



### CIRCULAR

The University has notified Ordinance OA-23A relating to the Degree in Bachelor of Vocation (B. Voc.) based on the NEP 2020 and National Credit Framework 2023 effective from academic year 2025-2026.

The syllabus of Semester I and II of the **Bachelor of Vocation in Electronics** Programme approved by the Academic Council in its meeting held on 24<sup>th</sup> April, 12<sup>th</sup> & 13<sup>th</sup> May 2026 is attached.

The Dean & Vice-Dean (Academic) of the School of Physical and Applied Sciences are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

(Ashwin V. Lawande)  
Deputy Registrar – Academic

To,

1. The Dean, School of Physical and Applied Sciences, Goa University.
2. The Vice-Dean (Academic), School of Physical and Applied Sciences, Goa University.

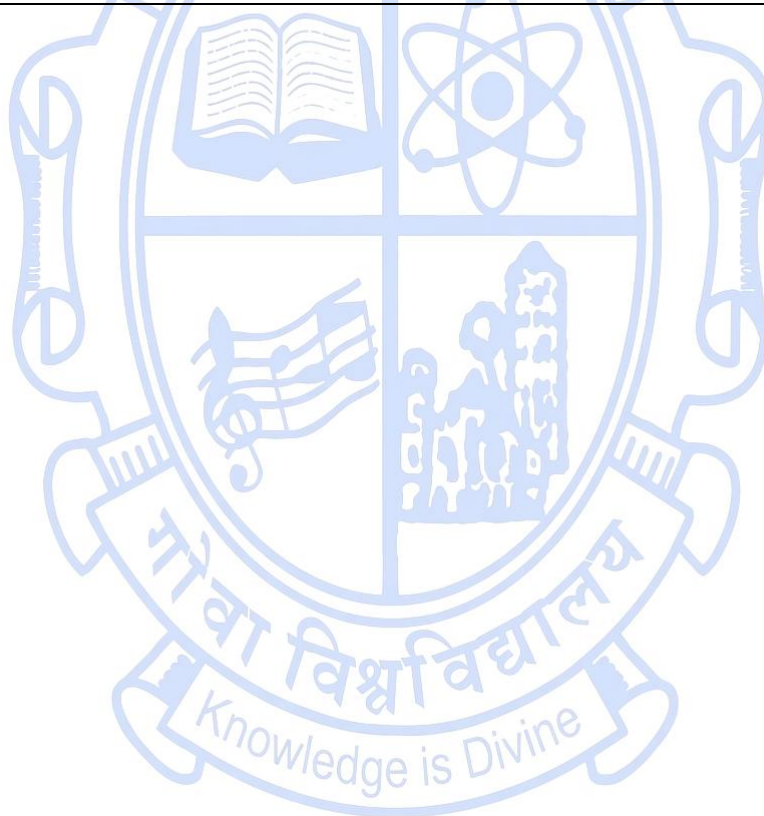
Copy to:

1. Chairperson, BoS in Skill Enhancement & Vocational Studies., Goa University.
2. Programme Director B.Voc., Goa University.
3. Controller of Examinations, Goa University.
4. Assistant Registrar Examinations (UG), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

## Bachelor of Vocation in Electronics

### Programme Structure under NEP 2020

<b>PROGRAMME SPECIFIC OUTCOMES (PSO)</b>	
PSO 1.	Gain profound knowledge about Internet of Things (IoT), and Artificial Intelligence and related products
PSO 2.	Hands-on approach to AI-embedded systems and developing solutions for data security.
PSO 3.	Design sustainable electrical and analogue electronic solutions by integrating fundamental circuit analysis
PSO 4.	Designing and implementing IoT-based systems using sensors, single-board computers, microcontrollers, and cloud platforms to solve real-world problems.
PSO 5.	Implement and maintain state-of-the-art technological applications to provide efficient, hardware-driven solutions for localized societal challenges while adhering to modern technical standards.



## Certificate in Electronics (Semester I and Semester II)

NSQF Level / Semester	Course Code	Course Title	Credits (Theory)	Credits (Practical)	Contact Hours	Evaluation Scheme					
<b>SEMESTER-I</b>											
<b>Level 4.5</b>	<b>General Education</b>					<b>Theory</b>		<b>Practical</b>		<b>Total Marks</b>	
						<b>ISA</b>	<b>SEA</b>	<b>ISA</b>	<b>SEA</b>		
	<a href="#"><u>BEL-100</u></a>	Communication Skills	4	0	60	20	80	-	-	100	
	<a href="#"><u>BEL-101</u></a>	Basic Electrical and Electronics	2	2	90	10	40	10	40	100	
	<b>Skill component</b>										
	<a href="#"><u>BEL-121</u></a>	Essentials of Internet of Things (Mapped with QP ELE/N0167)		8	165					200	
<a href="#"><u>BEL-122</u></a>	Internet of Things Lab		4	120					100		

**General Education: 8 Credits, 150 Hours and 200 Marks**

**Skill Development: 12 Credits, 285 Hours and 300 Marks**

**Total: 20 Credits, 435 Hours and 500 Marks**

NSQF Level / Semester	Course Code	Course Title	Credits (Theory)	Credits (Practical)	Contact Hours	Evaluation Scheme				
<b>SEMESTER-II</b>										
<b>Level 4.5</b>	<b>General Education</b>					<b>Theory</b>		<b>Practical</b>		<b>Total Marks</b>
						<b>ISA</b>	<b>SEA</b>	<b>ISA</b>	<b>SEA</b>	
	<a href="#"><u>BEL-102</u></a>	Environmental Studies	4	0	60	20	80	-	-	100
	<a href="#"><u>BEL-103</u></a>	Analog Electronics	2	2	90	10	40	10	40	100
	<b>Skill component</b>									
<a href="#"><u>BEL-123</u></a>	AI Embedded Product Developer (mapped to QP ELE/Q1407)		12	225					300	

**General Education: 8 Credits, 150 Hours and 200 Marks**

**Skill Development: 12 Credits, 225 Hours and 300 Marks**

**Total: 20 Credits, 375 Hours and 500 Mark**

## SEMESTER I

<b>Title of the Course</b>	Communication Skills
<b>Course Code</b>	BEL-100
<b>Number of Credits</b>	04
<b>Theory/Practical</b>	Theory
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Nil	
<b>Course Objectives:</b>	<p>This course is intended to:</p> <ol style="list-style-type: none"> <li>1. Develop proficiency in communication by improving listening, speaking, reading, and writing skills.</li> <li>2. Promote effective interpersonal and professional communication abilities among students.</li> <li>3. Enhance knowledge of grammar, vocabulary, and technical writing techniques.</li> <li>4. Enable students to communicate clearly, concisely, and effectively in academic and professional contexts.</li> </ol>	
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>
	CO1: Identify the key elements of communication, including barriers and techniques for effective listening, reading, and speaking, to enhance interpersonal and professional communication skills.	PSO 5
	CO2: Apply interpersonal and group communication skills, such as emotional intelligence, group discussion techniques, and presentation strategies, to improve workplace interactions and professional demeanour.	PSO 5
	CO3: Analyse and use appropriate grammatical structures, vocabulary, and proofreading techniques to produce clear and concise communication.	PSO 5
	CO4: Create well-structured professional documents, including letters, emails, reports, and	PSO 5

	resumes, by adhering to formal formats and technical writing conventions.			
<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Module 1:</b>	<p><b>Communication:</b> Stages of Communication, Channels of Communication, Verbal Communication, Non-verbal Communication, Barriers to Effective Communication, Critical thinking Communication, Global Communication, Social Communication, Cross Cultural Communication.</p> <p><b>Listening:</b> Hearing and listening, Active Listening, Empathetic Listening, Critical Listening, Appreciative Listening, Barriers to Listening. Exercises on Listening Comprehension.</p> <p><b>Reading:</b> Skimming and Scanning, Reading different types of texts, Note Making Techniques, Topicalizing, Methods of Sequencing, Summarizing, Paraphrasing an article from any source, Comprehension Skill enhancement exercises.</p> <p><b>Speaking:</b> Pitch, Tone, Articulation, Intonation, and Body Language. Public Speaking Skills, Barriers to Effective Speaking and how to overcome them through preparation, practice, and perseverance. Conversational Skills and Situational Dialogues.</p>	<b>12</b>	CO1	K2,K3, K4
<b>Module 2:</b>	<p><b>Inter - Personal Skills:</b> Developing a professional attitude; self-esteem; and emotional intelligence.</p> <p><b>Group Discussion:</b> Group Discussions, Do's and Don'ts, Traits of a good GD Member.</p> <p><b>Presentation:</b> Effective ways of content delivery and presentation.</p> <p><b>Interviews:</b> Interview Process, Characteristics of the Job Interview, Pre-interview preparation techniques.</p> <p><b>Company Meetings:</b> Notice, Agenda, Minutes of the Meeting.</p>	<b>18</b>	CO2	K2, K3, K5, K6
<b>Module 3:</b>	<p><b>Grammar and Vocabulary:</b> Tenses, Determiners, Prepositions, Punctuation and Capitalization, Modal Auxiliaries, Active and Passive Voice, Homonyms, Homophones, Acronyms (general abbreviations), Proofreading Symbols.</p>	<b>10</b>	CO3	K1, K2, K3
<b>Module 4:</b>	<p><b>Letter and Memorandum Writing:</b> Formal letter writing, Structure of a</p>	<b>20</b>	CO4	K3, K4,

	<p>Formal/Business Letter, Formal Letter Formats: Full Block Format and Modified Block Format, Memos.</p> <p><b>Email Writing:</b> Etiquettes in Email Writing, Characteristics of Successful Email Messages, Email Formats, Standard Email Practices.</p> <p><b>CV and Resume Writing:</b> Format, Structure Tone, and Keyword usage, Difference between CV and Resume.</p> <p><b>Reports Writing:</b> Format, Structure and Types, Technical Reports, Description and Proposal.</p> <p><b>Technical Writing:</b> Process Writing, Description Writing, User's Manual Writing, Instruction Writing.</p>			K6
<b>Pedagogy:</b>	Lectures/Tutorial/Assignments/Experiential Learning /Practice Sessions			
<b>Texts:</b>	Raman, M., and Sharma, S. Technical Communication-Principles and Practice. Fourth Edition, Oxford University Press, 2022.			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Lesikar, R. V., Flatley, M. E., and Rentz, K. Business Communication: Making Connections in a Digital World. Tata McGraw Hill, 2009.</li> <li>2. Kumar, S., and Lata, P. Communication Skills. Second Edition, Oxford University Press, 2015.</li> <li>3. Raman, M., and Singh, P. Business Communication. Second Edition, Oxford University Press, 2012.</li> <li>4. Leech, G., and Svartvik, J. A Communicative Grammar of English. Third Edition, Routledge, 2015.</li> <li>5. Morgan, K. Technical Writing Process. Lightning Source Inc, 2015.</li> </ol>			
<b>Web Resources:</b>	<a href="https://www.youtube.com/playlist?list=PLbMVogVj5nJSZB8BV29_sPwwkzMTYXpaH">https://www.youtube.com/playlist?list=PLbMVogVj5nJSZB8BV29_sPwwkzMTYXpaH</a>			

<b>Title of the Course</b>	Basic Electrical and Electronics
<b>Course Code</b>	BEL-101
<b>Number of Credits</b>	04 (02+02)
<b>Theory/Practical</b>	Theory +Practical
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Should have basic knowledge of current, voltage concepts, AC and DC voltages.			
<b>Course Objectives:</b>	This course is intended to: 1. Introduce students to the basics of electrical and electronic circuits, concepts, theory. 2. Give a student hands-on experience as a starting point to design the basic circuits.			
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>		
	CO1: Gain knowledge about basics concepts and terminology of electrical and electronics. Getting familiar with current and voltage measuring devices.	PSO 3		
	CO2: Identify basic electronics components such as resistors, capacitors, inductors, switches and relays, and understand their working.	PSO 3		
	CO3: Select electronic/electric components based on the requirements.	PSO 3		
	CO4: Apply the knowledge of theorems/laws to analyze the simple circuit diagrams.	PSO 3, PSO 5		
<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Module 1:</b>	<b>Basic Electrical concepts</b> Concept of electric charge, potential difference, current and voltage, AC source and DC source, measuring devices: voltmeters and ammeters. Positive and negative cycle,	<b>5</b>	CO1	K1, K2

	Frequency, RMS value, Peak value, Single phase and Three phase supply, grounding.			
<b>Module 2:</b>	<b>Introduction to Resistors</b> Resistor: different types of resistors, colour coding of resistors, tolerance value, Wattage of resistors, series and parallel concept, Ohms law, kirchhoff law.	<b>5</b>	CO2	K1, K2, K3, K4
<b>Module 3:</b>	<b>Introduction to Capacitors</b> Working principle of capacitors, dielectric constant, capacitive reactance, types of Capacitors, measuring capacitance and capacitive reactance, series and parallel, resonance.	<b>6</b>	CO2	K1, K2, K3, K4
<b>Module 4:</b>	<b>Introduction to Inductor and Inductance</b> Definition of inductance, types, Inductive reactance, measuring inductance, series and parallel, self and mutual inductance, coefficient of coupling, transformer, power factor.	<b>7</b>	CO2	K1, K2, K3, K4
<b>Module 5:</b>	<b>Circuit Breaker, switches and Relays</b> Circuit breaker working and construction, types of circuit breakers, Types of Switches: one-way (single-pole), two-way (double-pole), light dimmer, SPST, SPDT, DPST, DPDT, pushbutton switches, selector switches, limit switches. Design of a Relay, working and construction of relay, NC and NO condition.	<b>7</b>	CO2, CO3, CO4	K1, K2, K3, K4, K5
<b>Practical / Lab</b>	<b>Minimum 8 experiments to be carried out</b> Expt. 1: Getting familiar with measuring instruments (Voltmeter, Ammeter, DMM, Current source, Voltage Source) Expt. 2: Study of AC waveform parameters Expt. 3: Understanding resistor color code and implementation of Parallel and series combination of resistor Expt. 4: Verifying Ohm's law and Kirchhoff's law Expt. 5: Implementation Series and parallel combinations of capacitor	<b>60</b>	CO1, CO2, CO3, CO4	K1, K2, K3, K4

	<p>Expt. 6: Implementation Charging and discharging of capacitors</p> <p>Expt. 7: Implementation Series and parallel combinations of inductor</p> <p>Expt. 8: Measuring voltage across different step down transformer</p> <p>Expt. 9: Turning light/lamp/led ON and OFF using relay</p> <p>Expt. 10: Implementation of switch in the electrical circuit</p> <p>Expt. 11: Implementation of different types circuit breaker</p> <p>Expt. 12: Study of different types of switches</p> <p>Expt. 13: Study of different types of Relays</p> <p>Expt. 14: Implementation of miniature Circuit breaker</p>			
<b>Pedagogy:</b>	Lectures/Tutorial/Assignments/ Experiential Learning /Practice Sessions/Practicals			
<b>Texts:</b>	<ol style="list-style-type: none"> <li>1. Mehta, V. K., and Mehta, R. Basic Electrical Engineering, Revised Edition, S. Chand Publishing, 1988.</li> <li>2. Mehta, V. K., and Mehta, R. Principles of Electronics. Twelfth Edition, S. Chand Publishing, 2020.</li> </ol>			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Theraja, B. L., and Theraja, A. K. A Textbook of Electrical Technology: Volume I, Basic Electrical Engineering. Twenty Fourth Edition, S. Chand Publishing, 2023.</li> <li>2. Theraja, B. L., and Theraja, A. K. A Textbook of Electrical Technology: Volume II, AC and DC Machines. Twenty Third Revised Edition, S. Chand Publishing, 2006.</li> <li>3. Veatch, H. C. Electrical Circuit Action. Science Research Associates, 1971.</li> <li>4. Gurevich, V. Electric Relays: Principles and Applications. First Edition, CRC Press, 2005.</li> <li>5. Seymour, A. F. Basic Electronic Components: Model ECK-10 Instruction Manual, Elenco Electronics, 2012.</li> </ol>			
<b>Web Resources:</b>	<a href="https://www.youtube.com/watch?v=3TR_DS_7z2w">https://www.youtube.com/watch?v=3TR_DS_7z2w</a>			

<b>Title of the Course</b>	Essentials of Internet of Things (Mapped with QP ELE/N0167)
<b>Course Code</b>	BEL-121
<b>Number of Credits</b>	08
<b>Theory/Practical</b>	Theory
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Nil	
<b>Course Objectives:</b>	<p>This course is intended to:</p> <ol style="list-style-type: none"> <li>1. Develop an understanding of IoT concepts, architecture, and applications.</li> <li>2. Develop Python programming skills using Raspberry Pi for IoT solutions.</li> <li>3. Apply Git and GitHub for version control and collaborative development.</li> </ol>	
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>
	CO1: Explain and analyse IoT architecture, components, communication protocols, security challenges, ethical considerations, and sensor-based hardware systems to design basic IoT-enabled solutions.	PSO 1, PSO 2
	CO2: Apply Git and GitHub tools to manage repositories, implement branching strategies, collaborate through pull requests, and automate workflows using GitHub Actions.	PSO 1, PSO 2, PSO 4
	CO3: Develop Python-based IoT applications on Raspberry Pi by interfacing sensors, utilizing Linux commands, integrating IoT platforms, and implementing data visualisation techniques.	PSO 1, PSO 4, PSO 5
	CO4: Analyse network architectures, protocols, IP addressing, wireless communication standards, and implement secure socket-based communication for IoT systems.	PSO 1, PSO 4
	CO5: Design, implement, and evaluate a complete IoT solution integrating hardware, networking, programming, version control, data security, and user-centred design principles.	PSO 4, PSO 5

Content:		No. of hours	Mapped to CO	Cognitive Level
<b>Module 1: IoT Overview</b> <b>(Mapped to QP ELE/N0167)</b>	<b>IoT overview:</b> IoT overview, IoT architecture, IoT components, IoT communication protocols and their specific use cases; Functions of key IoT hardware such as sensors, actuators, and microcontrollers; IoT platform, gateways, and cloud services in enabling IoT applications, IoT network; Security challenges and vulnerabilities associated with IoT devices and networks, Ethical implications of IoT, privacy concerns and data ownership issues; IoT applications, emerging trends and future directions in IoT technology and applications	15	CO1	K1, K2, K4, K5
<b>Module 2: Hardware and Sensor overview</b> <b>(Mapped to QP ELE/N0167)</b>	<b>Hardware and Sensor overview:</b> Roles and functions of essential hardware components in IoT systems, including microcontrollers, microprocessors, and integrated circuits; Principles and applications of various types of sensors (e.g., temperature, humidity, motion, light, pressure); Integration of sensors with microcontrollers or microprocessors using platforms like Arduino and Raspberry Pi; Methods for acquiring, converting, and processing data from sensors, including analog-to-digital conversion and signal conditioning; Overview of Integrated Development Environments (IDEs) and other software tools for programming and debugging sensor-based IoT systems;	15	C01	K2, K3, K4
<b>Module 3: Git &amp; Git/Hub Control</b> <b>(Mapped to QP ELE/N0167)</b>	<b>Version Control:</b> fundamental concepts, repositories, branches, commits, merges, conflicts, Initialization, clone repositories, create, manage, and switch between branches, Stage, commit, and amend changes. Git commands for rebasing, cherry-picking, and reverting changes; <b>Git:</b> Overview & Installation, Understand and create meaningful commit messages, Git hooks, best practices for branching strategies; <b>GitHub:</b> Create and manage repositories on GitHub, add and manage remote repositories. Push changes to and pull updates from remote repositories, GitHub	15	CO2	K1, K2, K3, K4

	workflows, including forking, cloning, and pull requests, branches, and code reviews, repository settings, remote-tracking branches, GitHub Issues for bug tracking and feature requests, GitHub Actions for CI/CD pipelines, GitHub Pages for hosting project documentation and websites, and best practices for branching strategies;			
<b>Unit/Module 4: Introduction to Python, Linux, and Node.js on Raspberry Pi, IoT Platform &amp; Data Visualization and Design Thinking (Mapped to QP ELE/N0167)</b>	<p><b>Introduction to Python and Linux:</b> Python syntax, data types, control structures (loops, conditionals), functions, and object-oriented programming (OOP) concepts, Python scripts and programs to solve computational problems and manipulate data; standard Python libraries (e.g., os, sys, math) and third-party modules; hardware components (e.g., GPIO pins, sensors) using Python libraries such as RPi.GPIO or Adafruit Circuit Python libraries; Navigate and operate within the Linux environment of the Raspberry Pi; Command-line tools and utilities for managing files, directories, and processes; Interface Python scripts with external devices connected to the Raspberry Pi, including sensors, actuators, and displays. Communicate with external APIs and web services using the Python requests library or MQTT for IoT applications;</p> <p>Raspberry Pi OS Command, Understanding Linux, Shell Programming, Editors and IDEs; Mini Project using GPIO Zero;</p> <p><b>Node.js for IoT:</b> Node.js Overview, Basic Node.js Programming, Raspberry Pi with Node-RED, and Error Handling and Troubleshooting;</p> <p><b>IoT Platform &amp; Data Visualization:</b> Introduction to IoT Platform, IoT Open Platform Mobius Installation &amp; Operation, OpenHAB(Open Automation Bus) and Data Visualization;</p> <p><b>Design Thinking:</b> Design Thinking and its need, five steps of design thinking;</p>	15	CO3	K1, K2, K3, K4
<b>Unit/Module 5: Introduction to Network Communication (Mapped to QP ELE/N0167)</b>	<p><b>Understanding Network:</b> Basic principles of computer networks, types of networks: LAN, WAN, MAN; network topologies, network architecture: client-server vs. peer-to-peer; OSI (Open Systems Interconnection) model and its layers; IP addressing, subnetting, and routing principles;</p> <p><b>Networking Protocols and Standards:</b> Identify and describe key networking protocols and standards such as TCP/IP, UDP, HTTP, HTTPS, FTP, DNS, DHCP, and SNMP, TCP/IP protocol suite; emerging trends in network communication such as IoT (Internet of Things), 5G networks, SDN (Software-Defined Networking), and cloud computing</p>	15	CO4	K1, K2, K3, K4

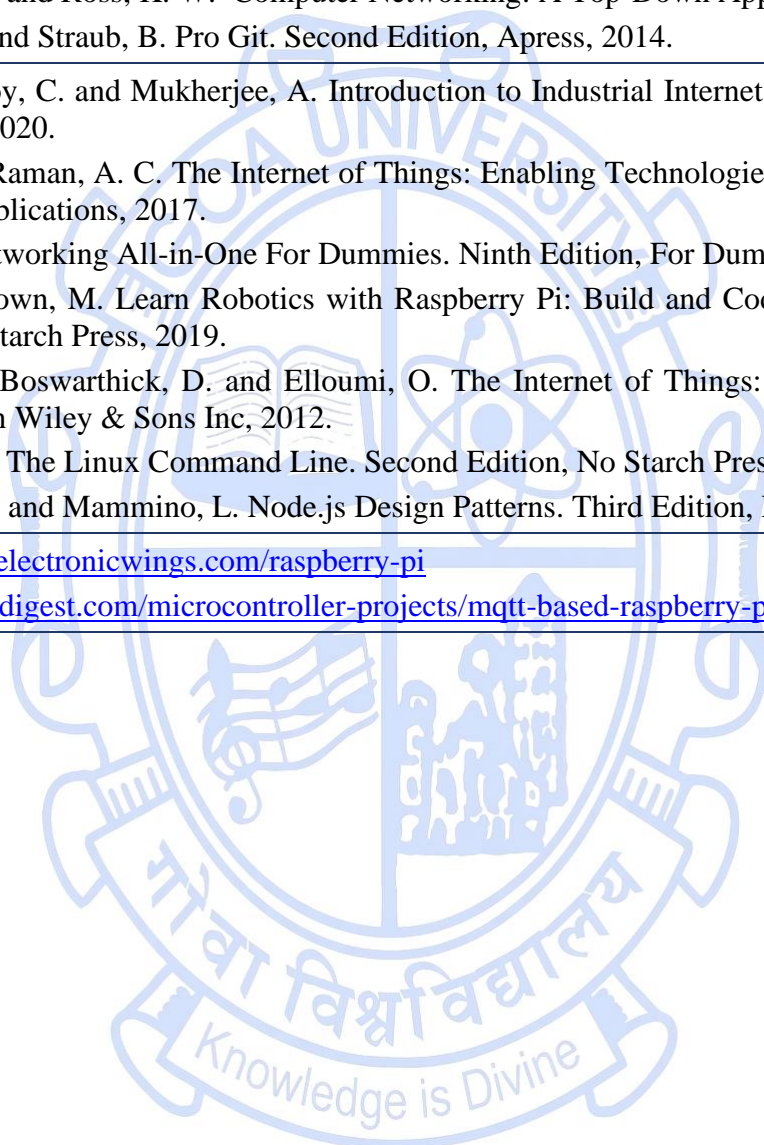
	and Understand the impact of IoT, 5G networks, SDN and cloud computing on traditional network infrastructures and deployment scenarios; <b>Socket Programming and Network Security:</b> firewalls, encryption, VPNs (Virtual Private Networks), and access control lists (ACLs), common network security threats and vulnerabilities, wireless networking technologies and standards (e.g., Wi-Fi, Bluetooth, Zigbee); Configuration and troubleshooting of wireless networks, including security considerations; legal and ethical considerations related to network communication, including privacy, data protection, and regulatory compliance (e.g., GDPR, HIPAA);			
<b>Practical/Lab: IoT Capstone Project (Mapped to QP ELE/N0167)</b>	<b>IoT Capstone Project:</b> Selecting an appropriate IoT solution, project planning, resource allocation, and time management for IoT projects, UI/UX design in IoT systems and optimising user interaction, methodologies for effective data handling, ensuring data integrity and security, evaluation process for IoT solutions and measurement of project success;	<b>90</b>	CO5	K4, K5
<b>Pedagogy:</b>	Lectures/Experiential Learning/Assignment/Practical			
<b>Texts:</b>	<ol style="list-style-type: none"> <li>Misra, S., A. Mukherjee, and A. Roy. Introduction to IoT. First Edition, Cambridge University Press, 2021.</li> <li>Matthes, E. Python Crash Course. 2nd ed., No Starch Press, 2019.</li> <li>Kurose, James F., and Keith W. Ross. Computer Networking: A Top-Down Approach. 8th ed., Pearson, 2021.</li> <li>Chacon, Scott, and Ben Straub. Pro Git. 2nd ed., Apress, 2014.</li> </ol>			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>Misra, S., C. Roy, and A. Mukherjee. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.</li> <li>Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A Hands-on Approach. Universities Press.</li> <li>Hersent, Olivier, David Boswarthick, and Omar Elloumi. The Internet of Things: Key Applications and Protocols. 2nd ed., Wiley, 2012.</li> <li>Shotts, William E. The Linux Command Line. 2nd ed., No Starch Press, 2019.</li> <li>Casciaro, Matteo, and Leonardo Mammino. Node.js Design Patterns. 3rd ed., Packt Publishing, 2020.</li> <li>Model Curriculum for Essentials of Internet of Things, Electronics Sector Skills Council of India.</li> </ol>			
<b>Web Resources:</b>	<a href="https://www.youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE">https://www.youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE</a>			

<b>Title of the Course</b>	Internet of Things Lab
<b>Course Code</b>	BEL-122
<b>Number of Credits</b>	04
<b>Theory/Practical</b>	Practical
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Nil	
<b>Course Objectives:</b>	<p>This course is intended to:</p> <ol style="list-style-type: none"> <li>1. Apply the understanding of IoT concepts, architecture, and applications to design basic IoT-enabled solutions.</li> <li>2. Apply Python and Node.js programming skills using Raspberry Pi for IoT solutions.</li> <li>3. Apply Git and GitHub for version control and collaborative development.</li> <li>4. Apply the understanding of network architecture, protocols, programming, and communication for IoT applications.</li> </ol>	
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>
	CO1: Demonstrate proficiency in interfacing and communicating with sensors and peripherals (I2C, UART) using Python on Raspberry Pi.	PSO 4, PSO 5
	CO2: Develop skills in version control, collaboration, and advanced Git management for software projects.	PSO 4, PSO 5
	CO3: Design and implement home automation and IoT systems, including sensor data acquisition, MQTT messaging, and device control, using Node.js and Python.	PSO 4, PSO 5
	CO4: Configure and manage network infrastructure, including network protocols, topologies, VPNs, and SDN, to ensure secure and efficient connectivity.	PSO 4, PSO 5
	CO5: Set up and operate server environments, including database servers and network devices,	PSO 4, PSO 5

	and simulate network architectures for scalable and secure communication.			
<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Practical/Lab</b>	<p><b>Minimum 8 experiments to be carried out</b></p> <ol style="list-style-type: none"> <li>1. Implement I2C and UART communication using python on Raspberry Pi.</li> <li>2. Interface humidity, temperature, and air-quality level sensors using python on Raspberry Pi.</li> <li>3. Implement version control, branching, and collaboration using Git.</li> <li>4. Implement advanced Git management – Stashing and Commit Analysis.</li> <li>5. Home automation using python on Raspberry Pi.</li> <li>6. Home automation using Node.js on Raspberry Pi.</li> <li>7. Use Node.js on Raspberry Pi to publish/subscribe sensor data via MQTT for scalable IoT communication.</li> <li>8. Implement a smart camera system using python on Raspberry Pi.</li> <li>9. Implement network protocols (TCP/IP, UDP, HTTP, and FTP).</li> <li>10. Design and simulate different network topologies (star, ring, bus, mesh).</li> <li>11. Set up a Virtual Private Network (VPN) server and client to secure remote connections.</li> <li>12. Implement IP addressing, subnetting and configure Open Shortest Path First (OSPF).</li> <li>13. Set up Software-Defined Networking (SDN) architecture.</li> <li>14. Study and configure functionalities of a router and switches (or by simulation).</li> <li>15. Set up a database server on Raspberry Pi and communicate via sockets.</li> </ol>	<b>120</b>	CO1, CO2, CO3, CO4, CO5	K3, K4, K5
<b>Pedagogy:</b>	Lectures/Experiential Learning/Assignment/Practical			
<b>Texts:</b>	<ol style="list-style-type: none"> <li>1. Misra, S., Mukherjee, A., and Roy, A. Introduction to IoT. First Edition, Cambridge University Press, 2022.</li> <li>2. Bahga, A., and Madisetti, V. Internet of Things: A Hands-on Approach. Universities Press, 2014.</li> <li>3. Lutz, M. Learning Python. Fifth Edition, O'Reilly Media, 2013.</li> </ol>			

	<ol style="list-style-type: none"> <li>4. Kurose, J. F., and Ross, K. W. Computer Networking: A Top-Down Approach. Eight Edition, Pearson, 2021.</li> <li>5. Chacon, S., and Straub, B. Pro Git. Second Edition, Apress, 2014.</li> </ol>
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Misra, S., Roy, C. and Mukherjee, A. Introduction to Industrial Internet of Things and Industry 4.0. First Edition, CRC Press, 2020.</li> <li>2. Raj, P., and Raman, A. C. The Internet of Things: Enabling Technologies, Platforms, and Use Cases. First Edition, Auerbach Publications, 2017.</li> <li>3. Lowe, D. Networking All-in-One For Dummies. Ninth Edition, For Dummies, 2024.</li> <li>4. Timmons-Brown, M. Learn Robotics with Raspberry Pi: Build and Code Your Own Moving, Sensing, Thinking Robots. No Starch Press, 2019.</li> <li>5. Hersent, O., Boswarthick, D. and Elloumi, O. The Internet of Things: Key Applications and Protocols. Second Edition, John Wiley &amp; Sons Inc, 2012.</li> <li>7. Shotts, W. E. The Linux Command Line. Second Edition, No Starch Press, 2019.</li> <li>8. Casciaro, M., and Mammino, L. Node.js Design Patterns. Third Edition, Packt Publishing, 2020.</li> </ol>
<b>Web Resources:</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.electronicwings.com/raspberry-pi">https://www.electronicwings.com/raspberry-pi</a></li> <li>2. <a href="https://circuitdigest.com/microcontroller-projects/mqtt-based-raspberry-pi-home-automation">https://circuitdigest.com/microcontroller-projects/mqtt-based-raspberry-pi-home-automation</a></li> </ol>



## SEMESTER II

<b>Title of the Course</b>	Environmental Studies
<b>Course Code</b>	BEL-102
<b>Number of Credits</b>	04
<b>Theory/Practical</b>	Theory
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Concern and watchfulness about the current status of the environment.	
<b>Course Objectives:</b>	This course is intended to: 1. Provide students with knowledge of biodiversity conservation, pollution control, and environmental protection concepts. 2. Create awareness about e-waste management and promote responsible disposal and recycling practices. 3. Encourage the adoption of sustainable practices for environmental preservation and resource management. 4. Develop social and environmental ethics among students while enabling them to analyse and address current environmental challenges.	
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>
	CO1: Analyse the significance of biodiversity, differentiate between types of biodiversity, and propose conservation strategies to protect endangered species and ecosystems.	PSO5
	CO2: Identify various forms of environmental pollution, examine their causes and effects, and recommend effective measures for prevention, control, and disaster mitigation.	PSO5
	CO3: Understand the components and hazards of e-waste, evaluate its impact on health and the environment, and design sustainable strategies for its management.	PSO5

	CO4: Explain the interplay between social issues and environmental ethics, assess challenges in sustainable development, and formulate solutions for ethical and sustainable environmental practices.		PSO5	
	CO5: Analyse the impacts of tourism on the environment and society, and develop sustainable tourism models to balance growth and conservation.		PSO5	
	CO6: Examine the effects of human population growth on the environment and human health, and propose welfare and policy solutions to mitigate these impacts.		PSO5	
<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Module 1: Environment and Biodiversity</b>	<p>Definition, scope and importance of environment - need for public awareness. Ecosystem and Energy flow - ecological succession. Types of biodiversity: genetic, species and ecosystem diversity -values of biodiversity, India as a mega-diversity nation - hot spots of biodiversity.</p> <p>Threats to biodiversity: habitat loss, poaching of wildlife, and man-wildlife conflicts. Endangered and endemic species of India.</p> <p>Conservation of biodiversity: In situ and ex-situ conservation of biodiversity.</p>	<b>12</b>	CO1	K1
<b>Module 2: Pollution:</b>	<p>Environmental Pollution: Definition, Cause, effects, and Preventive measures of Water, Soil, Air and Noise Pollution. Air Pollution: Types of particulates, topography, effects of air pollution on living organisms, plants, materials, stratosphere. Control measures for air pollution, Air quality.</p> <p>Water Pollution: Point and non-point sources, causes of water pollution, control measures.</p> <p>Soil Pollution: Causes of soil degradation, problems with pesticide use.</p> <p>Noise Pollution: Effects on noise pollution on physical health, permitted noise levels, control measures.</p> <p>Role of an individual in prevention of pollution. Pollution case studies. Disaster mitigation and management-floods, droughts, earthquakes, landslides, cyclones, tsunamis.</p>	<b>12</b>	CO2	K1,K2
<b>Module 3: E-Waste</b>	Introduction, Type of contaminants in e-waste, toxic substances and precious metals			

<b>Management:</b>	associated with e-waste and their health impacts, treatment strategies of e-waste: Recycling, landfill disposal, biological treatment, advanced methods, Conclusion.	<b>10</b>	CO3	K1,K3
<b>Module 4: Social Issues and Ethics:</b>	Social Issues and the Environment: From Unsustainable to Sustainable Development. Urban problems related to energy. Water conservation: Rainwater Harvesting, Watershed Management. Resettlement and Rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Issues involved in the enforcement of environmental legislation. Public awareness.	<b>12</b>	CO4	K3,K4
<b>Module 5: Tourism and Environment</b>	Definition and typology of tourism; mass tourism and environment - aspects of degradation and exploitation, physical and social impacts; examples at local, regional, national and international levels. Sustainable tourism.	<b>6</b>	CO5	K5
<b>Module 6: Human Population and the Environment</b>	Human population growth: Impacts on environment, human health and welfare. Family Welfare Programs, Human Rights, environment and human health, infectious diseases, water-related diseases, risks due to chemicals in food, and cancer.	<b>8</b>	CO6	K5
<b>Pedagogy:</b>	Lectures/Tutorial/Assignments/ Practice Sessions			
<b>Texts:</b>	Bharucha, E. Textbook of Environmental Studies for Undergraduate Courses, India. Universities Press (India) Pvt. Limited, 2005.			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Kaushik, A., and Kaushik, C. P. Perspectives in Environmental Studies. Sixth Edition, New Age International Publishers, 2018.</li> <li>2. Hulme, M., Editor. Climates and Cultures. First Edition, SAGE Publications, 2015.</li> <li>3. Garrett, M., Editor. Encyclopedia of Transportation: Social Science and Policy. First Edition, SAGE Publications, 2014.</li> <li>4. Steel, B. S., Editor. Science and Technology: An A-to-Z Guide to Issues and Controversies, CQ Press, 2014.</li> </ol>			
<b>Web Resources:</b>	<a href="https://nptel.ac.in/courses/109105203">https://nptel.ac.in/courses/109105203</a>			

<b>Title of the Course</b>	Analog Electronics
<b>Course Code</b>	BEL-103
<b>Number of Credits</b>	04 (02+02)
<b>Theory/Practical</b>	Theory + Practical
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Students should have some basic idea of electrical concepts and some basic knowledge of electronics.	
<b>Course Objectives:</b>	<p>This course is intended to:</p> <ol style="list-style-type: none"> <li>1. Understand fundamental concepts of semiconductor devices and rectifier circuits.</li> <li>2. Explain the operation of transistors, amplifier configurations, and power supply systems.</li> <li>3. Analyse feedback mechanisms, oscillator circuits, and operational amplifier fundamentals.</li> <li>4. Develop practical skills for constructing and testing analogue electronic circuits.</li> </ol>	
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>
	CO1: Explain the characteristics and working principles of semiconductor diodes and rectifier circuits.	PSO3
	CO2: Analyse transistor biasing techniques, amplifier configurations, and regulated power supply circuits.	PSO3
	CO3: Evaluate feedback mechanisms, oscillator circuits, and operational amplifier configurations.	PSO3
	CO4: Construct, test, and verify rectifiers, amplifiers, oscillators, and OP-AMP-based circuits in the laboratory.	PSO5

<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Module 1</b>	<b>Introduction to the semiconductor diode</b> Intrinsic and extrinsic semiconductors, P and N type semiconductor, P.N. junction, barrier potential, effect of temperature, breakdown voltage, Forward and reverse bias, Half wave, full wave rectifiers and bridge rectifiers. Types of diodes (Light emitting diode, Zener)	<b>05</b>	CO1	K1
<b>Module 2</b>	<b>Introduction to Transistor and Amplifiers</b> Working principle of Transistor, NPN and PNP transistor, Basics of transistor amplifier, Biasing of transistors.	<b>05</b>	CO2	K2,K4
<b>Module 3</b>	<b>Introduction to Power Supply</b> Unregulated and regulated DC power supply, Short circuit protection, Overload protection, Fixed and variable voltage regulators, Switching Mode Power Supply.	<b>04</b>	CO2	K2,K4
<b>Module 4</b>	<b>Basic Amplifier and feedback</b> Gain, I/O resistance, Classes of amplifier, Decibel, Amplifier bandwidth. Types of feedback, Voltage and current feedback, series and shunt feedback. Barkhausen criterion, types of oscillators	<b>08</b>	CO3	K4,K5
<b>Module 5</b>	<b>Linear IC's and Operational Amplifiers</b> Differential Amplifier, OP-Amp characteristics, Differential and Common mode gains, inverting and non-Inverting amplifier, Applications of op-amps (summers, subtractors, integrator and differentiator)	<b>08</b>	CO3, CO4	K3,K5
<b>Practical / Lab</b>	<b>Minimum 8 experiments to be carried out</b> Expt. 1: Identifying and testing of diode, NPN and PNP transistors. Expt. 2: Implementation of bridge rectifier Expt. 3: Implementation of Voltage regulator using Zener diode	<b>60</b>	CO4	K3, K6

	<p>Expt. 4: Calculation of Load regulation and line regulation</p> <p>Expt. 5: Implementation of Wien's bridge oscillator</p> <p>Expt. 6: Implementation of Phase shift oscillator</p> <p>Expt. 7: Implementation of Hartley oscillator and</p> <p>Expt. 8: Implementation of Colpitts oscillator</p> <p>Expt. 9: Implementation of Non-inverting and inverting amplifier</p> <p>Expt. 10: Design of Integrator using OP-AMP</p> <p>Expt. 11: Design of differentiator using OP-AMP</p> <p>Expt. 12: Design of class A amplifiers</p> <p>Expt. 13: Implementation of Integrator using OP-AMP</p> <p>Expt. 14: Implementation of Differentiator using OP-AMP</p>			
<b>Pedagogy:</b>	Lectures, Experiential Learning, Assignments, Practical			
<b>Texts:</b>	<ol style="list-style-type: none"> <li>1. Bhargava, N. N., Kulshreshtha, D. C. and Gupta, S. C. Basic Electronics and Linear Circuits. Second Edition, Tata McGraw-Hill, 2017.</li> <li>2. Mehta, V. K., and Mehta, R. Principles of Electronics. Seventh Edition, S. Chand &amp; Company, 2014.</li> </ol>			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Floyd, T. L. Electronic Devices. Tenth Edition, Pearson Education, 2021.</li> <li>2. Boylestad, R. L., and Nashelsky, L. Electronic Devices and Circuit Theory. Eleventh Edition, Pearson Education, 2012.</li> <li>3. Eggleston, D. Basic Electronics for Scientists and Engineers. First Edition, Cambridge University Press, 2011.</li> <li>4. Horowitz, P., and Hill, W. The Art of Electronics. Cambridge University Press, 1980.</li> <li>5. Millman, J., and Halkias, C. C. Integrated Electronics: Analog and Digital Circuits and Systems. McGraw-Hill International Student Edition, 1972.</li> </ol>			
<b>Web Resources:</b>	<a href="https://www.youtube.com/watch?v=9g9dowLjmCA">https://www.youtube.com/watch?v=9g9dowLjmCA</a>			

<b>Title of the Course</b>	AI Embedded Product Developer (mapped to QP ELE/Q1407)
<b>Course Code</b>	BEL-123
<b>Number of Credits</b>	12
<b>Theory/Practical</b>	Theory
<b>Level</b>	100
<b>Effective from AY</b>	2026-27

<b>Pre-requisites for the Course:</b>	Nil			
<b>Course Objectives:</b>	<p>This course is intended to:</p> <ol style="list-style-type: none"> <li>1. Develop skills in AI project planning and execution.</li> <li>2. Teach data acquisition and preparation techniques.</li> <li>3. Introduce AI solution development methods.</li> <li>4. Explain AI and data security practices.</li> <li>5. Cover project evaluation and reporting processes.</li> </ol>			
<b>Course Outcomes:</b>	Students will be able to:	<b>Mapped to PSO</b>		
	CO1: Plan and execute AI-based projects effectively.	PSO 2		
	CO2: Acquire and prepare data for analysis.	PSO 2		
	CO3: Develop Artificial Intelligence solutions.	PSO 1 , PSO 2		
	CO4: Implement AI and data security measures.	PSO 2		
	CO5: Evaluate projects and prepare comprehensive reports.	PSO 2 , PSO5		
<b>Content:</b>		<b>No of hours</b>	<b>Mapped to CO</b>	<b>Cognitive Level</b>
<b>Module 1:</b>	The Concept of Artificial Intelligence and historical overview, Applications of Artificial			

<b>Introduction to Artificial Intelligence:</b> (Mapped to QP ELE/Q1407)	Intelligence, Techniques in Artificial Intelligence, Artificial Intelligence: Trends and Markets, Privacy, and Transparency in AI, and Introduction to TensorFlow.	<b>15</b>	CO1	K1
<b>Module 2: Advanced Mathematics and Exploratory Data Analysis for Artificial Intelligence:</b> (Mapped to QP ELE/Q1407)	<b>Math for Data Science:</b> Introduction, Basic Math for Data Science, Understanding Data Science: Vector and Exploratory data analysis(EDA), Understanding Data Science: Matrix, Understanding Deep Learning: Derivatives, Essential python tools. <b>NumPy Arrays:</b> NumPy Array Data Structure for Optimal Computational Performance, Optimal Data Exploration Through Pandas, Pandas Data Preprocessing for Optimal Model Execution, Data Visualisation for Various Data Scales. <b>Probability and Statistics:</b> Understanding of Probability, Understanding of Statistics I, Understanding of Statistics II, Statistical Hypothesis Testing, Regression Analysis and ANOVA	<b>45</b>	CO2, CO4	K1,K2
<b>Module 3: Machine Learning:</b> (Mapped to QP ELE/Q1407)	<b>Supervised Learning:</b> Machine Learning Based Data Analysis, Application of Supervised Learning Model for Numerical Prediction, Application of Supervised Learning Model for Classification, Decision Tree, Naïve Bayes Algorithm, KNN Algorithm, SVM Algorithm, Ensemble Algorithms. <b>Unsupervised Learning:</b> Unsupervised Machine Learning Algorithm, Hierarchical Clustering, Non-Hierarchical Clustering (K-means), Linear Factor Model for Dimensionality Reduction, PCA, LDA	<b>45</b>	CO3	K1,K3
<b>Module 4: NLP, Neural Networks, Deep Learning(Mapped to QP ELE/Q1407)</b>	<b>NLP:</b> Text Mining, Text Preprocessing, Language Model, Natural Language Processing with Keras <b>Neural Network and Deep Learning:</b> Basics of Neural Network (neurons, layers, activation function, backpropagation algorithm), TensorFlow Basics, Deep Learning Methods with TensorFlow and Keras, CNN model, Recurrent Neural Network (RNN) for Sequential Data Modelling, Generative Adversarial Neural Network to Create Non-Existent Images, Autoencoders.AI Application Cases	<b>30</b>	CO3	K3,K4
<b>Practical / Lab: AI</b>	<b>AI Capstone Project:</b> Project Preparation, Design Thinking, Using a Ready-Made CNN	<b>90</b>	CO5	K5,K6

<b>Capstone Project (Mapped to QP ELE/Q1407)</b>	Model			
<b>Pedagogy:</b>	Lectures, Experiential Learning, Assignments, Practical			
<b>Texts:</b>	<ol style="list-style-type: none"> <li>1. Trivedi, M. C. A Classical Approach to Artificial Intelligence. Khanna Publishing House, 2014.</li> <li>2. Chopra, Rajiv. Machine Learning. Khanna Publishing House, 2019.</li> <li>3. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.</li> </ol>			
<b>References/ Readings:</b>	<ol style="list-style-type: none"> <li>1. Model Curriculum for AI Embedded Product Developer (Electronics), 2025 Electronics Sector Skills Council of India.</li> <li>2. Russell, Stuart J., and Peter Norvig. Artificial Intelligence: A Modern Approach. 3rd ed., Pearson Education, 2010.</li> <li>3. Rich, Edith, and Kevin Knight. Artificial Intelligence. 3rd ed., McGraw-Hill Education, 2017.</li> <li>4. Johnson, R. A., I. Miller, and J. E. Freund. Probability and Statistics for Engineers. 2000.</li> <li>5. Starmer, J. The StatQuest Illustrated Guide to Machine Learning. 2022. (Publisher info needed)</li> <li>6. Mitchell, Tom M. Machine Learning. Vol. 1, McGraw-Hill, 1997.</li> <li>7. Allen, James. Natural Language Understanding. Second edition, Benjamin/Cummings, 1995.</li> </ol>			
<b>Web Resources:</b>	<a href="https://pl1.harvard.edu/subject/artificial-intelligence">https://pl1.harvard.edu/subject/artificial-intelligence</a>			

