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ताळगांव पठार,
गोंय – ४०३ २०६
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(Accredited by NAAC)

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GU/Acad –PG/BoS -NEP/2025-26/260 Date: 22.07.2025

CIRCULAR

In continuation to the Circular No. GU/Acad –PG/BoS -NEP/2024/541 dated: 24.09.2024, the syllabus for Semester III & IV of the **Bachelor of Engineering in Electronics and Telecommunication Engineering** Programme approved by the Standing Committee of the Academic Council in its meeting held on 24th and 25th June 2025 is attached.

The Dean, Faculty of Engineering and Principals of affiliated Colleges offering the **Bachelor of Engineering in Electronics and Telecommunication Engineering** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.07.22 16:58:09 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,

1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

Copy to,

1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Electronics & Telecommunication Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar, Prof. Examinations (Technical and Allied), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

ELECTRONICS & TELECOMMUNICATION ENGINEERING SCHEME AY 2024-25

SEMESTER – III							
Sr. No.	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Credits**
1	**Major**	**ETC-200**	Circuit Analysis and Synthesis	3	0	0	3
		ETC-201	Circuit Analysis and Synthesis Lab	0	0	1	1
		VLI-200	Digital Electronics	3	0	0	3
		VLI-201	Digital Electronics Lab	0	0	1	1
3	**Professional elective**	**ETC-221**	Solid State Electronics	3	0	0	3
		ETC-222	Solid State Electronics Lab	0	0	1	1
		OR					
		EEL-223	Electrical and Electronics Material Science	3	0	0	3
		EEL-224	Electrical and Electronics Material Lab	0	0	1	1
4	**MC**	**SHM-233**	Linear Algebra & Probability Theory	3	0	0	3
5	**AEC**	**AEC-251**	*	0	0	2	2
6	**SEC**	**ETC-251**	Object Oriented Programming using C++ Lab	0	0	3	3
			TOTAL	**12**	**0**	**8**	**20**

** AEC Courses shall be notified by the University based on the recommendations of respective Board of Studies in languages.*

Approved by: Standing Committee of the Academic Council on 24th & 25th June 2025

SEMESTER – IV							
Sr. No.	**Course Category**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Credits**
1	**Major**	**ETC-202**	Electromagnetics	3	0	0	3
		ETC-203	Electromagnetics Lab	0	0	1	1
		ETC-204	Fundamentals of Signal Processing	2	0	0	2
		ETC-205	Fundamentals of Signal Processing Lab	0	0	2	2
		VLI-202	Microprocessor Architecture and Programming	3	0	0	3
		VLI-203	Microprocessor Architecture and Programming Lab	0	0	1	1
		ETC-206	Analog Electronics	3	0	0	3
		ETC-207	Analog Electronics Lab	0	0	1	1
2	**Professional elective**	**ETC-223**	Data Structures & Algorithms	3	0	0	3
		ETC-224	Data Structures & Algorithms Lab	0	0	1	1
		OR					
		ETC-225	Fundamentals of Artificial Intelligence	3	0	0	3
		ETC-226	Fundamentals of Artificial Intelligence Lab	0	0	1	1
			TOTAL	**14**	**0**	**6**	**20**

SEMESTER III

Major Courses

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : ETC-200
Title of the Course : Circuit Analysis and Synthesis
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Fundamentals of Electric Networks	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of graph theory and its application for network analysis. 2. Develop an understanding of linear electrical networks and perform time domain analysis of electrical networks. 3. Get familiarized with the electrical network concepts and model it into any equivalent two port network. 4. Gain an introduction to the design of filters and attenuators.	
Content:		**No. of Hours**
Unit-1	**Circuit Elements:** Active and passive, Bilateral and unilateral, linear and nonlinear elements, lumped and distributed. Resistance parameter, Inductance parameter and capacitance parameter. **Kirchhoff's law**: Kirchhoff's voltage law, voltage division, Kirchhoff's current law, current division. **Network Analysis**: Mesh analysis and nodal analysis, super-nodal analysis and super-mesh analysis.	**12**
Unit-2	**Network Theorems and analysis (DC Analysis):** Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Maximum power transfer theorem. **Graph theory**: Tree and co-tree, Twigs and links, Incidence matrix, properties of incidence matrix, incidence matrix with KCL, link currents, tie-set matrix, Cut-set and tree branch voltages, cut-set matrix.	**10**
Unit-3	**Complex impedance:** Impedance diagram, Series RL circuit, series RC circuit, series RLC circuit, Parallel RC circuit, parallel RL circuit, compound circuits. **Resonance**: Series resonance, bandwidth of an RLC circuit, Quality factor and its effect on bandwidth, magnification in Resonance, Parallel resonance, resonant frequency for a Tank	**12**

	circuit, Q-factor of parallel resonance, Reactance curves in parallel resonance.	
Unit-4	**Two-Port Networks:** Open-circuit impedance parameters, short circuit admittance parameters, transmission (ABCD) parameters, Hybrid (H) parameters, Inter-relationships of different parameters (Z-parameter to Y-parameter and vice-versa). **Filters**: Classification of filters, Filter networks, Equation of filter networks (T-network, Pi-network) **Attenuators**: T-type attenuator, Lattice attenuator, Bridged-T attenuator, L-type attenuator	**11**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. Sudhakar, P. Shyammohan, "Circuits & Networks- Analysis and Synthesis", McGraw-Hill India, 5th Edition, 2017, ISBN: 978-9339219604. 2. D. Roy Choudhary, "Networks & Systems", New Age International Publishers, India, 2nd Edition, 2013, ISBN: 978-8122427677. **Reference Books:** 1. M.E. Van Valkenburg, "Network Analysis", Pearson Education India, 3rd Edition, 2015, ISBN: 9789332550131. 2. A. Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai Publishing Company, India, 1st Edition, 2018, ISBN: 978-8177000009. 3. A. Anand Kumar, "Network Analysis and Synthesis", PHI Learning Pvt. Ltd., India, 1st Edition, 2019, ISBN: 978-9388028103.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the concepts related to electrical networks, graph theory, resonance and attenuators. CO 2. Apply the basic concepts of network theorems, and network synthesis methods, graph theory, resonance, two port networks and attenuators to simplify circuits. CO 3. Analyse working of electrical networks, attenuators using network theory. CO 4. Solve problems related to network theorem, graph theory, time domain analysis of networks, resonance, two port networks and attenuators.	

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-201**
Title of the Course : **Circuit Analysis and Synthesis Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of Electrical circuits	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the concepts of electric circuit models. 2. Develop an understanding of network theorems. 3. Appreciate the working and performance of electric circuits. 4. Gain an introduction to the concepts of electrical circuit synthesis.	
Content:		**No. of Hours**
	List of Experiments: 1. Charging and discharging characteristics of series RC circuits. 2. Study and verification of KVL, KCL. 3. Study and verification of Thevenin Theorem. 4. Study and verification of Norton's Theorem. 5. Study and verification of Superposition theorem. 6. Study and verification of Reciprocity Theorem. 7. Study and verification of Maximum Power Transfer Theorem. 8. Study and verification of Mesh Analysis. 9. Study and verification of Nodal Analysis. 10. Study the operation of an RL circuit.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Sudhakar, P. Shyammohan, "Circuits & Networks- Analysis and Synthesis", TataMcGraw-Hill, 5th Edition, 2017, ISBN: 978-9339219604. 2. D. Roy Choudhary, "Networks & Systems", New Age International Publishers, 2nd Edition, 2013, ISBN: 978-8122427677. **Reference Books:** 1. M.E. Van Valkenburg, "Network Analysis", Pearson Education India, 3rd Edition, 2015, ISBN: 9789332550131. 2. A. Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai Publishing Company, India, 1st Edition, 2018, ISBN: 978-8177000009. 3. A. Anand Kumar, "Network Analysis and Synthesis", PHI Learning Pvt. Ltd., India, 1st Edition, 2019, ISBN: 978-9388028103.	

Course Outcomes:	**After taking this course, student will be able to:** CO 1. Understand the operation of circuit components. CO 2. Verify the network theorems. CO 3. Analyze the operation of networks. CO 4. Design network circuits.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **VLI-200**
Title of the Course : **Digital Electronics**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of number systems, codes, and Boolean algebra essential for digital logic design. 2. Get familiarized with combinational circuits used in digital systems. 3. Develop skills related to sequential circuits including counters and shift registers used in digital systems. 4. Gain an introduction to the design of combinational and sequential circuits.	
Content:		**No. of Hours**
Unit-1	**Review of Number Systems & Codes:** Decimal, Binary, Octal & Hexadecimal number systems & their conversion from one form to another. Unsigned binary numbers, signed binary numbers. **Binary arithmetic:** Addition & subtraction using 2's complement method. Binary Coded-Decimal codes (BCD, Excess-3, GRAY), Error Detection codes (Parity generation & Detection). **Review of Logic Gates:** NAND & NOR as Universal gates. **Boolean Algebra:** Postulates & Theorems, Boolean functions and their Algebraic manipulation, Canonical & Standard forms, Minterms & Maxterms. Simplification of Boolean functions- K-maps for 2,3 and 4 variables only, POS & SOP simplification and their interconversions, NAND & NOR implementation.	**12**
Unit-2	**Combinational Logic Design:** Design and Analysis of Half Adder, Full Adder, Half Subtractor, Full Subtractor, Code Conversion, Ripple Carry Adder, Magnitude Comparator, Encoders and Decoders, Multiplexers and Demultiplexer, Parity generator and checker. Implementation of Boolean functions using Multiplexers and Decoder.	**10**
Unit-3	**Study of Flip Flops:** Study of Set-Reset (SR) flip flop, JK flip flop, Toggle (T) flip flop, Delay (D) flip flop. with their schematic symbol, truth table & excitation table. Race around condition in JK flip flop, Master slave JK (MSJK) flip flop. Triggering in Flip Flops, Level and Edge triggering. Setup time, Hold time and Propagation delay. Conversion between flip-flops.	**11**

	Finite State Machines, Mealy and Moore, State Diagram, FSM design using Flip Flops.	
Unit-4	**Study of Shift Registers:** Study of Serial in serial out (SISO), Serial in parallel out (SIPO), Parallel in serial out(PISO), Parallel in parallel out (PIPO) shift registers, Bidirectional Shift register, Universal shift register. **Study of Counters:** Difference between Asynchronous counters and Synchronous Counters, Design and Analysis of Asynchronous and Synchronous counters (up counter, down counter & up/down counters) using flip- flops, Study of Ring counter and Twisted Ring Counter.	**12**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education India, 1st Edition, 2016, ISBN-13: 978-9332542525. 2. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall of India, 4th Edition, 2016, ISBN: 978-8120352681. **Reference Books:** 1. R. J. Tocci, N. S. Widmer, & G. L. Moss, "Digital Systems- Principles & Applications", Pearson India, 10th Edition, 2009, ISBN: 978-8131727249. 2. D. P. Kothari, J. S. Dhillon, "Digital Circuits and Design", Pearson Education India, 1st Edition, 2015, ISBN: 978-9332543539. 3. Jr. Roth, Charles H., Larry N. Kinney, "Fundamentals of Logic Design", Cengage Learning, India, 7th Edition, 2024, ISBN: 978-9360535650.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain Number Systems, Codes, Boolean Algebra and working of various digital circuits. CO 2. Apply Boolean algebra and Karnaugh maps to optimize digital circuits. CO 3. Analyze combinational and sequential circuits. CO 4. Design combinational and sequential circuits.	

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : VLI-201
Title of the Course : Digital Electronics Lab
Number of Credits : 1
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the fundamental principles of digital logic design through hardware implementation. 2. Get familiarized with the implementation of combinational circuits using digital ICs. 3. Develop skills to implement sequential circuits using digital ICs. 4. Foster problem-solving and design skills.	
Content:		**No. of Hours**
	List of Experiments: 1. Design circuits to demonstrate NAND and NOR as Universal gates 2. Design circuits to demonstrate De Morgan's Theorem 3. Design Adders and subtractors 4. Design BCD Adder 5. Design Multiplexer & Demultiplexer 6. Design Encoder & Decoder 7. Design Magnitude Comparator 8. Design Asynchronous counter 9. Design Synchronous counters 10. Design Shift Registers	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education India, 1st Edition, 2016, ISBN-13: 978-9332542525. 2. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall of India, 4th Edition, 2016, ISBN: 978-8120352681. **Reference Books:** 1. R. J. Tocci, N. S. Widmer, & G. L. Moss, "Digital Systems- Principles & Applications", Pearson India, 10th Edition, 2009, ISBN: 978-8131727249. 2. D. P. Kothari, J. S. Dhillon, "Digital Circuits and Design", Pearson Education India, 1st Edition, 2015, ISBN: 978-9332543539.	

	3. Jr. Roth, Charles H., Larry N. Kinney, "Fundamentals of Logic Design", Cengage Learning, India, 7th Edition, 2024, ISBN: 978-9360535650.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Verify the functionality of basic digital circuits. CO 2. Apply logical thinking to optimize digital circuits. CO 3. Design combinational circuits and verify their functionalities. CO 4. Design sequential circuits and verify their operations.

Professional Electives

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : ETC-221
Title of the Course : Solid State Electronics
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic Knowledge of Physics	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the principles of semiconductor device modeling. 2. Gain knowledge of semiconductor physics. 3. Gain knowledge of various types of solid-state devices. 4. Develop an understanding of the working of Solid State Devices including Diode, BJT and MOSFET.	
Content:		**No. of Hours**
Unit-1	Evolution and uniqueness of Semiconductor Technology, Equilibrium carrier concentration, Thermal Equilibrium and wave particle duality, Intrinsic semiconductor: Bond and band models, Extrinsic semiconductor: Bond and band models, Carrier transport, Random motion, Drift and diffusion, Excess carriers, Injection level, Lifetime, Direct and indirect semiconductors, Procedure for analyzing semiconductor devices, Basic equations and approximations Poisson and continuity equations.	**15**
Unit-2	**P-N Junction:** Device structure and fabrication, Equilibrium picture, DC forward and reverse characteristics, Small-signal equivalent circuit, Switching characteristics, Clippers and clampers, LED, photo diode and solar cell.	**10**
Unit-3	**Bipolar Junction Transistor:** Device structures and fabrication, Transistor action and amplification, Common emitter DC characteristics, Small-signal Equivalent circuit, Ebers-Moll model, SPICE model	**10**
Unit-4	**MOS Junction:** C-V characteristics, threshold voltage, body effect, MOS capacitor, Metal Oxide Field Effect Transistor: Device structures and fabrication, Common source DC characteristics, Small-signal equivalent circuit, SPICE level-1 model, Differences between a MOSFET and a BJT	**10**

Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.
References/ Readings:	**Text Books:** 1. Ben G. Streetman, "Solid State Electronic Devices", Pearson Education India, 7th Edition, 2015, ISBN: 978-9332555082. 2. Nair, B. Somanathan, Deepa, S. R., "Solid State Devices", PHI Learning, India, 2nd Edition, 2021, ISBN: 978-9387472273. **Reference Books:** 1. S. Karmalkar, "Solid State Devices", hosted on NPTEL and YouTube. 2. S.M. Sze, Kwok K. Ng, "Physics of Semiconductor Devices", Wiley India, 3rd edition, 2008, ISBN: 978-8126517022. 3. Chih Tang Sah, "Fundamentals of Solid State Electronics", World Scientific Publishing Co Pte Ltd, Singapore, 1st Edition, 1991, ISBN: 978-9810206383.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the Principles of operation of PN Diodes, BJT, MOSFET and Opto-electronic Devices CO 2. Apply Poisson's and continuity equations to analyze carrier distribution and current flow in semiconductor devices. CO 3. Model the structure of solid state devices including PN Diodes, BJT, MOSFET. CO 4. Analyze the characteristics of semiconductor devices (P-N junctions, BJTs, MOSFETs) under various biasing conditions using DC and small-signal models.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-222**
Title of the Course : **Solid State Electronics Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic Knowledge of Physics	
Course Objectives:	**The course will enable the students to:** 1. Appreciate the principles of Semiconductor device modeling. 2. Gain knowledge of Semiconductor Physics concepts. 3. Develop an understanding of the performance of Solid-State Devices. 4. Gain hands-on experience of simulation tools used for device modeling.	
Content:		**No. of Hours**
	List of Experiments: 1. Rectifying and Breakdown Characteristics of pn-junctions and point contact diodes 2. Characteristics of Light emitting diodes. 3. Characteristics of photo diode 4. Characteristics of solar cell 5. Verification of Clipper circuits 6. Verification of Clampers circuits 7. Study input characteristics of BJT in common-emitter configuration. 8. Study output characteristics of BJT in common-emitter configuration for different base currents & hence determine hybrid parameters. 9. Study output characteristics of BJT in common-emitter configuration and find performance parameters (Voltage Gain, Current Gain, Input Impedance, Output Impedance). 10. Study of C-V characteristics of a MOS structure.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Ben G. Streetman, "Solid State Electronic Devices", Pearson Education India, 7th Edition, 2015, ISBN: 978-9332555082. 2. Nair, B. Somanathan, Deepa, S. R., "Solid State Devices", PHI Learning, India, 2nd Edition, 2021, ISBN: 978-9387472273. **Reference Books:** 1. S. Karmalkar, "Solid State Devices", hosted on NPTEL and YouTube.	

	2. S.M. Sze, Kwok K. Ng, "Physics of Semiconductor Devices", Wiley India, 3rd edition, 2008, ISBN: 978-8126517022. 3. Chih Tang Sah, "Fundamentals of Solid State Electronics", World Scientific Publishing Co Pte Ltd, Singapore, 1st Edition, 1991, ISBN: 978-9810206383.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Verify the concepts of solid state devices CO 2. Correlate the practical results with theoretical concepts. CO 3. Measure the output parameters for a given device. CO 4. Evaluate performance of solid state devices.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **EEL-223**
Title of the Course : **Electrical and Electronics Material Science**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of physics and chemistry	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the different materials used for electrical and electronic applications. 2. Gain knowledge of conductive, semi-conducting, dielectric and magnetic materials 3. Get familiarized with the properties exhibited by electrical and electronic materials. 4. Gain knowledge of the performance of various electrical and electronic components and devices.	
Content:		**No. of Hours**
Unit-1	**Conductive Materials:** Types of conductive materials, Electron theories – free electrons, energy band, brillouin zone; thermo-electric effect, Seebeck Effect, Thomson Effect, Thermal Conductivity – Wiedemann Franz Law, Lorentz relation. Numericals.	**12**
Unit-2	**Semi-Conductor Materials:** Types of semiconductors – intrinsic and extrinsic, compound semiconductors, Fermi Energy Level, Temperature effects, Direct & Indirect Energy Band semiconductors, Hall Effect, Continuity Equation; Numericals **Dielectric Materials** – classification, dielectric constant, strength, loss factor, polarization mechanisms, Clausius Mossotti Relation, Numericals.	**10**
Unit-3	**Magnetic Materials-** classification, diamagnetic, paramagnetic, ferromagnetic, anti-ferromagnetic, ferri-magnetic , soft & hard magnets, Curie temperature, magnetization curve, domain theory, eddy current losses, Langevin's theory; Numericals.	**12**
Unit-4	**Superconductors**, its properties, types, mechanism of super conduction, **Optical properties** of metals, semi-conductors, insulators; **Nanostructured Materials:** Carbon Nanotubes (CNT), classification, properties and applications; **Composite Materials** for electrical & electronics applications;	**11**

Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.
References/ Readings:	**Text Books:** 1. K. M. Gupta, Nishu Gupta, "Advanced Electrical & Electronics Materials", Wiley India Publications, 1st Edition, 2015, ISBN: 978-1118998359. 2. S. K. Bhattacharya, "Electrical & Electronic Engineering Materials & Components", Khanna Publishers, 1st Edition, 1996, ISBN:978-9387394247. **Reference Books:** 1. P .L. Kapoor, "A Text Book of Electrical & Electronic Engineering Materials", Khanna Publishers, 1st Edition, 1988, ISBN: 9788174091314. 2. S. O. Pillai , "Electrical and Electronics Engineering Materials", New Age International Pvt Ltd, 1st Edition (1 January 2011) India, ISBN : 8122432263
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Understand the different materials used for electrical and electronic applications CO 2. Classify these materials based on their properties. CO 3. Explain the electrical and electronic characteristics exhibited by these materials CO 4. Co-relate material composition to the properties and its performance characteristics

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **EEL-224**
Title of the Course : **Electrical and Electronics Material Science Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of physics and chemistry	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the electrical, electronic and thermal properties of materials. 2. Appreciate the principles governing the characteristic behavior of electrical and electronic materials. 3. Gain knowledge of practical systems such as motors, fiber optic cables. 4. Gain knowledge of properties of materials to their electrical and electronic responses.	
Content:		**No. of Hours**
	List of Experiments: 1. Electrical and Thermal Conductivity of Copper, Graphite, Aluminum, 2. Temperature Measurement using Different Types of Thermocouples – K and R 3. Characterization of Solar Cells 4. Dielectric Heating using Domestic Microwave Oven – water, ceramic, vegetables, plastic – understanding the di-electric response as a function of temperature. 5. Testing of Electrical Insulators – polymers, ceramics 6. Testing of Thermal Insulators – Foam, Ceramics, 7. Characterization of Optical Fibers using laser source 8. Determination of magnetic field strength using Magnetometers/ gauss meters for different types of magnets 9. Preparation of Glass Fiber, Epoxy Composite 10. Electrical and Thermal Conductivity of Silicon Carbide, Tungsten Filament.	**30**
Instructions	Lab Journal and Observation Note book to be maintained by every student	
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	

References/ Readings:	**Text Books:** 1. K. M. Gupta, Nishu Gupta, "Advanced Electrical & Electronics Materials", Wiley India Publications, 1st Edition, 2015, ISBN: 978-1118998359. 2. S. K. Bhattacharya, "Electrical & Electronic Engineering Materials & Components", Khanna Publishers, 1st Edition, 1996, ISBN:978-9387394247. **Reference Books:** 1. P .L. Kapoor, "A Text Book of Electrical & Electronic Engineering Materials", Khanna Publishers, 1st Edition, 1988, ISBN: 9788174091314. 2. S.O. Pillai , "Electrical and Electronics Engineering Materials", New Age International Pvt Ltd, 1st Edition (1 January 2011) India, ISBN : 8122432263
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Understand the electrical, electronic and thermal properties of materials. CO 2. Explain the principles governing the characteristic behavior of these materials CO 3. Apply the knowledge to practical system such as motors, fiber optic cables CO 4. Co-relate properties of materials to their electrical and electronic responses

Multi-disciplinary Courses

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : SHM-233
Title of the Course : Linear Algebra & Probability Theory
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Knowledge of Basic Mathematics	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding to characterize properties of matrices. 2. Get familiarized with vector spaces. 3. Develop an understanding of probability theory. 4. Get familiarized with concepts of random variables.	
Content:		**No. of Hours**
Unit-1	**Matrix Analysis:** Basic Concepts, type of matrices, scalar multiplication, matrix multiplication, properties, Hadamard product, inverse, rank, system of linear equations, linear transformation, Eigenvalues & Eigenvectors, positive definite matrix, Principal Component Analysis, Singular Value Decomposition.	**10**
Unit-2	**Vector Space:** Definition, scalars, addition, scalar multiplication, inner product (dot product), vector projection, cosine similarity, orthogonal vectors, normal and orthonormal vectors, vector norm, vector space, subspace, linear combination, linear span, linear independence, basis and dimension.	**10**
Unit-3	**Review of Probability Theory:** Probability Space, Marginal, Conditional, and Joint Probability, Statistical Independence, Bayes' Theorem, Bernoulli Trials. **Random Variables:** Concept of a Random Variable, Distribution and Density Functions- Cumulative Distribution Function, Probability Density Function, Joint Cumulative Distribution and Probability Density, Expectation, Variance, Correlation, and Covariance of Random Variables, Correlation Coefficient.	**13**
Unit-4	**Useful Distributions and Properties:** Uniform Distribution, Gaussian Probability Density, Cumulative Gaussian Probability – The Error Function, Rayleigh Probability Density, Rician Distribution, Binomial Distribution, Exponential Distribution and its Memoryless Property, Poisson Distribution.	**12**

	Useful Bound & Limits: Sample Mean, Limit theorems – Strong and Weak laws of Large Numbers, The Central Limit Theorem, Tchebyheff's Inequality, Schwarz Inequality.	
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books** 1. S. Lipschutz & M. Lipson, "Schaum's Outlines on Linear Algebra", McGraw Hill Education, India, 6th Edition, 2018, ISBN: 978-1260011449. 2. Sheldon Ross, "A First Course in Probability", Pearson India, 9th Edition, 2019, ISBN: 978-9353065607. **Reference Books** 1. G. Strang, "Linear Algebra & Its Applications", Cengage India, 4th Edition, 2018, ISBN: 978-8131501726. 2. Athanasios Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables, and Stochastic Processes, McGraw Hill Education, India, 4th Edition, 2019, ISBN: 978-0070486584. 3. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier India, 2nd Edition, 2019, ISBN: 978-9351073857	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain operations on Matrices, Vector Spaces and Random Variables. CO 2. Solve numericals using principles of Matrices, Vector Spaces and Random Variables. CO 3. Analyze vector spaces, null and column spaces of matrices, properties and behavior of random variables, CO 4. Apply concepts of linear algebra and probability theory to solve Engineering problems.	

Skill Enhancement Courses

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : ETC-241
Title of the Course : Object Oriented Programming using C++ Lab
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic Knowledge of Programming	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of Object-Oriented Programming (OOP) principles. 2. Gain hands-on experience with file handling. 3. Get familiarized with Standard Template Library (STL). 4. Foster problem-solving and logical thinking.	
Content:		**No. of Hours**
	List of Experiments: **Basic Concepts:** 1. Write a program to take user input (name, age, and marks) and display it using cin and cout. 2. Implement a program to demonstrate all arithmetic, relational, logical, bitwise, and assignment operators. 3. Write a menu-driven program using switch-case to perform basic arithmetic operations. 4. Implement a C++ program to demonstrate function overloading for addition of integers, floats, and strings. 5. Write a recursive function to compute the factorial of a number. **Object-Oriented Programming (OOP):** 1. Implement a Student class with private data members and public member functions for setting and getting values. 2. Create a Bank Account class with a constructor to initialize account details and a destructor to display a message when an object is destroyed. 3. Overload the + operator for adding two complex numbers. 4. Implement a friend function to access private members of two different classes. 5. Design a class hierarchy with Animal as a base class and Dog, Cat as derived classes. Implement a virtual function makeSound() to demonstrate runtime polymorphism. **Advanced Concepts:** 1. Implement an abstract class Shape with a pure virtual function area(), and derive Rectangle and Circle classes from	**90**

	it. 2. Implement a template function for finding the maximum of two numbers. 3. Write a program that demonstrates exception handling for division by zero. 4. Create a program to read and write student records using file handling (fstream). 5. Implement a program using std::vector to store and display a list of integers with iterators. **Mini-projects (Any 1):** 1. Student Management System (OOP, File Handling, STL) 2. Bank Management System (OOP, Inheritance, Polymorphism) 3. Library Management System (File Handling, STL, Exception Handling) 4. Railway Reservation System (Linked List, File Handling) 5. Hospital Management System (Classes, File Handling, Templates) 6. Contact Book (File Handling, STL – Vectors, Iterators) 7. Employee Payroll System (OOP, Polymorphism, File Handling) 8. To-Do List Application (STL - Vector, File Handling) 9. Quiz System (File Handling, Exception Handling, OOP) 10. Car Rental System (OOP, Polymorphism, STL)	
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Herbert Schildt, "C++: The Complete Reference", McGraw Hill Education, India, 4th Edition, 2017, ISBN-13: 978-0070532465. 2. Bjarne Stroustrup, "C++ Programming Language", Pearson Education India, 4th Edition, 2022, ISBN-13: 978-9356060135. **Reference Books:** 1. Stanley Lippman, J. Lajoie, B. Moo, "C++ Primer", Addison-Wesley, 5th Edition, 2012, ISBN-13: 978-0321714114. 2. Robert Lafore, “Object Oriented Programming in C++”, Pearson Education India, 4th Edition, 2008, ISBN: 978-8131722824. 3. E. Balaguruswamy, “Object Oriented Programming with C++”, 8th Edition, McGraw Hill India, 2020, ISBN: 978-9389949186.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain OOP principles in the context of improving software reusability and maintainability. CO 2. Develop algorithms to store and retrieve structured data. CO 3. Compare the efficiency of STL containers (vector, list, map) for	

	various operations. CO 4. Solve real-world problems using OOPs programming language searching, and numerical computation.

SEMESTER-IV

Major Courses

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : ETC-202
Title of the Course : Electromagnetics
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Fundamentals of Trigonometry and Calculus.	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of different coordinate systems, laws of electrostatics, magnetostatics, electromagnetics and transmission line theory. 2. Gain knowledge of principles of electrostatics and magnetostatic fields leading to Maxwell's equations. 3. Gain knowledge on existence and propagation of electromagnetic waves in material media and free space. 4. Appreciate various applications of electromagnetics.	
Content:		**No. of Hours**
Unit-1	**Review of coordinate systems and transformation:** Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates. Transformation from cartesian to cylindrical and spherical coordinate system. **Vector Calculus:** Differential length, area and volume in Cartesian, cylindrical and Spherical coordinate systems. Divergence of a vector, Divergence Theorem, Curl of a vector, Stoke's theorem, Laplacian of a scalar. **Electrostatics:** Coulomb's Law and field intensity, Electric Field due to continuous charge distributions (a line charge, a surface charge, a volume charge), Electric Flux density, Gauss's law, Applications of Gauss's law, Electric Potential, Relationship between E and V – Maxwell's Equation, An electric dipole and flux lines, Energy Density in Electrostatic Fields.	**12**
Unit-2	**Electric Fields in Material Space:** Properties of Materials, Convection and Conduction Currents, Conductors, Polarization in Dielectrics, Dielectric Constant and Strength, Continuity Equation and Relaxation Time, Boundary Conditions- Dielectric-Dielectric, Conductor-Dielectric, Conductor-Free Space.	**10**

	Electrostatic Boundary-Value Problems: Poisson's and Laplace's Equations, Resistance and Capacitance:Parallel Plate Capacitor, Coaxial Capacitor, Spherical Capacitor.	
Unit-3	**Magnetostatics:** Biot Savart's Law, Ampere's Circuit Law-Maxwell's Equation, Applications of Ampere's Law, Magnetic Flux Density- Maxwell's Equation, Maxwell's Equations for Static Fields, Magnetic Scalar and Vector Potentials. **Maxwell's Equations:** Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current, Maxwell's Equations in Final Form, Time-Varying Potentials. Waves in general, Wave propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, Wave Polarization, Power and Poynting Vector.	**11**
Unit-4	**Transmission-Line Theory:** Equation for characteristic impedance and propagation constant, Equation for Voltage; Current for line of cascaded T-sections, Expressions for Attenuation constant, Phase constant, velocity of propagation, Condition for minimum attenuation, Causes of distortion, condition for minimum distortion, concept of infinite line, transfer impedance. The distortionless line: Reflection on a line not terminated in Zo (Voltage and current-phasors), Reflection coefficient, Open- and short- circuited lines. **Standing Wave Theory:** Standing waves, relation between reflection coefficient and Standing waves.	**12**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. M. Sadiku, "Elements of Electromagnetics", Oxford University Press, India, 6th Edition, 2015, ISBN: 978-0199461851. 2. J. D. Ryder, "Networks, Lines and Fields", Pearson Education India, 2nd Edition, 2015, ISBN: 978-9332559516. **Reference Books:** 1. E. C. Jordan, K. G. Balmain, "Electromagnetic Waves & Radiating Systems", PHI, India, 2nd Edition, 2015, ISBN: 978-9332551770. 2. N. Ida, "Engineering Electromagnetics", Springer India Pvt. Ltd., 2nd Edition, 2008, ISBN: 978-8181282736. 3. William H. Hayt Jr, John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, India, 6th Edition, 2002, ISBN: 978-0070445802.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the concepts of electric fields, magnetic fields,	

	electromagnetic fields and transmission lines. CO 2. Analyse electrostatic and magnetostatic fields, propagation in material media and free space. CO 3. Apply the concepts of calculus in electric, magnetic and electromagnetic fields. CO 4. Evaluate field quantities and characteristic parameters of electromagnetic waves.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-203**
Title of the Course : **Electromagnetics Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic programming skills	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of numerical solutions related to different coordinate systems, laws of electrostatics, magnetostatics and electromagnetics. 2. Gain skills to model various physical quantities related to electromagnetics. 3. Gain programming skills to numerically solve problems in electromagnetics. 4. Explore various applications of electromagnetics.	
Content:		**No. of Hours**
	List of Experiments: **Programs to be written using Python/Matlab/Scilab/TK Solver** 1. Simulation to perform scalar and vector analysis (Gradient, Divergence and Curl). 2. Simulation to calculate volume and area of an enclosed surface or volume. 3. Simulation to verify Divergence Theorem. 4. Simulation to verify Stokes theorem. 5. Simulation to find Electric Potential and Potential Energy. 6. Simulation to find Electric field due to point and line charge. 7. Simulation to find Magnetic Vector Potential and verify Biot-Savart Law. 8. Simulation to solve Boundary Value problems using 1-D Laplace's and Poisson's equations. 9. Modeling and Simulation of power flow of EM wave by verifying Poynting's theorem. 10. Simulation of Standing Wave Patterns in transmission lines.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. M. Sadiku, "Elements of Electromagnetics", Oxford University Press, India, 6th Edition, 2015, ISBN: 978-0199461851. 2. J. D. Ryder, "Networks, Lines and Fields", Pearson Education India, 2nd	

	Edition, 2015, ISBN: 978-9332559516. **Reference Books:** 1. E. C. Jordan, K. G. Balmain, "Electromagnetic Waves & Radiating Systems", PHI, India, 2nd Edition, 2015, ISBN: 978-9332551770. 2. N. Ida, "Engineering Electromagnetics", Springer India Pvt. Ltd., 2nd Edition, 2008, ISBN: 978-8181282736. 3. William H. Hayt Jr, John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, India, 6th Edition, 2002, ISBN: 978-0070445802.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Demonstrate concepts of electric fields, magnetic fields and electromagnetic fields. CO 2. Simulate Electrostatic and Magnetostatic fields, propagation in free space and material media. CO 3. Verify concepts of calculus in electric, magnetic and electromagnetic fields. CO 4. Evaluate EM field quantities and characteristic parameters of electromagnetic waves.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-204**
Title of the Course : **Fundamentals of Signal Processing**
Number of Credits : **2**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of Mathematics	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the fundamental concepts of time-domain and frequency-domain analysis of signals. 2. Get familiarized with mathematical techniques to solve problems involving signals and systems. 3. Gain knowledge of the frequency response of linear time-invariant (LTI) systems using Fourier and Laplace transforms. 4. Comprehend system behavior in time and frequency domain to determine system stability, causality, and performance.	
Content:		**No. of Hours**
Unit-1	**Signals and Systems:** Continuous-Time and Discrete-Time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, The Unit Impulse and Unit Step Functions, Continuous-Time and Discrete-Time Systems, Basic System Properties **Linear Time-invariant System:** Introduction, Discrete-Time LTI Systems:The Convolution Sum,Continuous-Time LTI Systems: The Convolution Integral, Properties of Linear Time-Invariant Systems, Causal LTI Systems Described by Differential and Difference equations: Linear Constant -Coefficient Differential Equations, Linear Constant-Coefficient Difference Equations, Singularity Functions	**8**
Unit-2	**Fourier Series Representation of Periodic Signals:** The Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Fourier Series Representation of Discrete-Time Periodic Signal, Properties of Discrete- Time Fourier Series, Fourier Series and LTI Systems	**7**
Unit-3	**Continuous-Time Fourier Transform Representation of Aperiodic** **Signals:** The Continuous-Time Fourier Transform, The Fourier Transform	**8**

	for Periodic Signals, Properties of the Continuous-Time Fourier Transform, The Convolution Property, Tables of Fourier Properties and of Basic Fourier Transform Pairs. **Systems Characterized by Linear Constant-Coefficient Sampling:** Representation of a Continuous-Time Signal by Its Samples, The Sampling Theorem: Impulse-Train Sampling, Sampling with a Zero-Order Hold, Reconstruction of a Signal from Its Samples Using Interpolation, The Effect of Undersampling: Aliasing.	
Unit-4	**The Laplace Transform:** The Laplace Transform, The Region of Convergence for Laplace Transforms, The Inverse Laplace Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot Properties of the Laplace Transform Linearity of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems using the Laplace Transform: (Causality , Stability, LTI Systems Characterized by Linear Constant-Coefficient Differential Equations), The Unilateral Laplace Transform: Examples of Unilateral Laplace Transforms, Properties of the Unilateral Laplace Transform.	**7**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, "Signals and Systems", PHI Learning, India, 2nd Edition, 1997, ISBN: 978-8120312463. 2. Simon Haykin, Barry Van Veen, “Signals and Systems”, Wiley India, 2nd Edition, 2007, ISBN: 978-8126512652. **Reference Books:** 1. Richard Baraniuk, "Signals and Systems", Orange Grove Texts Plus, Pap/Psc Edition, 2009, ISBN-13: 978-1616100681. 2. P. Ramesh Babu, R. Anananatarajan, “Signals and Systems”, Scitech Publications India Pvt. Ltd., 4th Edition, 2011, ISBN: 978-8183712880. 3. A. Anand Kumar, “Signals and Systems”, Prentice Hall India Learning Pvt. Ltd., 3rd Edition, 2013, ISBN: 978-8120348400.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Describe the time-domain and frequency-domain analysis of signals using Fourier and Laplace transforms. CO 2. Solve problems involving signals and systems CO 3. Analyze the frequency response of LTI systems CO 4. Assess system behavior using impulse and step responses in both time and frequency domains.	

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-205**
Title of the Course : **Fundamentals of Signal Processing Lab**
Number of Credits : **2**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of programming.	
Course Objectives:	**The course will enable the students to:** 1. Get introduced to different types of signals in both time and frequency domains. 2. Develop an understanding of spectral properties of signals using Fourier Series, Fourier Transform, and Discrete-Time Fourier Transform (DTFT). 3. Get familiarized with convolution operations and signal reconstruction 4. Gain knowledge of audio signal spectrum and explore practical applications of signal processing techniques.	
Content:		**No. of Hours**
	List of Experiments: **Programs to be written using Python/Matlab/Scilab/TK Solver** 1. Plot different types of signals 2. Explore elementary operations on signals. 3. Explore operations on the time variable of signals and decompose signals into their even and odd parts. 4. Plot the complex exponential signal 5. Explore transformation of Signals 6. Explore the relation between the unit impulse and the unit step functions. 7. Compute and plotConvolution of two signals 8. Compute and plot Fourier Series Coefficients of Continuous-time Periodic Signals 9. Demonstrate Gibbs phenomenon 10. Plot the Effect of System on Harmonic Content 11. Compute and plot the Fourier Series Coefficients of Discrete-time Periodic Signals 12. Compute and plot the Continuous-time Fourier Transform 13. Sample and reconstruct a continuous time signal. 14. Compute Laplace Transform and Inverse Laplace Transform 15. Perform signal analysis on any real world signals	**60**

Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.
References/ Readings:	**Text Books:** 1. Fatos Tunay Yarman Vural, Emre Akbas, "Signals and Systems: Theory and Practical Explorations with Python", Wiley, 2024, 1st Edition, ISBN: 978-1394215775. 2. Aydin Akan, "Signals and Systems using MATLAB", Academic Press, 4th Edition, 2024, ISBN: 9780443157097. **Reference Books:** 1. Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, "Signals and Systems", PHI Learning, India, 2nd Edition, 1997, ISBN: 978-8120312463. 2. Simon Haykin, Barry Van Veen, "Signals and Systems", Wiley India, 2nd Edition, 2007, ISBN: 978-8126512652. 3. Richard Baraniuk, "Signals and Systems", Orange Grove Texts Plus, Pap/Psc Edition, 2009, ISBN-13: 978-1616100681.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Compare different types of signals and apply mathematical operations to modify them. CO 2. Compute Fourier Series, Fourier Transform, and Discrete-Time Fourier Transform (DTFT) for periodic and non-periodic signals. CO 3. Develop Python programs to perform convolution, sampling, and reconstruction of signals, ensuring practical understanding of signal processing concepts. CO 4. Analyze the spectral characteristics of audio signals and justify the selection of appropriate signal processing techniques for various applications.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **VLI-202**
Title of the Course : **Microprocessor Architecture and Programming**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the architecture and operation of Intel 8085 microprocessor. 2. Get familiarized with assembly language programs. 3. Gain knowledge of different types of memories and peripheral ICs like 8255, 8259 and 8251. 4. Develop an understanding about the interfacing of various input and output devices with the 8085 processor.	
Content:		**No. of Hours**
Unit-1	**Introduction of Microcomputer System:** CPU, I/O devices, clock, memory, bus architecture, tri-state logic, address bus, data bus and control bus. **Architecture of 8-bit Microprocessor:** Intel 8085A microprocessor, Pin description and internal architecture. **Operation and Control of Microprocessor:** Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles.	**12**
Unit-2	**Instruction Set:** Addressing modes, Data transfer, arithmetic, logical, branch, machine control instructions, Stacks and Subroutines. Writing, Assembling & Executing A Program, Debugging The Programs, Decision Making, Looping, Developing Counters And Time Delay Routines, Code Conversion, BCD Arithmetic And 16-Bit Data Operations.	**10**
Unit-3	**Interfacing:** Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs, and toggle-switches as examples, memory mapped and isolated I/O structure. **Programmable Peripheral Interface:** Intel 8255, pin configuration and block diagram, modes of operation, programming; ADC and DAC chips, stepper motor their interfacing and programming.	**11**

Unit-4	**Interrupts:** Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, Handling multiple interrupts, and programming. **Programmable Interrupt Controller:** Intel 8259, Block diagram, Interrupt operation, programming. **Serial I/O Concepts:** SID and SOD, Intel 8251A programmable communication Interface, pin configuration, internal block diagram, programming.	**12**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications", Penram International, India, 5th Edition, ISBN-13: 978-8187972884. 2. Hall D. V., "Microprocessor and Interfacing-Programming and Hardware", Tata McGraw-Hill Publishing Company Limited, India, 2nd Edition, 2008, ISBN-13: 9781283188982 **Reference Books:** 1. Stewart J; "Microprocessor Systems- Hardware, Software and Programming", Prentice Hall International Edition, India, 1990, ISBN: 978013582395. 2. Short K. L., "Microprocessors and Programmed Logic", Pearson Education India, 2nd Edition, 2008, ISBN: 9780135806067. 3. William Routt, "Microprocessors: Architecture, Programming, and Systems Featuring 8085", Cengage Learning India, 1st Edition, 2009, ISBN: 978-8131508480.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the architecture, working, and programming model of the Intel 8085 microprocessor and peripheral ICs like 8255, 8259, and 8251. CO 2. Analyze the instruction set of the 8085 microprocessor and interpret the timing sequences of various instructions. CO 3. Develop efficient Assembly language programs to solve specific computational and control tasks. CO 4. Implement the interfacing of memory and various I/O devices with the 8085 microprocessor.	

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : VLI-203
Title of the Course : Microprocessor Architecture and Programming Lab
Number of Credits : 1
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of assembly language programming. 2. Foster problem-solving and algorithm design skills. 3. Gain hands-on experience with peripheral interfacing. 4. Develop system integration and debugging skills.	
Content:		**No. of Hours**
	List of Experiments: 1. Find the sum of 10 numbers stored in the memory and store the sum and carry in registers of 8085. 2. Reverse a given block of data. 3. Find the count of Odd/ Even numbers in a series of 10 numbers stored in memory. 4. Find the count of Positive/Negative numbers in a series of 10 numbers stored in memory. 5. Find the number of 1's or 0's in a given series of numbers stored in the memory. 6. Find the largest/ smallest number in a given series of numbers stored in the memory. 7. Add only positive numbers from a given array. Ignore the negative numbers. Store sum and carry in registers. 8. Arrange a given series of numbers in Ascending/Descending order and store in the memory. 9. Interface a buzzer and buzz it continuously after some delay. 10. Interface and program 8255.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications", Penram International, India, 5th Edition, ISBN-13: 978-8187972884. 2. Hall D. V., "Microprocessor and Interfacing-Programming and Hardware", Tata McGraw-Hill Publishing Company Limited, India, 2nd	

	Edition, 2008, ISBN-13: 9781283188982 **Reference Books:** 1. Stewart J; "Microprocessor Systems- Hardware, Software and Programming", Prentice Hall International Edition, India, 1990, ISBN: 978013582395. 2. Short K. L., "Microprocessors and Programmed Logic", Pearson Education India, 2nd Edition, 2008, ISBN: 9780135806067. 3. William Routt, "Microprocessors: Architecture, Programming, and Systems Featuring 8085", Cengage Learning India, 1st Edition, 2009, ISBN: 978-8131508480.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Demonstrate the ability to write, test, and debug efficient assembly language programs for data manipulation, arithmetic operations, and control structures. CO 2. Apply logical thinking to develop and optimize algorithms for practical problems like sorting, searching, and numerical computation. CO 3. Interface and control external devices like LEDs, seven segment displays, LCDs, keyboards, motors, and sensors using 8085 processor. CO 4. Design and implement microprocessor-based systems that involve both hardware and software, addressing real-time constraints and practical requirements.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-206**
Title of the Course : **Analog Electronics**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of circuit analysis and synthesis	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of transistor amplifiers, biasing schemes, feedback, oscillators, current mirror, multivibrators, OPAMPs, Filters, DAC, ADC circuits. 2. Get familiarized with basic analog electronics circuits. 3. Gain knowledge about the design of analog electronic circuits for given specifications. 4. Appreciate various applications of analog electronic circuits.	
Content:		**No. of Hours**
Unit 1	Transistor as an Amplifier; Large signal, d.c. and Small Signal CE values of Current Gain; Breakdown in Transistors; Ebers–Moll Model; Bias Stability, Methods of Transistor Biasing; Bias Compensation The "h-parameter" Model of Transistor; BJT Amplifiers; Single Stage Amplifiers; Small Signal Analysis of Single Stage BJT Amplifiers; Distortion in Amplifiers; Miller's Theorem and its Dual; Design of Single Stage RC Coupled Amplifier using BJT; Two Stage RC Coupled Amplifier; Darlington Amplifier; Cascode Amplifier	**11**
Unit 2	Classification of Basic Amplifiers; Basic Concept of Feedback; Transfer Gain with Feedback; General Characteristics of Negative-feedback Amplifiers; Effect of Negative Feedback on Input Resistance; Effect of Negative Feedback on Output Resistance; Method of Identifying Feedback Topology and Feedback Factor; Voltage-Series Feedback; Current-Series Feedback; Current-Shunt Feedback; Voltage-Shunt Feedback. Classification of Oscillators; Conditions for Oscillation (Barkhausen Criterion); General form of an LC Oscillator; Hartley Oscillator; Colpitts Oscillator; Clapp Oscillator; Multivibrators: Astable and Monostable.	**11**
Unit 3	**Basics of Op-Amp:** Differential amplifiers, ac and dc analysis; constant current bias, current mirror circuit, op-amp parameters, definitions, measurements. Functional block diagram and working specification of IC741, equivalent circuit	**12**

	of Op-amp and voltage transfer curve, open loop inverting, non-inverting, differential amplifier. Disadvantages of open loop op-amp, closed loop inverting and non-inverting amplifiers, voltage follower. **Applications of op-amp:** Differentiator, integrator, summing, scaling and averaging; Instrumentation amplifier, V-I & I-V converter, Op-Amps as comparators, zero crossing detectors, Schmitt trigger, sample and hold circuit. Advantages of active filter, Butterworth low pass, high pass, band pass, band reject filter, design problems.	
Unit 4	**Voltage Regulators:** Fixed Voltage Regulators, Adjustable Voltage Regulators. **ADC and DAC:** Introduction to resolution and accuracy in convertors. Principle of successive approximation ADC, Binary weighted resistors and R-2R resistor ladder DAC. **Voltage controlled oscillator:** IC566 - Pin configuration, Block diagram, typical connection diagram and output waveforms. **PLL:** Basic principles of phase-locked loop and block diagram, transfer characteristics of PLL, lock range and capture range. **IC 555:** Functional block diagram and specification, modes of IC555, applications of IC555 as monostable and astable multivibrator, design problems.	**11**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. S. Salivahanan, "Electronic Devices and Circuits", McGraw Hill India, Standard Edition, 2022, ISBN: 978-9355322067. 2. R. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Education India, 4th Edition, 2015, ISBN: 978-9332549913. **Reference Books:** 1. Millman, C. Halkias, C Parikh, "Millman's Integrated Electronics - Analog and Digital Circuit and Systems", Tata McGraw-Hill, India, 2nd Edition, 2010, ISBN: 978-0070151420. 2. A.S. Sedra, K.C. Smith, T. Carusone, V. Gaudet, "Microelectronic Circuits", Oxford University Press, India, 8th Edition, 2020, ISBN: 978-0190853464 3. P. Gray, P. Hurst, S. Lewis, R. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley, India, 6th Edition, 2024, ISBN:978-1394220069. 4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,USA, 3rd Edition, 2015, ISBN-10: 0521809266. 5. A. Tilak, "Design of Analog Circuits", Khanna Publishing House, India, Standard Edition, 2022, ISBN: 978-9391505004.	

Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the concepts of transistor amplifiers, biasing schemes, feedback, oscillators, current mirror, multivibrators, OPAMPs, Filters, DAC, ADC circuits. CO 2. Analyse basic analog electronics circuits. CO 3. Evaluate the output parameters for a given circuit. CO 4. Design analog electronic circuits for given specifications.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-207**
Title of the Course : **Analog Electronics Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basic knowledge of circuit analysis and synthesis	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding about the functionality of different types of transistor amplifiers. 2. Appreciate the importance of feedback & oscillation in electronic circuits. 3. Get familiarized with working principles of various OP-AMP subsystems. 4. Gain knowledge related to introduction of the design of analog electronic circuits.	
Content:		**No. of Hours**
	List of Experiments : 1. BJT and biasing (Voltage Divider, Fixed Bias) 2. h-parameter measurement of BJT 3. Amplifiers using BJT (Voltage gain and frequency response) 4. Oscillator (Hartley, Colpitt) using BJT 5. Multivibrators with BJT 6. Op-Amp based circuits 7. Integrator, Differentiator, Summing, scaling and averaging using Op-Amp 8. Schmitt trigger/Filter using Op-Amp 9. Voltage Regulators and A/D and D/A convertors 10. IC555 as multivibrator	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. S. Salivahanan, "Electronic Devices and Circuits", McGraw Hill India, Standard Edition, 2022, ISBN: 978-9355322067. 2. R. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Education India, 4th Edition, 2015, ISBN: 978-9332549913. **Reference Books:** 1. Millman, C. Halkias, C Parikh, "Millman's Integrated Electronics - Analog and Digital Circuit and Systems", Tata McGraw-Hill, India, 2nd Edition, 2010, ISBN: 978-0070151420.	

	2. A.S. Sedra, K.C. Smith, T. Carusone, V. Gaudet, "Microelectronic Circuits", Oxford University Press, India, 8th Edition, 2020, ISBN: 978-0190853464 3. P. Gray, P. Hurst, S. Lewis, R. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley, India, 6th Edition, 2024, ISBN:978-1394220069. 4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,USA, 3rd Edition, 2015, ISBN-10: 0521809266. 5. A. Tilak, "Design of Analog Circuits", Khanna Publishing House, India, Standard Edition, 2022, ISBN: 978-9391505004.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the concepts of transistor amplifiers, biasing schemes, feedback, oscillators, current mirror, multivibrators, OPAMPs , Filters, DAC, ADC circuits. CO 2. Correlate the practical results with theoretical concepts. CO 3. Measure the output parameters for a given circuit. CO 4. Design analog electronic circuits for given specifications.

Professional Electives

Name of the Programme : B.E. Electronics & Telecommunication Engineering
Course Code : ETC-223
Title of the Course : Data Structures & Algorithms
Number of Credits : 3
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic Programming skills	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of fundamental concepts of data structures and algorithms. 2. Comprehend data structures and algorithms to solve specific computational problems. 3. Get familiarized with various algorithms, data structures, and the trade-offs between time and space complexity. 4. Appreciate algorithmic solutions by integrating knowledge of data structures with advanced algorithm design techniques.	
Content:		**No. of Hours**
Unit-1	**Introduction to Data Structures & Algorithms:** Variables, Data Types, Data Structures, Abstract Data Types (ADTs), Analysis of Algorithms, Rate of Growth, Types of Analysis, Notations, Asymptotic Analysis, Divide and Conquer Master Theorem, Subtract and Conquer Master Theorem, Method of Guessing and Confirming, Amortized Analysis **Recursion and Backtracking:** Format of a Recursive Function, Recursion and Memory (Visualization), Recursion versus Iteration, Example Algorithms of Recursion, Example Algorithms of Backtracking **Linked Lists:** Linked Lists ADT, Comparison of Linked Lists with Arrays & Dynamic Arrays, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists.	**12**
Unit-2	**Stacks:** Stack ADT, Applications, Implementation, **Queues:** Queue ADT, Exceptions, Applications, Implementation **Trees:** Types of Binary Trees, Properties of Binary Trees, Binary Tree Traversals **Priority Queues and Heaps:** Priority Queue ADT, Priority Queue Applications, Priority Queue Implementations, Heaps and Binary Heaps, Binary Heaps, Heapsort.	**12**
Unit-3	**Sorting:** Classification of Sorting Algorithms, Bubble Sort, Selection Sort, Insertion Sort	**10**

	Searching: Types of Searching, Unordered Linear Search, Sorted/Ordered Linear Search, Binary Search **Symbol Tables:** Introduction, What are Symbol Tables? Symbol Table Implementations **Hashing:** HashTable ADT, Understanding Hashing, Components of Hashing, Hash Table, Hash Function	
Unit-4	**String Algorithms:** String Matching Algorithms, Brute Force Method, Data Structures for Storing Strings, Hash Tables for Strings, Binary Search Trees for Strings. **Algorithms Design Techniques:** Classification, Classification by Implementation Method, Classification by Design Method. **Greedy Algorithms:** Greedy Strategy, Elements of Greedy Algorithms, Advantages and Disadvantages of Greedy Method, Greedy Applications, Understanding Greedy Technique. **Dynamic Programming:** Strategy, Properties of Dynamic Programming Strategy, Dynamic Programming Approaches, Understanding Dynamic Programming.	**11**
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 5th Edition, Careermonk Publications, India, 2016; ISBN: 978-8193245279. 2. Aditya Y. Bhargava, "Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People", Manning, USA, 1st Edition, 2016, ISBN: 978-1617292231. **Reference Books:** 1. Bradley W. Miller, David L. Ranum, "Problem Solving with Algorithms and Data Structures Using Python", Franklin, Beedle & Associates Inc, Standard Edition, 2006, ISBN: 978-1590280539. 2. T. H. Cormen, C.E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", 4th edition, MIT Press, ISBN: 978-0262046305. 3. Robert Sedgewick, "Algorithms in C", 3rd Edition, Addison-Wesley, ISBN: 978-0201314526.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain the basic concepts of data structures. CO 2. Apply algorithmic techniques to solve specific computational problems, demonstrating an understanding of when to use each technique effectively. CO 3. Analyze the efficiency of algorithms by evaluating their time and space complexity and comparing different algorithms for solving the same problem.	

	CO 4. Design and evaluate new algorithmic solutions by synthesizing concepts such as combining data structures with algorithm design techniques to solve complex computational problems.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-224**
Title of the Course : **Data Structures & Algorithms Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basics of Computer Programming	
Course Objectives:	**The course will enable the students to:** 1. Develop an understanding of the basics of programming data structures and algorithms. 2. Gain knowledge of data structures and algorithms to solve computational problems. 3. Get familiarized with complex data structures and algorithms, with an emphasis on efficiency and correctness. 4. advanced algorithmic solutions for real-world problem-solving challenges.	
Content:		**No. of Hours**
	List of Experiments: 1. Write a C/C++/ Python program to implement Recursion 2. Write a C/C++/ Python program to implement Linked List 3. Write a C/C++/ Python program to implement Stacks 4. Write a C/C++/ Python program to implement Queues 5. Write a C/C++/ Python program to implement Trees 6. Write a C/C++/ Python program to implement Sorting Algorithms 7. Write a C/C++/ Python program to implement Searching Algorithms 8. Write a C/C++/ Python program to implement Hashing 9. Write a C/C++/ Python program to implement String Algorithms 10. Write a C/C++/ Python program to implement Greedy Algorithms	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 5th Edition, Careermonk Publications, India, 2016; ISBN: 978-8193245279. 2. Aditya Y. Bhargava, "Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People", Manning, USA, 1st Edition, 2016, ISBN: 978-1617292231.	

	Reference Books: 1. Bradley W. Miller, David L. Ranum, "Problem Solving with Algorithms and Data Structures Using Python", Franklin, Beedle & Associates Inc, Standard Edition, 2006, ISBN: 978-1590280539. 2. T. H. Cormen, C.E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", 4th edition, MIT Press, ISBN: 978-0262046305. 3. Robert Sedgewick, "Algorithms in C", 3rd Edition, Addison-Wesley, ISBN: 978-0201314526.
Course Outcomes:	**After taking this course, student will be able to:** 1. Explain basic programs for implementing data structures, demonstrating their fundamental operations. 2. Apply precise programming techniques to implement algorithms, ensuring correctness and efficiency in their solutions. 3. Analyze existing implementations of algorithms, articulate improvements, and optimize their code for better performance. 4. Design and implement advanced algorithmic solutions integrating multiple concepts seamlessly into practical applications.

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-225**
Title of the Course : **Fundamentals of Artificial Intelligence**
Number of Credits : **3**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	**The course will enable the students to:** 1. Gain an introduction to the principles and practices of AI. 2. Develop an understanding of state space search and knowledge representation in AI. 3. Get familiarized with various learning methods of AI. 4. Appreciate various applications of AI in solving real world problems.	
Content:		**No. of Hours**
Unit-1	Introduction to Artificial Intelligence: Overview, Applications. Problem Solving by Search: Importance of search in AI. State space search: DFS, BFS, Comparison of BFS and DFS. Heuristic Search, Heuristic Functions, Best First Search, Hill Climbing. Uninformed search vs Informed search techniques. Random Search: Genetic Algorithm, Travelling Salesman Problem. Finding Optimal paths: Brute force, Branch & Bound, Dijkstra's Algorithm, Algorithm A*.	**11**
Unit-2	Knowledge Representation: Representation and Mapping, Approaches to knowledge Representation. Using Predicate Logic, Representing simple facts in logic, Computable functions and predicates, Unification and resolution. Weak slot and filler structure: Semantic nets, partitioned semantic nets, Frames.	**11**
Unit-3	Learning: Introduction, Designing a learning System, Supervised and Unsupervised Learning. Decision tree Learning: Introduction, Appropriate problems for decision tree learning, Basic Decision Tree Learning Algorithm. Bayesian Learning: Introduction, Bayes theorem, Naive Bayes Classifier, K-Nearest neighbor classifier. Clustering: Introduction, k-Means Clustering, Expectation-Maximization Algorithm. Classification vs Regression. Linear Regression, Random Forest Regression.	**12**
Unit-4	Introduction to Artificial Neural Networks: McCulloch and Pitts Neuron, Perceptron, Weights and Activation functions (Signum	**13**

	and Sigmoid), Learning in NN, Learning Basic Boolean functions like AND, OR, XOR, XNOR. Feedforward Networks. Backpropagation Algorithm.	
Pedagogy	The teaching-learning process shall integrate interactive, reflective, and inquiry-based methods, with a strong emphasis on critical thinking and problem-solving skills.	
References/ Readings:	**Text Books:** 1. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw Hill India, 3rd Edition, 2017, ISBN: 978-0070087705. 2. Deepak Khemani, "A First Course in Artificial Intelligence", 1st Edition,McGraw Hill India, 2013, ISBN: 978-1259029981. **Reference Books:** 1. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill India, ISBN: 978-1259096952. 2. Struart Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach", 3rd edition, Prentice Hall, India, ISBN: 978-0136042594 3. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, 4th Edition, ISBN: 9780262043793.	
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Explain concepts of search techniques, knowledge representation and learning in AI. CO 2. Differentiate between the various types of search methods and learning techniques. CO 3. Apply search methods and machine learning techniques for solving basic problems. CO 4. Formulate solutions for real-world problems using AI.	

Name of the Programme : **B.E. Electronics & Telecommunication Engineering**
Course Code : **ETC-226**
Title of the Course : **Fundamentals of Artificial Intelligence Lab**
Number of Credits : **1**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Basics of Computer Programming	
Course Objectives:	**The course will enable the students to:** 1. Gain an introduction to uninformed and Heuristic search techniques in AI. 2. Develop an understanding of machine learning techniques. 3. Get familiarized with the basics of problem solving using neural networks. 4. Gain an introduction to classification and regression using AI.	
Content:		**No. of Hours**
	List of Experiments: 1. Implementation of Breadth first search algorithm 2. Implementation of Depth first search algorithm 3. Implementation of Heuristic search algorithm. 4. Implementation of A* algorithm. 5. Build decision trees and random forest models. 6. Implementation of Naive Bayes Classifier. 7. Implementation of K-nearest neighbor classifier for the given dataset. 8. Implementation of K-means clustering algorithm. 9. Implementation of Hierarchical clustering algorithm 10. Build simple Neural Networks models.	**30**
Pedagogy	The teaching-learning process shall combine instructional learning, constructive thinking, inquiry-based and collaborative learning, experiential learning, and problem-solving approaches.	
References/ Readings:	**Text Books:** 1. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw Hill India, 3rd Edition, 2017, ISBN: 978-0070087705. 2. Deepak Khemani, "A First Course in Artificial Intelligence", 1st Edition,McGraw Hill India, 2013, ISBN: 978-1259029981. **Reference Books:** 1. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill India, ISBN: 978-1259096952. 2. Struart Russell and Peter Norvig, "Artificial Intelligence, A Modern Approach", 3rd edition, Prentice Hall, India, ISBN: 978-0136042594 3. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press,	

	4th Edition, ISBN: 9780262043793.
Course Outcomes:	**After taking this course, student will be able to:** CO 1. Implement and simulate classical search algorithms CO 2. Apply the A* algorithm for optimal pathfinding in AI problems. CO 3. Evaluate decision tree and random forest models for classification tasks. CO 4. Implement Naive Bayes and K-nearest neighbor classifiers for a given dataset and analyze their performance