital voltmeter, digital frequency meter, signal generator, strain gauge, and LVDT and temperature transducers, different building block, principle of operation of oscilloscope and measurement techniques of voltage, current, frequency and phase by oscilloscope**.**

CO3. Understand the numerical problems related to analog meters, instrument transformer, and measurement of power, energy, resistance, inductance and capacitance

CO4. Understand the specify applications of analog and digital measuring instruments, sensors and transducers

Relevant Links:

Study Material	**Coursera**	**Nptel:**	**LinkedIn Learning:**	**Infosys Springboard:**

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Measurements and Analog meters: Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments. General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamometer, Induction instruments. Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers. AI in Advancements in Field Instrumentation: Enhancing Efficiency and Accuracy. AI used for Automated Calibration of Instruments.	***International Academia***: (https://ocw.mit.edu/courses/2-693-principles-of-oceanographic-instrument-systems-sensors-and-measurements-13-998-spring-2004/pages/readings/) ***AICTE-prescribed syllabus***: (https://old.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf) Industry Mapping: Multisim, MATLAB	7	1. 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. Design an unknown temperature measurement system of a Furnace using Thermocouple.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications	1,2,3,7,8,9
2	Instrument transformer and Measurement of Power: Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Principle of operation of current & potential transformer, errors. Principle of operation of Electrodynamics & Induction type wattmeter. Wattmeter errors.	***International Academia***: (https://ocw.mit.edu/courses/2-693-principles-of-oceanographic-instrument-systems-sensors-and-measurements-13-998-spring-2004/pages/readings/) ***AICTE-prescribed syllabus***: (https://old.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf) Industry Mapping: Multisim, MATLAB	9	1. Design a model short transmission system and determine its efficiency by applying Instrument Transformers.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications	10,11

3	Measurement of Energy, Potentiometer and AC Bridges: Construction, theory and application of AC energy meter, testing of energy meters. Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer. Application. Measurement of Inductance, Capacitance and frequency by AC bridges.	***International Academia***: (https://ocw.mit.edu/courses/2-693-principles-of-oceanographic-instrument-systems-sensors-and-measurements-13-998-spring-2004/pages/readings/) ***AICTE-prescribed syllabus***: (https://old.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf) Industry Mapping: Multisim, MATLAB	8	1. Design and calibrate a power and energy measurement system using Digital energy meter. 2. Measurement of unknown capacitance of a low pass filter circuit using De Sauty Bridge and its condition monitoring using Schering Bridge 3. Design a signal conditioning device using Arduino to measure the unknown capacitance based on the principle of a Schering Bridge 4. Design a signal conditioning device using Arduino to measure the unknown inductance based on the principle of a Anderson Bridge.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications	12,15,16
4	Cathode ray oscilloscope (CRO), Electronic Instruments and Introduction to Sensors & Transducers. Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator.	***International Academia:*** (https://ocw.mit.edu/courses/mas-836-sensor-technologies-for-interactive-environments-spring-2011/pages/lecture-notes/) ***AICTE-prescribed syllabus***: (https://old.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf) Industry Mapping: Multisim, MATLAB	11	1.Core displacement measurement using LVDT through Digital Storage Oscilloscope. 2. Calibration of Strain Gauge 3. Rotational speed measurement system using Photo Magnetic pick up.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications	21,25,26

	Pressure Sensors: Strain gauge, Displacement Sensors: LVDT, Temperature transducers, Flow measurement using magnetic flow measurement. Introduction to Condition Monitoring. Introduction to Phasor Technology and Wide Area Monitoring System (WAMS), Phasor Measurement Unit (PMU), Block Diagram of PMU, Phasor Data Concentrator (PDC), Introduction to Basic Communication Infrastructure for data transfer to PDC. AI used for Predictive Maintenance in Industrial Equipment. Applications of AI models to flowmeters and sensors for multiphase flow metering.			4. Water level measurement system by using capacitive transducer 5. Design of an Angular Displacement Measurement system using Capacitive transducer.		

Lesson Plan:

Module 1: Measurements and Analog meters: 2nd Year, (Faculty : Prof. Arijita Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Method of measurement, Measurement system, Classification of instruments
Day 2	Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement
Day 3	Classification of errors
Day 4	loading effect due to shunt and series connected instruments
Day 5	General features, Construction, Principle of operation and torque equation of Moving coil instruments
Day 6	General features, Construction, Principle of operation and torque equation of Moving iron instruments
Day 7	General features, Construction, Principle of operation and torque equation of Electrodynamometer instruments
Day 8	General features, Construction, Principle of operation and torque equation of Induction type instruments
Day 9	Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers
Day 10	AI in Advancements in Field Instrumentation: Enhancing Efficiency and Accuracy
Day 11	AI used for Automated Calibration of Instruments

Module 2: Instrument transformer and Measurement of Power: 2nd Year, (Faculty : Prof. Arijita Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Instrument transformer and Measurement of Power
Day 2	Instrument transformer and Measurement of Power
Day 3	Measurement of Power: Disadvantage of shunt and multipliers
Day 4	Advantages of Instrument transformers
Day 5	Principle of operation of current & potential transformer, errors
Day 6	Principle of operation of current & potential transformer, errors
Day 7	Principle of operation of Electrodynamics
Day 8	Principle of operation of Electrodynamics
Day 9	Induction type wattmeter
Day 10	Induction type wattmeter
Day 11	Wattmeter errors

Module 3: Measurement of Energy, Potentiometer and AC Bridges: 2nd Year, (Faculty : Prof. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Syllabus Discussion, Measurement of Energy, Potentiometer
Day 2	AC Bridges: Construction, theory and application of AC energy meter, testing of energy meters,
Day 3	Principle of operation and application of Crompton's DC potentiometer
Day 4	Polar and Co-ordinate type AC potentiometer. Application.
Day 5	Measurement of Inductance, Capacitance and frequency by AC bridges.
Day 6	Term 1 Exam
Day 7	Term 1 Exam

Module 4: Cathode ray oscilloscope (CRO), Electronic Instruments and Introduction to Sensors & Transducers: 2nd Year, (Faculty : Prof. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Cathode ray oscilloscope (CRO), Electronic Instruments and Introduction to Sensors & Transducers. Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO.
Day 2	Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator.
Day 3	Pressure Sensors: Strain gauge, Displacement Sensors: LVDT, Temperature transducers, Flow measurement using magnetic flow measurement. Basic concept of PMU, PDC for WAMS
Day 4	Term 2 Exam
Day 5	Practical/ Sessional Exam
Day 6	Practical/ Sessional Exam
Day 7	End Semester Exam
Day 8	

TEXT BOOK:

1. **A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications.**

REFERENCE BOOKS:

1. David A Bell, "Electronic Instrumentation and Measurements", Second Edition, PHI
2. Albert D.Helfrick and William D.Cooper "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

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University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023-2027

Subject Name: CMOS Design **Credit: 3**

Subject Code: PCC-EEE-404 **Lecture Hours: 36**

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Suman Sarkar

Pre-requisite: Basic Electronics engineering, Analog Electronics

Course objectives:

The purpose of learning this course is

1. To learn basic CMOS Circuits
2. To learn CMOS process technology
3. To learn techniques of chip design using programmable devices

Course outcomes:

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

CO1. To learn basic CMOS Circuits
CO2. To learn CMOS process technology
CO3. To learn techniques of chip design using programmable devices
CO4. To analyse CMOS digital electronic circuits

Relevant Links:

Study Material	Coursera	Nptel:	LinkedIn Learning:	Infosys Springboard:

Detail Syllabus:

Module number	Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	MOS Transistors: Introduction to Semiconductor Devices, Charge Carriers in Semiconductors, Parallel Plate Capacitor, MOS Capacitor, MOS Transistor, MOSFET Threshold Voltage, MOSFET Current Equation, MOSFET V-I Characteristics, MOSFET Scaling, Small Geometry Effects, MOSFET Capacitances, MOSFET Modelling	***International Academia:*** https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2009/pages/lecture-notes/ ***Industry Mapping:*** MATLAB	8	Current Efficiency plot, Intrinsic Gain Plot and Transit Frequency characterization in VLSI EDA Tools	Debaprasad Das, VLSI DESIGN, OXFORD SECOND EDITION,	Chapter 2
2	MOS Inverters: Introduction, Voltage Transfer Characteristics, Resistive Load Inverter, Enhancement – type nMOS Load Inverter, Depletion-type nMOS Load Inverter, CMOS Load Inverter, Design of Symmetric Inverter, Transient Analysis of CMOS Inverter, Power Supply Voltage Scaling in CMOS Inverter, Inverter Delay Chain, Schmitt Trigger	***International Academia:*** https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2009/233ad45634556a336043aafac36b0880_MIT6_012F09_lec14.pdf ***Industry Mapping:*** MATLAB	10	Design CMOS Inverter for measurements of Static, Dynamic Power, Delay, Rise/Fall Time in VLSI EDA Tools	Debaprasad Das, VLSI DESIGN, OXFORD SECOND EDITION,	Chapter 3

3	Analog CMOS design : Introduction, MOSFET Small Signal Model, MOSFET as a switch, MOS current source and sink, Resistor realization using swtiched capacitor, CMOS amplifier, MOS Differential amplifier, Cascode amplifier, Current amplifier, CMOS Operational amplifier, Switched capacitor	***International Academia:*** https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/c3/ ***Industry Mapping:*** MATLAB	8	Design and Simulate analog Circuit CMOS Chip for Common Source Amplifier, Current Mirror, Differential Amplifier Using VLSI EDA Tools	Debaprasad Das, VLSI DESIGN, OXFORD SECOND EDITION,	Chapter 5
4	Digital CMOS Design : Introduction, Digital Logic Design, CMOS Logic Design, CMOS Design Methodology, Design of CMOS Inverter (NOT) Gate, Design of Two-Input NAND Gate with CMOS logic, Design of Two-Input NOR Gate using CMOS logic, Classification of CMOS digital Logic Circuit, Combinational Logic Circuit, Sequential Logic Circuit, Pseudo-nMOS Logic, CMOS Transmission Gate, Dynamic CMOS Logic, Complementary Pass Transistor Logic, Voltage Bootstrapping	***International Academia:*** https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/ ***Industry Mapping:*** MATLAB	10	1. Design and Simulate a Digital Circuit CMOS Chip Using Electric VLSI EDA Tools. 2. Design of Digital Circuits with VHDL/ Verilog Programming.	Debaprasad Das, VLSI DESIGN, OXFORD SECOND EDITION,	Chapter 6

Lesson Plan:

Module 1: MOS Transistors: 2nd Year, (Faculty: Prof. Suman Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction to Semiconductor Devices.
Day 2	Charge Carriers in Semiconductors,
Day 3	Parallel Plate Capacitor,
Day 4	MOS Capacitor, MOS Transistor,
Day 5	MOSFET Threshold Voltage,
Day 6	MOSFET Current Equation,
Day 7	MOSFET V-I Characteristics,
Day 8	MOSFET Scaling,
Day 9	Small Geometry Effects,
Day 10	MOSFET Capacitances,
Day 11	MOSFET Modelling

Module 2: MOS Inverters: 2nd Year, (Faculty: Prof. Suman Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction, Voltage Transfer Characteristics,
Day 2	Resistive Load Inverter,
Day 3	Enhancement – type nMOS Load Inverter,
Day 4	Depletion-type nMOS Load Inverter,
Day 5	CMOS Load Inverter,
Day 6	Design of Symmetric Inverter,
Day 7	Transient Analysis of CMOS Inverter,
Day 8	Power Supply Voltage Scaling in CMOS Inverter,
Day 9	Inverter Delay Chain,
Day 10	Schmitt Trigger

Module 3: Analog CMOS design: 2nd Year, (Faculty: Prof. Suman Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction, MOSFET Small Signal Model,
Day 2	MOSFET as a switch,
Day 3	MOS current source and sink,
Day 4	Resistor realization using swtiched capacitor,
Day 5	CMOS amplifier,
Day 6	MOS Differential amplifier,
Day 7	Cascode amplifier,
Day 8	Current amplifier,
Day 9	CMOS Operational amplifier, Switched capacitor
Day 10	Term 1 Exam

Module 4: Digital CMOS Design: 2nd Year, (Faculty: Prof. Suman Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction, Digital Logic Design,
Day 2	CMOS Logic Design, CMOS Design Methodology,
Day 3	Design of CMOS Inverter (NOT) Gate, Design of Two-Input NAND Gate with CMOS logic, Design of Two-Input NOR Gate using CMOS logic,
Day 4	Classification of CMOS digital Logic Circuit, Combinational Logic Circuit, Sequential Logic Circuit,
Day 5	Pseudo-nMOS Logic, CMOS Transmission Gate, Dynamic CMOS Logic,
Day 6	Complementary Pass Transistor Logic, Voltage Bootstrapping
Day 6	Term 2 Exam
Day 7	Practical/ Sessional Exam
Day 8	Practical/ Sessional Exam
Day 9	End Semester Exam

Text Books:

1. Debaprasad Das, VLSI DESIGN, OXFORD SECOND EDITION,

Reference Books:

1. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979
2. N.H.E. Weste and D.M. Harris "CMOS VLSI design: A Circuits and Systems Perspective" 4thEdition, Pearson Education India, 2011.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

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Syllabus for B.Tech Admission Batch 2023

Subject Name: Sustainability, Climate Actions & Environmental Sciences **Credit: 2**

Lecture Hours: 24 **Subject Code: MCC471**

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Study Material LinkedIn NPTEL Coursera

~~Subject Code: MCC471~~

Course Outcomes:

The concepts developed in this course will help the students in their higher studies. The course will enable the student to

CO1: Understand fundamental concepts of environmental systems, sustainability, United Nations Sustainable Development Goals (UNSDGs) and their interrelationship with human society.

CO2: Apply knowledge of sustainable practices, different technical tools and existing frameworks to address environmental and societal challenges.

CO3: Analyze the challenges and strategies associated with climate change mitigation, sustainable cities, and waste management within the context of international agreements and frameworks.

CO4: Evaluate and design innovative approaches to energy, water, and waste management, considering the principles of the circular economy and global SDG progress reports.

Module Number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
I	**Overview - United Nations Sustainable Development Goals (UNSDGs)**	Basic ideas of environment, basic concepts: man, society & environment, their interrelationship. Significance of sustainability in today's world. 17 United Nations Sustainable Development Goals (UNSDGs) - background, significance, interconnectedness of goals, global challenges and recent progress. Climate change and mitigation. Explain and evaluate the evidence for human-caused climate change, in the context of historical climate change, as well as the relevant scientific uncertainties and possible evidence to the contrary.	***International Academia:*** ***https://unccelearn.org/course/view.php?id=170&page=overview*** ***https://unccelearn.org/course/view.php?id=181&page=overview*** ***Industry Mapping:***	4	Assess the college campus alignment with the United Nations Sustainable Development Goals (SDGs) and rank the performance across selected goals mentioning the actionable strategies for improvement.~~labs~~
II	**Sustainable Management**	Sustainable management of water and sanitation- introduction, key components, challenges and innovative approaches. Ensure access to affordable, reliable, sustainable, and modern energy- introduction, importance, key targets, challenges and strategies. Sustainable Cities and Communities- Definition of sustainable cities, current challenges, strategies, innovative solution, smart city	***International Academia:*** ***https://ocw.mit.edu/courses/res-env-006-teaching-with-sustainability-january-iap-2022/*** ***Industry Mapping:***	4	Design and propose innovative, sustainable solutions for managing water, energy, and urban systems, inspired by the principles of SDG 6, SDG 7 and SDG 11.

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III	**Climate Action**	Climate change and its consequences, international agreements on climate change, strategies and actionable step, Life Below Water- Importance of water bodies and marine ecosystem, strategies for protecting aquatic life and water bodies, Life on Land- importance of biodiversity, carbon sequestration, Food security, Strategies for Conservation and Restoration of Ecosystems, Sustainable Land Management, Biodiversity Conservation, Accountable steps for life on land. The successes and failures of past national and international efforts to address climate change, and evaluate prospects for future management of climate change. Provisions of the United Nations Framework Convention on Climate Change, Paris Agreement	***International Academia:*** ***https://unccelearn.org/course/view.php?id=7&page=overview&lang=en*** ***https://unccelearn.org/course/view.php?id=145&page=overview*** ***https://unccelearn.org/course/view.php?id=48&page=overview*** ***https://ocw.mit.edu/courses/res-env-001-climate-action-hands-on-harnessing-science-with-communities-to-cut-carbon-january-iap-2017/***	4	Using data analytics and modeling tools - evaluate climate change impacts, assess ecosystem health, and propose technical solutions for mitigation and conservation efforts.

IV	**UN-call for Action**	Focuss on **annual SDG Goals Report** and the **United Nations Secretary-General's calls for action** to accelerate the progress on the Sustainable Development Goals (SDGs). Examine the global progress trends, challenges highlighted in recent reports, and key priorities proposed by the Secretary-General to achieve the 2030 Agenda.	***International Academia:*** ***https://unccelearn.org/course/view.php?id=175&page=overview*** ***Industry Mapping:***	4	Using quantitative analysis, strategic planning, and innovative approaches, evaluate the global progress on the Sustainable Development Goals (SDGs) as highlighted in the annual SDG Goals Report.
V~~I~~	**Environmental Systems Analysis**	Environmental impact assessment - lifecycle assessment (LCA),—Using of LCA software tools – OpenLCA, Environmental, social, and governance (ESG), Integrated Impact Assessment of ESG, Carbon Management, Green Hydrogen, Importance of green building (LEED, IGBC etc.) certification. Environmental Management System (EMS) in industry - ISO 14001.	***International Academia:*** https://www.lse.ac.uk/united-states/Assets/Documents/Syllabus-Hub-PDFs/Michael-Carbajales-Dale-Clemson-Environmental-Systems-Analysis.PDF https://www.igmpi.ac.in/environmental-social-governance?gad_source=1 https://www.iso.org/standard/60857.html#:~:text=ISO%2014001%20is%20the%20internationally,continually%20improve%20their%20environmental%20performance.	4	Life Cycle Assessment of a college building using OpenLCA software.

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VI	**Waste Mmanagement**	Waste Management Rules - Hazardous Waste, —E-waste, Municipal Solid Waste, Bio-medical waste, Plastic Waste & Construction and Demolition Waste. Management of different waste streams – collection, transportation, treatment, storage and disposal. Basel Convention, Extended producer responsibility (EPR) Energy & Resource Recovery - Incineration, Co-processing, Composting, Bio-methanation, ——Management of solar photo-voltaic modules or panels or cells, Battery Waste Management Rules, Circular Economy.	***International Academia:*** ***https://cpcb.nic.in/rules-6/*** ***https://ocw.mit.edu/courses/ec-716-d-lab-waste-fall-2015/*** ***https://unccelearn.org/course/view.php?id=131&page=overview*** ***https://unccelearn.org/course/view.php?id=87&page=overview*** ***Industry -Mapping:***	5	Mapping the supply chain of different waste management system and finding the issues & challenges.

Field works will be assigned for each and every student/ group of students, on completion of which they have to give a presentation along with a model display if possible.

Learning Resources:

Text Books:

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023-2027

Subject Name: Object Oriented Programming & Java Lab **Credit: 1**

Lecture Hours: 18 + 30 **Subject Code: OEC-EEE481A**

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Saptamee De Saha

Pre-requisite:

Course Objective:

1. To apply the concepts of classes.
2. To understand and implement packages and interfaces.
3. To handle I/O and exception handling.
4. To understand file processing operations.
5. To develop applications using event handling

Course Outcome:

CO1: Build software development skills using java programming for real-world applications

CO2: Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.

CO3: Develop and implement Java programs using Inheritance and Interfaces.

CO4: Develop and implement Java programs using array list, exception handling and multithreading.

Relevant Links:

Study Material	Coursera	Nptel	LinkedIn Learning	Infosys Springboard:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1.	**Familiarity with the programming environment:** Understanding the build system, IDE, debugging, profiling and source code management. Introduction to various programming paradigms, advantages of OOP, comparison of OOP with Procedural Paradigm	**International Academia:**(https://drive.google.com/file/d/10z00dMd26WjiPThhCercGbsi6u3ciE62/view?usp=drive_link)(https://drive.google.com/file/d/1k3qrfDL9p5_IJR_iP2mt6c6AzwmByNtf/view?usp=sharing)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_C urriculum/AICTE%20-%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank, TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE will be use*	**2+4**	Familiarity with terminal/command prompt, using git commands and github to pull/ commit/ push/ merge code, writing, compiling and running simple programs, debugging by setting breakpoints	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**1**
2	**Basic principles of the object-oriented development process:** Introduction to Object-Oriented Paradigm: Data encapsulation, modularity, code reuse, identifying classes, attributes, methods and objects, class relationships	**International Academia:**(https://drive.google.com/file/d/1Rc1KOzkVRHqLEWApFBplwz7s8IwsyFlf/view?usp=sharing)(https://drive.google.com/file/d/1e8g7D6nuMwEruToXtNDbh68vx2VKUrgS/view?usp=sharing)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_C urriculum/AICTE%20-	4+4	Importing pre-written classes using the this keyword, calling and defining methods, writing and instantiating classes, setter/getter methods,	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**2**

		%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE will be used*		instance variables, returning values, debugging using print function, containment and association, scope and parameter passing		
3	**Advanced features of OOP:** Interfaces, inheritance, polymorphism, abstract classes, immutability, copying and cloning objects. Polymorphism and AI-driven Adaptability	**International Academia:** International Standards Mapping (MIT Open Courseware): String: immutability, BufferReader, StringBuilder (https://ocw.mit.edu/ans7870/6/6.005/s16/classes/09-immutability/) Polymorphism : Methods : Overloading and overriding Methods, overloading constructors(https://ocw.mit.edu/courses/6-088-introduction-to-c-memorymanagement-and-c-objectoriented-programming-januaryiap-2010/67b1aec3f2867734ec0fb33034c8b5c8_MIT6_088IAP10_lec0 5.pdf) **AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model _Curriculum/AICTE%20-%20UG%20CSE.pdf) ***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE will be used.*	2+6	Parameter polymorphism, method resolution, declared v/s actual type, partially and fully overriding methods, calling superclass constructor from child class constructor, protected fields and methods, using an abstract parent class v/s an interface with default and abstract	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**3**

				methods, object equality check, object comparison (Comparable/Compar ator interface), Cloneable interface/copy constructor		
4	**Using lang uage APIs:** Language supported libraries for handling advanced data structures. Abstraction: abstract class,design debugging interface,multiple inheritance, packages Access control, class scope, packages, Java API	**International Academia:**(https://drive.google.com/file/d/1yFNf2IBXgy6ch47hR6TGHzddvCPfVm8p/view?usp=sharing)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE will be used.*	2+3	Big-O notation, Java collection framewor k (or Boost libraries), sorting objects, iterating over objects	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**4**
5	**Defensive program:** Exception handling, assertions, Java Thread Programming	**International Academia:**(https://drive.google.com/file/d/1kbRGF396sQPdQbA4wN81ElKU_bdGgFs/view?usp=sharing)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform.*	2+3	Exception handling using try/catch block, nesting try/catch blocks, throw and throws keywords, rethrowing exceptions, handling checked exception, user defined exceptions.Thread Synchronization	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**5**

		NetBeans and Eclipse IDE will be used		and Thread Communication		
6	**Modeling and Design pattern:** Basic modeling techniques –e.g. Class diagram, sequence diagram, use case diagrams, etc. Introduction to design patterns: iterator, singleton, flyweight, adapter, strategy, template, prototype, factory, façade, decorator, composite, proxy, chain of responsibility, observer, state) Model View Controller	**International Academia:**(https://drive.google.com/file/d/1DQ VPfhmcyKog-PryPdZbxufUC7D0Cfl/view?usp=sharing)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform. NetBeans and Eclipse IDE will be used.*	2+6	UML modeling.	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**6**
7	**Basic Android Programming:** Android Components – Activity, Services, Content Provider, Broadcast Receiver; Simple UI Design,Applet and Swin	**International Academia:**(https://online.stanford.edu/courses/ cs108-object-oriented-systemsdesign)**AICTE-prescribed syllabus:** (https://www.aicteindia.org/sites/default/files/Model_ Curriculum/AICTE%20-%20UG%20CSE.pdf)***Industry Mapping:****Hackerrank,TCS Codevita projects, GitHub platform,. Android Studio will be used.*	+6	Android app making	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson	**7**

Lesson Plan:

Module 1: Familiarity with the programming environment: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Understanding the build system, IDE,
Day 2	debugging, profiling
Day 3	source code management.
Day 4	Introduction to various programming paradigms, advantages of OOP
Day 5	Comparison of OOP with Procedural Paradigm

Module 2: Basic principles of the object-oriented development process: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Introduction to Object-Oriented Paradigm: Data encapsulation
Day 2	modularity, code reuse,
Day 3	identifying classes,
Day 4	attributes, methods
Day 5	objects, class relationships

Module 3: Advanced features of OOP: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Interfaces, inheritance,
Day 2	polymorphism, abstract classes,
Day 3	immutability, copying and cloning objects.
Day 4	Polymorphism and
Day 5	AI-driven Adaptability
Day 6	Term 1 Exam

Module 4: Using lang uage APIs: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Language supported libraries for handling advanced data structures.
Day 2	Language supported libraries for handling advanced data structures.
Day 3	Abstraction: abstract class,
Day 4	design debugging interface,
Day 5	multiple inheritance,
Day 6	packages Access control, class scope
Day 7	packages, Java API

Module 5: Defensive program: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Exception handling
Day 2	assertions,
Day 3	Java Thread Programming
Day 4	Java Thread Programming

Module 6: Modeling and Design pattern: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Basic modeling techniques –e.g. Class diagram, sequence diagram, use case diagrams, etc. Introduction to design patterns: iterator, singleton, flyweight, adapter, strategy, template, prototype, factory, façade, decorator, composite, proxy, chain of responsibility, observer, state)
Day 2	Basic modeling techniques –e.g. Class diagram, sequence diagram, use case diagrams, etc. Introduction to design patterns: iterator, singleton, flyweight, adapter, strategy, template, prototype, factory, façade, decorator, composite, proxy, chain of responsibility, observer, state)
Day 3	Basic modeling techniques –e.g. Class diagram, sequence diagram, use case diagrams, etc. Introduction to design patterns: iterator, singleton, flyweight, adapter, strategy, template, prototype, factory, façade, decorator, composite, proxy, chain of responsibility, observer, state)
Day 4	Basic modeling techniques –e.g. Class diagram, sequence diagram, use case diagrams, etc. Introduction to design patterns: iterator, singleton, flyweight, adapter, strategy, template, prototype, factory, façade, decorator, composite, proxy, chain of responsibility, observer, state)
Day 5	Model View Controller

Module 7: Basic Android Programming: 2nd Year, (Faculty:)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Android Components – Activity,
Day 2	Services, Content Provider,
Day 3	Broadcast Receiver;
Day 4	Simple UI Design, Applet and Swin
Day 5	Term 2 Exam
Day 6	Practical/ Sessional Exam
Day 7	Practical/ Sessional Exam
Day 8	End Semester Exam

Suggested sources of learning:

TEXT BOOK:
1. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
2. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

REFERENCE BOOKS:
1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

Examination Rules & Regulations:
https://iemcollege-my.sharepoint.com/:b:/g/personal/iemcoe_office_iem_edu_in/EXrcoe3d6oxIogHKO074XeUBC9qm3XNaf_qUeSiVTNh5OQ?e=MMQn40

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023

Subject Name: Programming using Python Lab **Credit: 1**
Lecture Hours: 10+30 **Subject Code: OECEEE481B**

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Pratik De Sarkar
2. Prof. Sujoy Kumar Banerjee

Study Material	Coursera	Nptel	LinkedIn Learning	Infosys Springboard

Course Objective:

1. To develop logical skills and basic technical skills so that students should be able to solve basic computing problems.
2. The students should be able to learn the basic of any computer programming language.

Course Outcome:

CO1: Understand real world problems and developing computer solutions for those.

CO2: Understand the basics of python.

CO3: Apply python for solving basic programming solutions.

CO4: Create algorithms using learnt programming skills.

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	**Introduction to Python** Data Types, Operators, Expression, Indexing & Slicing, Strings, Conditionals, Functions, Control Flow, Nested Loops, Sets &Dictionaries.	*International Academia:* https://tinyurl.com/bdass3 *AICTE-prescribed syllabus:* https://tinyurl.com/32a8mp5t *Industry Mapping:* Jupyter Notebook	**2+6**	1. Hands-on exploration of core Python data types for analysing 10-year climate dataset. 2. Hands-on experiments to implement and apply arithmetic and logical operators in power calculations of thermal power plant using Python. 3. Design Python indexing techniques in image processing in healthcare. 4. Developing real-time decision-making systems for healthcare solutions using conditional statements, control flow, and nested loops using Python. 5. Design a dictionary to manage student records, mapping roll numbers to scores using Python. 6. Designing sets to find students enrolled in common or unique subjects using Python.	David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, "Python Basics: A Practical Introduction to Python 3", 4th Edition, Real Python.	**3,4,5,6,8, 9**

2	**Introduction to Machine Learning** Machine Learning Vs Statistical Modelling, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning, Reinforcement Learning, Applications, Python libraries suitable for Machine Learning: Pandas, Numpy, Scikitlearn, Visualization libraries: matplotlib etc. Gen AI for Feature Scaling in Machine Learning	*Internation al Academia:* https://tinyurl.com/2jphac8c *AICTE-prescribed syllabus:* https://tinyurl.com/32a8mp5t *Industry Mapping:* Spyder, SK Learn, Mat Plot Lib, NumPy, Pandas	**2+6**	1. Create and analyse features relevant to the design parameters of solar cells using Python. 2. Design mathematical transformations to preprocess and enhance data for anomaly detection in industrial windmill performance using Python. 3. Create insightful visualizations of data distributions: (a) Scatter plots of customer segmentation for marketing, (b) Heatmaps for supply chain optimization and (c) Trend analysis in stock prices using Python. 4. Use of Eigenvalues and Eigenvectors in Principal Component Analysis (PCA) for dimensionality reduction in machine learning using Python. 5. Matrix Rank in detecting redundancy in industrial sensor data using Python. 6. Create 'Training' and 'Testing' using Python by treating algorithms like decision trees and nearest neighbours as black boxes, focusing on their application in healthcare domain.	Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning using Python", First Edition, Wiley India Pvt. Ltd.	**1**
3	**Regression Model using Python** Simple Linear Regression, Multiple Linear Regression, Nonlinear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models.	*International Academia:* https://tinyurl.com/9d4brw22 *AICTE-prescribed syllabus:* https://tinyurl.com/32a8mp5t *Industry Mapping:* Spyder, Regression ML Algorithms	**2+6**	1. Create a Linear Regression and a Non-linear Regression model to predict the performance of a solar cell under different lighting conditions using Python. 2. Create a Non-linear Regression model to predict the suitable material to design a highly efficient solar cell using Python. 3. Performance evaluation of different Regression Models suitable for fault detection of a solar power plant using Python.	Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning using Python", First Edition, Wiley India Pvt. Ltd.	**4**

4	**Classification Model using Python** Introduction to Classification, K-Nearest Neighbour, Decision Trees, Logistic Regression, Support Vector Machines, Logistic regression vs Linear regression, Evaluation Metrics in Classification.	*International Academia:* https://tinyurl.com/9d4brw22 *AICTE-prescribed syllabus:* https://tinyurl.com/32a8mp5t *Industry Mapping:* Spyder, Classification ML Algorithms	**2+6**	1. Design a K Nearest Neighbour Classifier that categorizes data points of disease diagnosis in healthcare using Python. 2. Create a Decision Tree algorithm to help in load forecasting, energy demand prediction, and dynamic adjustment of power distribution to prevent overloads using Python. 3. Design a Logistic Regression model that can analyze energy usage data and suggest or implement optimal energy-saving strategies for smart thermostats or lighting systems using Python. 4. Design Support Vector Machine models that are trained on historical fault data and can automatically detect abnormalities or anomalies in real-time data of short circuits or voltage imbalances in power grids using Python. 5. Performance evaluation of different Classification Models suitable for predicting peak usage times and adjusting energy distribution or prices dynamically to prevent power shortages using Python.	Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning using Python", First Edition, Wiley India Pvt. Ltd.	**5**

5	**Unsupervised Learning using Python** Introduction to Clustering, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering, Content-based recommender systems, Collaborative Filtering.	*International Academia:* https://tinyurl.com/9d4brw22 *AICTE-prescribed syllabus:* https://tinyurl.com/32a8mp5t *Industry Mapping:* Spyder, Clustering ML Algorithms	**2+6**	1. Design a K-Means Clustering model that detects anomalies in equipment behaviour; predictive maintenance models help prevent costly downtime and improve the lifespan of machinery. using Python. 2. Design a Hierarchical Clustering model that enhances image clarity, reduces errors, and improves the efficiency of diagnostic equipment using Python. 3. Design a Based Clustering model that results in more accurate and reliable sensor systems, improving the performance of Smart irrigation system. 4. Develop a system that recommends the most suitable electronic components (resistors, capacitors, transistors, etc.) for a given circuit design based on specific requirements (e.g., power rating, tolerance, capacitance). 5. Develop a collaborative filtering-based system to recommend settings or features for smart home devices (e.g., thermostats, lighting, or security cameras) based on user behavior and preferences.	Andreas C. Muller and Sarah Guido, "Introduction to Machine Learning with Python", First Edition, O'Reilly Media, Inc.	**3**

Module 1: Introduction to Python: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
1	Hands-on exploration of core Python data types for analysing 10-year climate dataset.
2	Hands-on experiments to implement and apply arithmetic and logical operators in power calculations of thermal power plant using Python.
3	Design Python indexing techniques in image processing in healthcare.
4	Developing real-time decision-making systems for healthcare solutions using conditional statements, control flow, and nested loops using Python.
5	Design a dictionary to manage student records, mapping roll numbers to scores using Python.
6	Designing sets to find students enrolled in common or unique subjects using Python.

Module 2: Introduction to Machine Learning: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
7	Create and analyse features relevant to the design parameters of solar cells using Python.
8	Design mathematical transformations to preprocess and enhance data for anomaly detection in industrial windmill performance using Python.
9	Create insightful visualizations of data distributions: (a) Scatter plots of customer segmentation for marketing, (b) Heatmaps for supply chain optimization and (c) Trend analysis in stock prices using Python.
10	Use of Eigenvalues and Eigenvectors in Principal Component Analysis (PCA) for dimensionality reduction in machine learning using Python.
11	Matrix Rank in detecting redundancy in industrial sensor data using Python.
12	Create 'Training' and 'Testing' using Python by treating algorithms like decision trees and nearest neighbours as black boxes, focusing on their application in healthcare domain.

Module 3: Regression Model using Python: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
13	Create a Linear Regression and a Non-linear Regression model to predict the performance of a solar cell under different lighting conditions using Python.
14	Create a Non-linear Regression model to predict the suitable material to design a highly efficient solar cell using Python.
15	Performance evaluation of different Regression Models suitable for fault detection of a solar power plant using Python.

Module 4: Classification Model using Python: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
16	Design a K Nearest Neighbour Classifier that categorizes data points of disease diagnosis in healthcare using Python.
17	Create a Decision Tree algorithm to help in load forecasting, energy demand prediction, and dynamic adjustment of power distribution to prevent overloads using Python.
18	Design a Logistic Regression model that can analyze energy usage data and suggest or implement optimal energy-saving strategies for smart thermostats or lighting systems using Python.
19	Design Support Vector Machine models that are trained on historical fault data and can automatically detect abnormalities or anomalies in real-time data of short circuits or voltage imbalances in power grids using Python.
20	Performance evaluation of different Classification Models suitable for predicting peak usage times and adjusting energy distribution or prices dynamically to prevent power shortages using Python.

Module 5: Unsupervised Learning using Python: 2nd Year, (Faculty : Prof. Pratik De Sarkar)

DAY	LESSON PLAN – DESCRIPTION
21	Design a K-Means Clustering model that detects anomalies in equipment behaviour; predictive maintenance models help prevent costly downtime and improve the lifespan of machinery. using Python.
22	Design a Hierarchical Clustering model that enhances image clarity, reduces errors, and improves the efficiency of diagnostic equipment using Python.
23	Design a Based Clustering model that results in more accurate and reliable sensor systems, improving the performance of Smart irrigation system.
24	Develop a system that recommends the most suitable electronic components (resistors, capacitors, transistors, etc.) for a given circuit design based on specific requirements (e.g., power rating, tolerance, capacitance).
25	Develop a collaborative filtering-based system to recommend settings or features for smart home devices (e.g., thermostats, lighting, or security cameras) based on user behavior and preferences.

Projects:

1. Develop a machine learning model to predict failures or maintenance needs of electrical equipment (motors, transformers, etc.) based on sensor data.
2. Create a model to predict energy consumption patterns in smart grids based on historical usage data.
3. Use machine learning to predict the output of solar panels based on weather and environmental data.
4. Develop a machine learning model to optimize the placement and operation of EV charging stations.
5. Build a condition monitoring system for transformers using ML to predict transformer failures and optimize their operation.

Suggested sources of learning:

TEXT BOOK:

1. David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, “Python Basics: A Practical Introduction to Python 3”, 4th Edition, Real Python.
2. Manaranjan Pradhan and U Dinesh Kumar, “Machine Learning using Python”, First Edition, Wiley India Pvt. Ltd.
3. Andreas C. Muller and Sarah Guido, “Introduction to Machine Learning with Python”, First Edition, O’Reilly Media, Inc.

REFERENCE BOOKS:

1. Mark Lutz, “Learning Python”, Fourth Edition, O’Reilly Media, Inc.

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1	**February 10, 2025 to February 21, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2	**March 24, 2025 to April 2, 2025**	Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination	**April 21, 2025 to May 9, 2025**	Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

Examination Rules & Regulations:

https://iemcollege-my.sharepoint.com/:b:/g/personal/iemcoe_office_iem_edu_in/EXrcoe3d6oxIogHKO074XeUBC9qm3XNaf_qUeSiVTNh5OQ?e=MMQn40

Name of the Course/ Subject	**Electric Machine-I Laboratory**	**Subject Code:**	**PCC-EEE491**
Semester	**IV**	**Course Nature**	**Practical**
Pre-Requisite(s):	Basic Electrical Lab, Electric Circuit Theory Lab		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
2	**0**	**0**	**1**

Course Objective (s):
The purpose of learning this course is to:

1. Identify appropriate equipment and instruments for the experiment.

2. Test the instrument for application to the experiment.

3. Construct circuits with appropriate instruments and safety precautions.

4. Validate different characteristics of DC machine, methods of speed control of DC motor and parallel operation of the transformer.

Laboratory Experiment: -

Experiment No.	**Description**	**No of Hours**
1	Design and Simulation of DC Machine using MATLAB SIMULINK	2
2	Speed control of DC traction motor for a locomotive-based system using power electronics drives (Hardware/MATLAB).	2
3	Speed Control of DC motors for air compressor-based application (Hardware/MATLAB)	2
4	Design and assembling of a single a phase 220/12V, 20-30VA shell type transformer for EV changing.	2
5	Acceptance tests of dry type transformer as per BIS11172 by undertaking a) open circuit test, b) Short Circuit test	2

6	Acceptance tests of dry type transformer as per BIS11172 by undertaking c) voltage ratio test d) insulation test	
7	Load Sharing and flexible load management by paralleling multiple single-phase transformers.	2
8	Vector grouping of three-phase transformer as per BIS 2026.	2
9	Design and Construction of a BLDC motor winding.	2
10	Simulation of DC Machine with a variable Torque using MATLAB Simulink	2
11	Type test of Singer Phase transformer at different load and temperature rise tests.	2
12	IOT Based control of Brushless DC Motor (BLDC) for ceiling fan application	2

Laboratory Outcome(s) (LOs):

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

LO1. Identify appropriate instruments and electric machines, and handle them carefully and safely to make measurements of physical quantities and perform data analysis.

LO2. Identify the strength and limitations of theoretical models and establish a relationship between measured data and underlying physical principles.

LO3. Design and build a hardware part to meet desired specifications and tests it using appropriate Testing strategy and/or equipment's.

LO4. To be able to differentiate between theoretical and practical knowledge of all the instruments.

Name of the Course/ Subject	Digital Electronic Lab	Subject Code:	PCC EEE 492
Semester	**IV**	**Course Nature**	**Sessional**
Pre-Requisite(s):	Basic Electronics Lab, Analog Electronics Lab		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
2	**0**	**2**	**1**

Course Objective(s):

The purpose of learning this course is to:

1. Learn the basics of gates.

2. Construct basic combinational circuits and verify their functionalities

3. Apply the design procedures to design basic sequential circuits

4. Learn about counters

5. Learn about Shift registers

6. To understand the basic digital circuits and to verify their operation

Laboratory Experiments:

Experiment No.	Description	No of Hours
1	Overview of breadboards, Basic Gates FPGAs, power supplies, and digital ICs.	3
2	Basic VHDL programming concepts: entity, architecture, signals, and assignments.	3
3	Design of Multi-bit binary adder /Basic arithmetic units in small-scale processors using VHDL/Verilog. Also perform the experiment using IC7483.	3
4	Design of Carry Look-Ahead Subtractor circuit using VHDL/Verilog and verify the result on FPGA board.	3

5	Design 16X1 Multiplexer using 4X1 multiplexer using VHDL/Verilog and verify the result on FPGA board. Also perform the experiment using TTL and CMOS ICs.	3
6	Design 1-16 Demultiplexer using 1-4 Demultiplexer using VHDL/Verilog and verify the result on FPGA board. Also perform the experiment using TTL and CMOS ICs.	3
7	Design a code converter circuit using FPGA Board.	3
8	Design and simulate flip-flop circuits (SR, D, JK, T) using VHDL. Build a small RAM module using D flip-flops.	3
9	Design a sequential circuit to control a traffic light system with specific timing using VHDL/Verilog. Also perform the experiment using Flip flop ICs.	3
10	Design a circuit that detects a specific binary sequence using hardware.	3
11	Design a sequential circuit which can convert serial Data to parallel data using register.	3
12	Design of Temperature Indicator using IC ADC AD570. Design a circuit using IC Chip AFEx8201 Digital-to-Analog Converters (DACs) for PLC applications.	3

Laboratory Outcome(s):

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

LO1. Learn the basics of gates.

LO2. Construct basic combinational circuits and verify their functionalities

LO3. Apply the design procedures to design basic sequential circuits

LO4. Learn about counters and shift registers.

Name of the Course/ Subject	**Electrical and Electronics Measurement Lab**	Subject Code:	PCC EEE 493
Semester	**IV**	**Course Nature**	**Practical**
Pre-Requisite(s):	1. Statistics 2. Thermodynamics 3. Circuit Theory		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	**0**	**2**	**1**

Course objective(s):

The purpose of learning this course is to:

1. Developed adequate knowledge of the compensating circuits.

2. Introduce to synchronous motor.

3. Introduce to measurements techniques.

4. Emphasis Knowledge on control system.

5. Emphasis Knowledge on digital techniques used to measure voltage, current, power etc.

Experiment No.	Description	Number of 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	Design a signal conditioning device using Arduino to measure the unknown capacitance based on the principle of a Schering Bridge.	2
11	Design a signal conditioning device using Arduino to measure the unknown inductance based on the principle of a Anderson Bridge.	2
12	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

Laboratory outcome(s):

At the end of the course, the students will be able to-
LO1. Get adequate knowledge of the implementation of different compensating circuits.
LO2. Get adequate about different power and energy measuring circuits.
LO3. Design different measuring circuits using microcontrollers based systems.
LO4. Have Knowledge on control system and digital techniques used to measure voltage, current, power etc. gets enhanced.