FOURTH YEAR ELECTRONICS AND COMPUTER ENGINEERING PROGRAM
SYLLABUS, REVISED COURSE (2019-2020)

SEMESTER – VII

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP710
Title of the Course : Industrial Automation and Instrumentation
Number of Credits : 03
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Basic Electronics</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of the principle and working of the Data acquisition systems, CRO and different types of transducers.
2. Introduction to Virtual Instrumentation using LABVIEW.
3. Introduction to the automation systems using the programmable logic controllers.
4. An understanding of the different types of industrial interfacing standards.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table><tr><td>ECOMP 710.1</td><td>Explain the principle and working of the CRO, DSO, Data acquisition systems, different types of industrial communication standards.</td></tr><tr><td>ECOMP 710.2</td><td>Design and simulate virtual instruments for sensors and data acquisition using appropriate software.</td></tr><tr><td>ECOMP 710.3</td><td>Evaluate between different types of transducers for a given application.</td></tr><tr><td>ECOMP 710.4</td><td>Design and simulate various industrial control applications using the programmable logic controllers.</td></tr></table></td></tr>
<tr><td>Content:</td><td>UNIT- 1
Electronic Voltmeter: Non-integrating type: Ramp type, Staircase Ramp, Continuous balance, Successive Approximation. Integrating type: Potentiometer Integrating, Dual Slope Integrating Voltmeter. Sensitivity & Resolution of a DVM.
Oscilloscope: Block diagram, Classification of CROs, CRT control circuits, delay lines, multiple trace CRO, Time base circuits, synchronizing circuits, Digital storage oscilloscope. CRO probes: Active & Passive probes, Compensation for probes.
Virtual Instrumentation: Historical perspective, advantages, block diagram, Virtual instruments examples, the front panel, Sub VIs.
Data Acquisition systems (DAS): Basic block diagram of DAS, objective of DAS, Components of a DAQ system, types of signals,</td><td>11 Hours.</td></tr>
</table>

	signal conditioning of inputs, importance of instrumentation and isolation amplifier, Signal grounding and measurements, DAQ hardware configuration, Digital and Analog I/O considerations.	
	UNIT-2	
	Temperature Measurement Transducers: Resistance Temperature Detectors, Thermistors, Thermocouples. **Displacement Transducers**: Basic displacement measurement scheme, different types of displacement transducers: Strain Gauge, Linear Variable Differential Transformer, Capacitive, Inductive, Piezoelectric, and Potentiometer. **Pressure Transducers**: Inductive, Resistive and Capacitive transducers for measuring pressure. **Velocity Transducers**: Basic principle of measuring velocity, Tachogenerator. **Flow measurement transducers**: Turbo magnetic Flow meter, Electromagnetic Flow meter. **Optical transducers**: Photoresistor, Photodiode, Phototransistor.	**11 Hours**
	UNIT -3	
	Programmable Logic Controllers (PLC): PLC Advantages & Disadvantages, Overall PLC System, CPU & Programmable Monitors, PLC input & Output Modules (Interfaces). **General PLC Programming Procedure**: Proper Construction of PLC Ladder diagrams, Process Scanning considerations. **Basic PLC Programming**: Programming ON-OFF inputs to produce ON-OFF outputs, Concepts of latching, interlocking, jogging outputs via ladder programming. **PLC Timer Functions**: PLC timer functions, Examples of timers and Industrial process timing applications. **PLC Counter functions**: PLC Counters, Examples of Counter Functions, Industrial applications. **PLC data handling instructions**: Move, Conditional Jump, Call Subroutine instructions. Selecting a PLC: Factors to be considered while selecting a PLC.	**11 Hours.**
	UNIT -4	
	SCADA systems: Introduction and brief history of SCADA, Modern SCADA systems, SCADA software, Remote terminal units. Data logger basics, Advantages of data loggers, anatomy of a data logger, types of data loggers, factors to be considered in selecting a datalogger. **Basic standards**: RS-232 and RS-485, Electrical signal characteristics, Modbus: General overview, Modbus protocol structure.	**12 Hours.**

	Fieldbus: Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard.	
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning. One or more assignments to be carried out on topics covered in each unit above- Total time allotted 15 hours.	
References/ Readings:	**Text Books:** 1. H. S. Kalsi; Electronic Instrumentation; 3E. (2012). India: Tata McGraw-Hill. 2. Robert H. Bishop; Learning with LABVIEW 7 Express; Pearson Education. 3. John Webb, Ronal Weiss; Programmable Logic Controllers: Principles & Applications, 5th Edition; Prentice Hall of India. **Reference book** 1. Deon Reynders , Steve Mackay , Edwin Wright; Practical Industrial Data Communications: Best Practice Techniques; Newnes , 2004,An imprint of Elsevier. 2. Clarke, G., Reynders, D., Wright, E.; Practical Modern SCADA Protocols DNP3, 60870.5 and Related Systems, 1st Edition, Newnes, An imprint of Elsevier	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP721
Title of the Course : Blockchain Technology
Number of Credits : 03
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Expertise in programming, basic knowledge of computer security, cryptography.</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. To understand the building blocks of Blockchain.
2. To understand significance Distributed Ledger Technology and Smart Contract.
3. To study the impact of security in Blockchain.
4. To exploit applications of Blockchain in real world scenarios and their impacts.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECOMP 721.1</td><td>Understand Blockchain ecosystem and its services in real world sceneries</td></tr><tr><td>ECOMP 721.2</td><td>Apply and Analyze the requirement of Distributed Ledger Technology and Smart Contract.</td></tr><tr><td>ECOMP 721.3</td><td>Design and Demonstrate end-to-end decentralized applications.</td></tr><tr><td>ECOMP 721.4</td><td>Acquaint the protocol and assess their computational requirements.</td></tr></table></td></tr>
<tr><td>Content:</td><td>UNIT- 1</td></tr>
<tr><td></td><td>Fundamentals of Blockchain:Introduction, Origin of Blockchain,Blockchain Solution, Components of Blockchain,Block in a Blockchain,The technology and the future.
Blockchain Types and Consensus Mechanism:Introduction,Decentralization and Distribution,Types of Blockchain,Consensus Protocol</td><td>11 Hours</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Cryptocurrency – Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics , Types of Cryptocurrency, Cryptocurrency Usage
Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain</td><td>11 Hours</td></tr>
<tr><td></td><td>UNIT -3</td><td></td></tr>
<tr><td></td><td>Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts,Types of Oracles,Smart Contracts in Ethereum.
Private Blockchain System: Introduction, Key Characteristics of</td><td>11 Hours</td></tr>
</table>

	Private Blockchain,Why We Need Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, Smart Contract in Private Environment,State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault,Multichain	
	UNIT -4	
	Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Why We Need Consortium Blockchain, Hyperledger Platform. **Security in Blockchain**: Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication **Limitations and Challenges of Blockchain:** Blockchain Implementation – Limitations, Challenges.	**12 Hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Text Books:** 1. Chandramouli Subramanian, Asha A George , Abhilash K A , Meena Karthikeyan, Blockchain Technology, Universities Press (India) Pvt. Ltd., 1st Edition Publication,2020H. S. Kalsi; Electronic Instrumentation; Tata McGraw Hill. **Reference book** 1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st Edition, CA: Apress, Berkeley. 2. Wattenhofer, R. P, Distributed Ledger Technology: The Science of the Blockchain (Inverted Forest Publishing), 2017, 2nd Edition, Createspace Independent Pub, Scotts Valley, California, US.Newnes , An imprint of Elsevier.	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP722
Title of the Course : Machine Learning
Number of Credits : 03
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Engineering Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. The basic understanding of machine learning, covering concepts like association learning, classification, regression, and reinforcement learning.
2. Proficiency in supervised learning techniques such as classification and regression techniques
3. Familiarization of clustering techniques
4. Exploration of advanced concepts such as outlier detection, dimensionality reduction and model selection and evaluation.</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to:</td></tr>
<tr><td>ECOMP 722.1</td><td colspan="2">Explain fundamental machine learning concepts and select appropriate machine learning algorithms; perform classification tasks by implementing basic and advanced classification methods.</td></tr>
<tr><td>ECOMP 722.2</td><td colspan="2">Evaluate the classifier performance using appropriate metrics, and employing techniques to enhance classification accuracy</td></tr>
<tr><td>ECOMP 722.3</td><td colspan="2">Apply cluster analysis techniques to identify meaningful patterns in data, selecting suitable algorithms for different types of data.</td></tr>
<tr><td>ECOMP 722.4</td><td colspan="2">Apply dimensionality reduction techniques to simplify complex datasets and outlier detection methods to identify anomalous data points, thus improving the quality and efficiency of machine learning models.</td></tr>
<tr><td rowspan="2">Content:</td><td colspan="3">UNIT- I</td></tr>
<tr><td colspan="2">Introduction: What Is Machine Learning? Examples of ML Applications, ML Basics: Learning Algorithm, Capacity, Overfitting, Under fitting, Hyper parameters and validation sets, Bias-Variance Trade-off
Getting to Know Data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Similarity and Dissimilarity Measures, Data Cleaning: Missing Values & Noisy Data, Data Integration: Redundancy and Correlation Analysis, Data Transformation by Normalization
Basic Classification Methods: Decision Tree Induction (ID3), Naïve Bayesian Classification, Rule-Based Classification (IF-THEN rules, rules extraction from decision tree)</td><td>12 Hours</td></tr>
</table>

	UNIT-2	
	Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross-Validation, Bootstrap, ROC Curves, Techniques to Improve Classification Accuracy, Random Forests **Advanced Classification Methods:** Support Vector Machines, Classification Using Frequent Patterns, Lazy Learners: K- Nearest Neighbour	**11 Hours**
	UNIT-3	
	Cluster Analysis: Requirements, Partitioning Methods: k-means & k-medoids, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, BIRCH, Density-Based Methods: DBSCAN, Probabilistic Model-Based Clusters, Fuzzy Clusters, Expectation-Maximization Algorithm	**11 Hours**
	UNIT-4	
	Regression: Linear (simple & multiple), Logistic Regression **Outlier Analysis:** Types of Outliers, Challenges of Outlier Detection, Outlier Detection Methods, Parametric Methods **Dimensionality Reduction:** Introduction, Subset Selection, Principal Components Analysis, Linear Discriminant Analysis	**11 Hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Text Books:** 1. Jiawei Han and Micheline Kambers and JianPei, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufman Publications, 2012. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, 4th Edition 2020. 3. Ian Goodfellow, Yoshua Bengio and Aaron Courville "Deep Learning "MIT Press book, 2016. **Reference book** 1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012. 2. Daniel T. Larose, "Data mining and predictive analytics" , WILEY, Second Edition, 2015	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP723
Title of the Course : Hardware Description Languages
Number of Credits : 03
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Digital System Design</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding of the syntax and semantics of Verilog HDL.
2. An ability to write Verilog programs for combinational circuits.
3. An ability to write Verilog programs for sequential circuits.
4. Knowledge about syntax and semantics of System Verilog.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP723.1</td><td>Explain the syntax and semantics of Verilog HDL.</td></tr><tr><td>ECOMP723.2</td><td>Write programs to design combinational circuits using Verilog HDL.</td></tr><tr><td>ECOMP723.3</td><td>Write programs to design Sequential circuits using Verilog HDL.</td></tr><tr><td>ECOMP723.4</td><td>Explain the syntax and semantics of System Verilog.</td></tr></table></td></tr>
<tr><td rowspan="6">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Emergence of HDLs, Design Flow using HDLs, Importance of HDLs. Hierarchical Modeling Concepts: Modules, Instances.
Data Types: Nets, Registers, Vectors, Integer, Real, and Time, Arrays, Memories, Parameters, Strings.
Modules and Ports.
Gate Level Modeling: Design of Ripple Carry Adder, Multiplexer, Demultiplexer, Decoder, Encoder. Test benches to verify the Functionality.</td><td>11 Hours</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Dataflow Modeling: Continuous assignment (assign) statements,
Delays: Regular assignment delay, implicit assignment delay, and net declaration delay.
Define expressions, operators, and operands.
Operator types: for all possible operations - arithmetic, logical, relational, equality, bitwise, reduction, shift, concatenation, Replication and conditional.
Examples: 4:1 Multiplexer, Demultiplexer, Decoder, Encoder, Full Adder, Test benches to verify the Functionality.</td><td>11 Hours</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
<tr><td>Behavioral Modeling:
Structured procedures: always and initial. Blocking and non-blocking procedural assignments. Conditional statements using</td><td>11 Hours</td></tr>
</table>

	if and else. Multiway branching using case, casex, and casez statements, looping statements using while, for, repeat, and forever. Definition of sequential and parallel blocks. Generate Blocks (Loop, Conditional, Case) **Examples:** 4:1 Multiplexer, Flip Flops, shift registers, counters, ALU. Test benches to verify the Functionality.	
	UNIT -4	
	Tasks and functions: Differences between Tasks and Functions in Verilog, Task and Function declaration and invocation. Examples. **Finite State Machine:** Examples of design using Verilog HDL. **Switch Level Modeling:** Switch Level Elements- MOS, CMOS, Bidirectional and Resistive Switches, Power and Ground. Examples- CMOS Inverter, NAND, NOR, 2:1 Multiplexer. **System Verilog:** Introduction to System Verilog, Difference Between System Verilog and Verilog. **Basic Constructs of System Verilog:** Data types, Operators, Arrays, Queues, Associative Arrays, Common array manipulation methods, printing arrays.	**12 Hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Text Books:** 1. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson, Second Edition. 2. J. Bhasker, "Verilog HDL Synthesis - A Practical Primer", Star Galaxy Publishing, Allentown, PA) 1998. **Reference book** 1. "IEEE std 1364-95, Verilog Language Reference Manual", IEEE Press (NY, USA), 1995. 2. Stuart Sutherland and others, “System Verilog for Design” Springer, Second Edition	

Name of the Programme : **Electronics and Computer Engineering**
Course Code : **ECOMP724**
Title of the Course : **Wireless Sensor Networks**
Number of Credits : **03**
Effective from AY : **2024-25**

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">1. An introduction to wireless sensor network architecture, Software and applications.
2. An understanding of protocol stack used in wireless sensor networks.
3. An understanding of MAC protocols and routing algorithms.
4. An understanding of different strategies used in power management, time synchronization protocols, localization techniques and security challenges.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 724.1</td><td>Describe the hardware – software aspects and applications of wireless sensor networks</td></tr>
<tr><td>ECOMP 724.2</td><td>Analyze and evaluate the performance of different categories of MAC protocols</td></tr>
<tr><td>ECOMP 724.3</td><td>Analyze and evaluate the performance of different WSN routing strategies.</td></tr>
<tr><td>ECOMP 724.4</td><td>Analyze various time synchronization protocols in WSN.</td></tr>
<tr><td>ECOMP 724.5</td><td>Evaluate various power management strategies, localization techniques in WSN.</td></tr>
</table></td></tr>
<tr><td rowspan="5">Content</td><td>UNIT-1</td><td></td></tr>
<tr><td>Introduction and Overview of Wireless Sensor Networks (WSN):
Basic terminology – Sensing & Sensors, WSN, Challenges and Constraints, Protocol Stack for Wireless Sensor Networks.
Applications of WSN with prototypes: Structural Health Monitoring - sensing seismic events, Traffic Control, Health Care, Pipeline Monitoring, Precision Agriculture.
Node Architecture: Sensing subsystem, processor subsystem, communication interfaces, Prototype – IMote Node Architecture.</td><td>10 hours</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Medium access control: Overview, Wireless MAC protocols, Characteristics of MAC protocols in sensor networks.
Contention-free MAC protocols: Characteristics, traffic-adaptive medium access, Y-MAC, Low-Energy Adaptive Clustering Hierarchy.
Contention-based MAC protocols: Power aware multi-access with signalling, Sensor MAC, Timeout MAC, Pattern MAC,</td><td>10 hours</td></tr>
</table>

	Routine enhanced MAC, Data Gathering MAC.	
	UNIT-3	
	Network Layer: Introduction, Routing Metrics, Flooding and Gossiping, data Centric Routing Algorithms, Proactive Routing Algorithms, On-demand Routing Algorithms, Hierarchical Routing, Location based Routing Algorithms and QoS based Routing. **Time synchronization:** The synchronization problem, Reasons and challenges in time synchronization, Basics of time synchronization, Time Synchronization Protocols: Reference Broadcasts using Global Sources, Lightweight Tree Based Synchronization, Timing Sync Protocol, Flooding Time Synchronization Protocol; Reference Broadcast Synchronization, Time Diffusion Synchronization Protocol.	**13 hours**
	UNIT-4	
	Power Management: Local Power Management Aspects, Dynamic Power Management. **Localization:** Introduction, ranging techniques: ToA, TDoA, AoA, RSSI. Range based localization, GPS-Based Localization, Range-free localization, Event driven localization. **Security in WSN:** Fundamentals, Challenges of security, Security attacks in sensor networks, protocols and mechanisms for security.	**12 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. Fundamentals of Wireless Sensor Networks: Theory and Practice; by Waltenegus W. Dargie; Christian Poellabauer; John Wiley & Sons Ltd., 2010. **References:** 1. Wireless Sensor Networks: Technology, Protocols and Applications, by Taieb Znati Kazem Sohraby, Daniel Minoli, John Wiley & Sons Ltd., 2007. 2. Wireless Sensor Networks: An Information Processing Approach by Feng Zhao, Leonidas J. Guibas, Morgan Kaufmann Publishers, 2005. 3. Wireless Sensor Networks: A Networking Perspective, Jun Zheng, Abbas Jamalipour, Wiley, 2009. 4. Introduction to Wireless Sensor Networks, Anna Förster, Wiley-IEEE Press; John Wiley & Sons, 2016	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP725
Title of the Course : Advanced Database Systems
Number of Credits : 03
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>DBMS</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Distributed database concepts, architectures, and design principles for efficient data management in distributed environments.
2. Query processing and optimization, transaction processing, concurrency control, and DBMS reliability in distributed environments.
3. Spatial data management, emphasizing spatial data types, indexing techniques, and their applications in database systems.
4. Knowledge about the specialized database systems , XML-based information retrieval, and other databases, focusing on theory and practical applications.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECOMP725.1</td><td>Design and implement distributed database systems.</td></tr><tr><td>ECOMP725.2</td><td>Explain the emerging Database Models, Technologies and Applications</td></tr><tr><td>ECOMP725.3</td><td>Know how to design a Database and XML.</td></tr><tr><td>ECOMP725.4</td><td>Apply acquired knowledge for developing holistic solutions based on database systems/database techniques.</td></tr></table></td></tr>
<tr><td>Content:</td><td>UNIT- 1</td></tr>
<tr><td></td><td>Distributed Database Concepts:Distributed Data processing, Distributed Database System, Promises of distributed database systems(DDBMS),Complicating factors,Problem Areas.
Distributed DBMS Architecture:DBMS Standardisation,Architectural models for distributed database systems,Distributed DBMS architecture.
Distributed database design: Alternative Design Strategies, Distributed Database design issues, fragmentation,allocation. 12 Hours</td></tr>
<tr><td></td><td>UNIT-2</td></tr>
<tr><td></td><td>Overview Of Query processing: Query processing problem, Objectives of Query processing, characterization of query processors, layers of query processing.
Optimization of Distributed Queries:Query Optimization
Introduction to Transaction Processing: Definition of a transaction,properties of a transaction,types of transaction 11 Hours
Distributed Concurrency Control: serializability theory, taxonomy of concurrency control mechanisms, locking based concurrency control mechanisms,Dead lock management.
Distributed DBMS Reliability:Reliability concept and</td></tr>
</table>

	measures,failures and fault tolerance in distributed systems, failures in distributed DBMS, Local reliability protocols and distributed reliability protocols.	
	UNIT -3	
	Parallel Database systems:Database Servers,Parallel Architectures,Parallel DBMS techniques,Parallel Execution Problems. **Spatial Data management**: Types of Spatial Data and Queries, Introduction to spatial indexes,Indexing based on space filling curves. Grid files,R-trees **Object Database Systems**:Motivating example,Structured Data types,Operations on structured data types,Encapsulation and ADTs,objects,aIDs and reference types,OODBMS	**11 Hours**
	UNIT -4	
	Deductive Databases: Introduction to Recursive queries,Theoretical Foundations,Recursive queries with negation,from Datalog to SQL, Evaluating Recursive Queries **Information Retrieval and XML data:**Introduction to Information retrieval and , Indexing for text search, web search engine, managing text in a DBMS, a data model for XML, Querying XML data, and efficient evaluation of XML queries. **Other Database Systems**: Multimedia databases,Mobile Databases,Geographical Information Systems,Temporal Databases	**11 Hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Text Books:** 1. Principles of Distributed Database Systems; 2nd Editied By M. Tamer Ozsu and Patrick Valduriez, Person Education Asia. 2. Database Management Systems, 3rd edition, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill **Reference book** 1. Distributed Database; Principles & Systems By Publications, Stefano Ceri and Giuseppo Pelagatti,, McGraw-Hill International Editions 2. Fundamentals of Database Systems, 6thEdition, Elmasri and Navathe, Addison. Wesley (2003). 3. Database System Concepts, 5th edition, Avi Silberschatz , Henry F. Korth , S. Sudarshan: McGraw-Hill (2010)	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP730
Title of the Course : Industrial Automation and Instrumentation Lab
Number of Credits : 01
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Basic Electronics</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of the working of the CRO trainer.
2. An ability to determine the characteristics of the different types of the transducers.
3. An ability to construct the virtual instruments using the LABVIEW.
4. An ability to develop PLC Ladder diagrams for industrial control mechanisms.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP730.1</td><td>Demonstrate the working of the CRO trainer.</td></tr>
<tr><td>ECOMP730.2</td><td>Determine the characteristics of the different types of the transducers.</td></tr>
<tr><td>ECOMP730.3</td><td>Construct the virtual instruments using the LABVIEW.</td></tr>
<tr><td>ECOMP730.4</td><td>Develop PLC Ladder diagrams for industrial control mechanisms.</td></tr>
</table></td></tr>
<tr><td rowspan="2">Content:</td><td>Following experiments should be conducted.</td></tr>
<tr><td>1. Fault simulation using CRO trainer
2. Virtual Instruments , Sub VIS
3. Loops and Structures using LABVIEW
4. Arrays and Clusters using LABVIEW
5. Implementations Using Transducers
6. Data Acquisition using LABVIEW
7. Ladder program to implement latching, interlocking, jogging
8. Ladder program to implement timing & counting applications.
9. Implement any of the above ladder programs using the SCADA software.</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning ,Constructive planning of experiments ,Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>1. H. S. Kalsi; Electronic Instrumentation; Third edition,Tata McGraw Hill.
2. Robert H. Bishop; Learning with LABVIEW 7 Express; Pearson Education, 2003.
3. John Webb, Ronal Weiss; Programmable Logic Controllers: Principles & Applications, 5th Edition; Prentice Hall of India</td></tr>
</table>

SEMESTER – VIII

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP810
Title of the Course : Cryptography and Network Security
Number of Credits : 3
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Applied Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">1. An understanding of the fundamentals of cryptography.
2. Knowledge about the various encryption techniques.
3. An understanding of the concept of public key cryptosystems.
4. Ability to learn about message authentication and hash functions.
5. Ability to impart knowledge on network security.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 810.1</td><td>Describe the fundamentals of a secure network and analyse various encryption techniques in modern cryptography.</td></tr><tr><td>ECOMP 810.2</td><td>Illustrate various Public Key cryptographic techniques.</td></tr><tr><td>ECOMP 810.3</td><td>Discuss various message authentication code, cryptographic hash function and digital signatures.</td></tr><tr><td>ECOMP 810.4</td><td>Explain and Identify security aspects of various layers.</td></tr></table></td></tr>
<tr><td rowspan="6">Content</td><td>UNIT-1</td><td></td></tr>
<tr><td>Introduction: Introduction to Cryptography , Security Threats, Vulnerability, Active and passive attacks, security service and Mechanisms, Conventional Encryption Model, CIA model.
Basics of Cryptography: Plain Text and Cipher Text, Symmetric cipher Model, Cryptography, Cryptanalysis, Brute force Attacks.</td><td>10 hours</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Encryption Substitution Techniques: Caesar Cipher, Mono-alphabetic cipher, Poly-Alphabetic Cipher, Playfair Cipher,Hill Cipher,One time pad and Vigenere Cipher.
Transposition Techniques: Rail fence techniques, Rotor Machine and Steganography.
Block ciphers and Data Encryption Standards: Stream cipher, Block ciphers, Fiestal Cipher, Simplified Data Encryption standard and Data encryption standard</td><td>10 hours</td></tr>
<tr><td>UNIT-3</td><td></td></tr>
<tr><td>Public key cryptography and RSA: Principles of public key cryptosystems–Public key Cryptosystems–application for public key cryptosystem, RSA algorithm, Deffie Helman key exchange algorithm.
Cryptographic Hash Functions–Applications of cryptographic Hash</td><td>13 hours</td></tr>
</table>

	functions, 2 simple Hash functions, requirement and Security. **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions. **Digital Signature:** Digital Signature, Properties and Digital signature Requirements, Digital Signature Standard.	
	UNIT-4	
	Firewalls: Definition, Firewall Characteristics, Types of Firewalls. **509 Authentication Services:** X.509 Definition, X.509 Certificate. **Authentication Applications:** Kerberos version 5. **Electronic Mail Security:** PGP (Transmission, Reception, General format of PGP), S/ MIME functions.	**12 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. William Stallings, Cryptography and Network Security, 4th edition, Prentice Hall of India, 2008. 2. Cryptography and Network Security, Behrouz A. Forouzan, Debdeep Mukhopadyay, McGraw Hill Education, 2nd Edition, 2010. **References:** 1. Cryptography and Network Security, Atul Kahate, McGraw Hill Education, 3rd Edition, 2011. 2. C. Kaufman, R. Perlman, and M. Speciner, Network Security: Private Communication in a Public World, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2002. 3. William Stallings, "Network Security Essentials Applications and Standards", 2nd ed., Pearson Education, 2003.	

Name of the Programme : **Electronics and Computer Engineering**
Course Code : **ECOMP821**
Title of the Course : **Compiler Design**
Number of Credits : **3**
Effective from AY : **2024-25**

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Discrete Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">1. To understand the basic principles of compiler design, its various constituent parts, algorithms and structures required to be used in the compiler.
2. To understand the need to follow the syntax in writing an application program and to learn how the analysis phase of compiler is designed to understand the programmer ‘s requirements without ambiguity
3. To understand the relationship between machine and assembly language, compilers, interpreters, linkers, loaders, assemblers.
4. To study construction of symbol tables, code generation, optimization techniques.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to:
<table>
<tr><td>ECOMP 821.1</td><td>Understand fundamentals of compiler design and identify the relationships among different phases of the compiler.</td></tr>
<tr><td>ECOMP 821.2</td><td>Illustrate the role of parser in compiler design.</td></tr>
<tr><td>ECOMP 821.3</td><td>Understand tools to automate compiler construction such as LEX and YACC</td></tr>
<tr><td>ECOMP 821.4</td><td>Apply the concepts to design, implement, and test a compiler for a simple language.</td></tr>
</table></td></tr>
<tr><td>Content</td><td>UNIT-1</td><td></td></tr>
<tr><td></td><td>Language processor concepts. Structure of a compiler.
The Evolution of Programming Languages: The move to higher level languages, Impacts on Compilers.
A Simple Syntax-Directed Translator: Syntax Definition, Syntax-Directed Translation, Parsing, Lexical Analysis, Symbol Tables, Intermediate Code Generation.
Lexical Analysis: The Role of the Lexical Analyzer, Specification of Tokens, Recognition of Tokens, Finite Automata.
A Language for specifying lexical analyzer. Study of the features and applications of LEX/FLEX tool.</td><td>10 hours</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
</table>

	Syntax Analysis: Overview of Context free grammars, Defining Context Free Grammar for If, Nested IF, For, While, Switch, Nested For, Nested While. Derivations and Parse trees, Ambiguity, Elimination of Left recursion, Left factoring. **Top down parsing:** Recursive descent parsing and Predictive parsers. **Bottom up parsing:** Shift-reduce parsers. Operator precedence parsers, LR parsers. **Study of YACC Tool:** Programming with YACC. Combining YACC and FLEX.	**10 hours**
	UNIT-3	
	Intermediate Code Generation: Intermediate Language, Declarations, Assignment statements, Boolean expressions, Case statement, Backpatching, Procedure call. **Run Time environments:** Source language issues, Storage organization, Storage allocation. **Error detection and recovery:** Lexical phase errors, Syntactic phase errors, Semantic errors.	**13 hours**
	UNIT-4	
	Symbol tables: The content of a symbol table, Data structures for Symbol Table **Code generation:** Issues in the design of a code Generator, Basic blocks and flow graphs, Next-use information, A simple Code generator, The DAG representation of Basic blocks, Peephole Optimization, Generating code from DAGS. **Code optimization**: The principle sources of optimization, Optimization of basic blocks, Machine dependent optimization, Register allocation optimization.	**12 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. Aho and Ulman ; Principles of Compiler Design; Publisher: Narosa publishing House, ISBN: 81- 85015-61-9, Second Edition, 2002. 2. Aho, Ulman and Sethi; Compilers, Principles, techniques and tools; Publisher:Pearson Education Inc, 1986,2006 ISBN: 0-201-10088-6. 3. Vinu V. Das ; Compiler design with FLEX and YACC; PHI publication, ISBN:978-81-203-3251-5. **References:** 1. Louden; Compiler Construction, Principles and Practice; Galgotia Publication, ISBN:0-534-93972-4. 2. Systems Programming; D M Dhamdere, 2011 Tata McGraw Hill Education Private Limited.	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP822
Title of the Course : Digital VLSI
Number of Credits : 3
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">MOS transistor working</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. The capability to draw CMOS logic Structures.
2. An understanding of clocking strategies in sequential CMOS circuits.
3. Knowledge of test circuits required in the VLSI domain.
4. An understanding of semiconductor memory circuits.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP822.1</td><td>Draw the CMOS Logic Structures.</td></tr><tr><td>ECOMP822.2</td><td>Analyze clocking strategies in sequential CMOS circuits.</td></tr><tr><td>ECOMP822.3</td><td>Understand the test circuits required in the VLSI domain.</td></tr><tr><td>ECOMP822.4</td><td>Understand the working of semiconductor memory circuits.</td></tr></table></td></tr>
<tr><td rowspan="8">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>CMOS Logic circuits. BiCMOS Logic Circuits: Introduction, Basic BiCMOS Circuits: Static Behavior, Switching Delay in BiCMOS Logic Circuits, BiCMOS Applications.
Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS logic (C^2MOS), CMOS Domino logic.</td><td>12 Hours.</td></tr>
<tr><td colspan="2">UNIT-2</td></tr>
<tr><td>Clocking Strategies: Clocked Systems, Latches and Registers, Single Phase clocking, Two phase clocking, two phase memory structures, Clock distribution.
Clock and I/O circuits: : Introduction, ESD Protection, Input Circuits, Output Circuits and L(di/dt) Noise, On-Chip Clock Generation and Distribution, Latch-Up and Its Prevention.</td><td>11 Hours.</td></tr>
<tr><td colspan="2">UNIT -3</td></tr>
<tr><td>Design for Manufacturability: Introduction, Process Variations, Basic Concepts and Definitions, Design of Experiments and Performance Modeling
Design for testability : Introduction, Fault testing, observability, controllability, automatic test pattern generation (ATPG). Built in Self-test, Boundary scan.</td><td>11 Hours.</td></tr>
<tr><td colspan="2">UNIT -4</td></tr>
<tr><td>Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory, Ferroelectric Random Access Memory (FRAM)</td><td>11 Hours.</td></tr>
<tr><td>Pedagogy:</td><td colspan="2">Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning</td></tr>
</table>

References/ Readings:	**Text Books:** 1. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Analysis and Design, McGraw Hill, Fourth Edition. 2. Neil H. E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design, A System Perspective, Pearson Education Asia, Second Edition. **Reference book** 1. Digital Integrated Circuits, A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Pearson, Second Edition.

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP823
Title of the Course : Biomedical Electronics & Instrumentation
Number of Credits : 3
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Basics of Electronics</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">1. An introduction to human physiological system which is very important with respect to electronic design considerations.
2. The knowledge of the principles of operation and design of biomedical electronics & instruments.
3. An understanding of medical diagnosis and therapy techniques.
4. An ability to solve electronic engineering problems related to medical field.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 823.1</td><td>Describe the generation of bio-potentials and understand the basic bio-signals and their characteristics</td></tr>
<tr><td>ECOMP 823.2</td><td>Discuss electrodes and different bio-potential electrodes, biochemical transducers used to acquire bio-signals</td></tr>
<tr><td>ECOMP 823.3</td><td>Outline safety while designing and using biomedical equipment & also discuss about telemedicine technology</td></tr>
<tr><td>ECOMP 823.4</td><td>Explain different measuring and monitoring systems such as ECG, EEG, EMG, blood pressure monitoring and artificial life support systems</td></tr>
<tr><td>ECOMP 823.5</td><td>Understand different medical assistive techniques therapeutic equipment, clinical laboratory equipment/techniques</td></tr>
<tr><td>ECOMP 823.6</td><td>Discuss different medical imaging systems for visualization and analysis of medical images</td></tr>
</table></td></tr>
<tr><td>Content</td><td>UNIT-1</td><td></td></tr>
<tr><td></td><td>Cell and its structure: Resting and Action Potential, Bioelectric Potentials: ECG, EEG EMG, Cardiovascular system.
Electrodes: basic electrode theory, Nernst equation, biopotential electrodes, biochemical transducers.
Patient safety: Basic Elements of Intensive Care Unit, Electric shock hazards, leakage currents; testing instruments for checking safety parameters of biomedical electronic equipment.</td><td>11 hours</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Measuring and monitoring systems: EEG, ECG, EMG with block diagrams, Artifacts in bio-potential recordings.
Pacemakers: Pacing modes, lead wires and electrodes, synchronous pacemaker; rate responsive pacing.
Defibrillator: AC and DC,
Clinical laboratory Measurements: Blood cell Counter: Types Of</td><td>12 hrs</td></tr>
</table>

	Blood Cells, Method of Cell counting: Coulter Counter, Blood flow meters: Ultrasonic Doppler blood flow meter: Doppler –Shift Flow velocity Meter. **Blood pressure monitoring**: direct method, indirect method: Principle of blood pressure measurement based on Korotkoff sounds, Oscillometric Measurement Method	
	UNIT-3	
	Spirometry; Audiometers, Block diagram of heart-lung machine, Endoscopy Surgical diathermy; physiotherapy equipment: microwave diathermy; laser therapy, ultrasonic therapy unit, cryotherapy. **Telemedicine Technology**: Essential Parameters for telemedicine, Overview of Telemedicine system, Clinical Data Interchange/ Exchange Standards: DICOM	**10 hours**
	UNIT-4	
	X-Rays: X ray diagnostic methods, Production of X-ray, Use of X-ray imaging. **Computed Tomography:** Basic principles, system components, Medical applications and safety precautions. **Ultrasound:** Functional block diagram of basic pulse echo system for diagnostic purposes, A-SCAN, M-SCAN, B-SCAN, Application of ultrasound imaging. **Radio Nuclide Imaging:** Principles, radiation detectors, schematic functional diagram and components of gamma camera, Medical applications, safety precautions. **Magnetic Resonance Imaging:** Basic principles, Schematic functional diagram of MRI scanner with its sub systems. Medical applications, safety precautions.	**12 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. R. S. Khandpur; Handbook of Biomedical Instrumentation; McGraw Hill Education 2. Leslie Cromwell; Biomedical Instrumentation and Measurements; Prentice Hall India 3. J. G. Webster; Medical Instrumentation – Application & Design; John Wiley & Sons **References:** 1. W. Blesser; Systems approach to biomedicine; McGraw Hill. 2. S. K. Guha; Introduction to medical electronics; Bharati Bhavan. 3. C. A. Caceress; Biomedical telemetry; Academic press. 4. L. Geddes and L. Baker; Principles of applied biomedical instrumentation; Wiley-Blackwell. 5. Laurence J. Street; A Guide to Patient Care Technology: A Review of Medical Equipment; Taylor & Francis.	

GOA UNIVERSITY
गोवा विश्वविद्यालय
Knowledge is Divine

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP824
Title of the Course : Internet of Things
Number of Credits : 3
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">1. To understand the basic components of an IoT system.
2. To understand the technologies and current standards relating to each of the IOT layers.
3. To understand the importance of interoperability in IoT, and the concepts of Cloud computing and Fog computing via examples.
4. To appreciate and understand the appropriate use of various IoT technologies through real-life case studies and examples.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 824.1</td><td>Explain the basic components of an IOT system.</td></tr><tr><td>ECOMP 824.2</td><td>Demonstrate familiarity with communication protocols, technology and standards relating to each layer in IoT systems.</td></tr><tr><td>ECOMP 824.3</td><td>Explain the concepts of Cloud Computing and Fog Computing and their relevance to IoT.</td></tr><tr><td>ECOMP 824.4</td><td>Demonstrate an understanding of tools and IoT technologies that would be suited for building and deploying IoT-based solutions in various application domains through examples and case studies.</td></tr></table></td></tr>
<tr><td rowspan="4">Content</td><td>UNIT-1</td><td></td></tr>
<tr><td>Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex. Interdependence of Technologies, IoT Networking Components.
IoT Sensing and Actuation: Sensors, Sensing Types, Actuators, Actuator Types, Actuator Characteristics.
IoT Levels and deployment templates: IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.</td><td>11 hours</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>IOT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, Processing Offloading.
IOT Architecture Connectivity Technologies: Layered Architecture for IoT, Introduction to connectivity technologies and standards, IEEE 802.15.4, Zigbee, RFID, NFC, LORA, 6LoWPAN, Wi-Fi, Bluetooth.
IoT Communication Technologies: Introduction to communication technologies, Infrastructure Protocols and Discovery Protocols, Introduction to Data Protocols - RPL, MQTT,</td><td>11 hours</td></tr>
</table>

	CoAP, REST and Web Sockets.	
	UNIT-3	
	IOT Interoperability: Introduction, Standards, Frameworks. **Cloud Computing:** Introduction, Virtualisation, Cloud Models, Cloud Implementation, Sensor-cloud: Sensors-as-a-service. **Fog Computing and its application**: Introduction, Role of Cloud and Fog in IoT, View of a fog computing architecture, Fog Computing in IOT, Selected applications of FOG Computing.	**11 hours**
	UNIT-4	
	IOT Case studies and future trends: **Agricultural IoT**- Components of an agricultural IoT, Advantages of IoT in agriculture, Case Studies - In-situ assessment of leaf area index using IoT-based agricultural system Smart irrigation management system. **Vehicular IoT**- Introduction, Components of vehicular IoT, Advantages of vehicular IoT, Crime assistance in a smart IoT transportation system. **Healthcare IoT**- Introduction, Components of healthcare IoT, Advantages and risks of healthcare IoT. **Case Studies**- AmbuSens system. Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT.	**12 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, 2020 2. Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-On Approach, VPT edition1, 2014 3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017. **References:** 1. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O’Reilly Publisher, 2015. 2. RMD Sundaram, Shriram K. Vasudevan, Abhishek S. Nagarajan, Internet of Things, John Wiley and Sons, 2019 3. Cuno Pfister, Getting Started with the Internet of Things, Shroff Publisher, 2011 4. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications, 1st Edition, 2014. 5. Massimo Banzi, Michael Shiloh, Getting Started with the Arduino, Maker Media Publishers/ O’Reilly, 3rd edition, 2015.	

Name of the Programme : Electronics and Computer Engineering
Course Code : ECOMP825
Title of the Course : Data Analytics
Number of Credits : 3
Effective from AY : 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basics of programming</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">1. To understand the data science fundamentals and process.
2. To learn to manage data.
3. To learn to describe the relationship between data using statistical methods.
4. To present and interpret data R programming.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 825.1</td><td>Describe the significance of data science and understand the Data Science process.</td></tr><tr><td>ECOMP 825.2</td><td>Explain how data is collected, managed, and stored for data science.</td></tr><tr><td>ECOMP 825.3</td><td>Build, and prepare data for use with a variety of statistical methods and models.</td></tr><tr><td>ECOMP 825.4</td><td>Perform data analytic & visualization using R programming.</td></tr></table></td></tr>
<tr><td rowspan="8">Content</td><td>UNIT-1</td><td></td></tr>
<tr><td>Introduction To Data Science: Definition, Big Data and Data Science Hype, Datafication , Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process , A Data Scientist’s Role in this Process
Case Study: RealDirect.</td><td>12 hours</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Data Munging: Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing.
Mathematical Preliminaries: Probability, Descriptive Statistics, Correlation Analysis.
Scores and Rankings: Developing Scoring Systems, Z-scores and Normalization, Advanced Ranking Techniques</td><td>11 hours</td></tr>
<tr><td>UNIT-3</td><td></td></tr>
<tr><td>Statistical Analysis: Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values.
Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations.</td><td>11 hours</td></tr>
<tr><td>UNIT-4</td><td></td></tr>
</table>

	Introduction to R: GUI of R, R nuts and Bolts, Getting data into & out of R, Data types in R, Basic operations, Basic statistics, Generic functions, Data visualization using R, Data exploration & presentation, Statistics for model building & evaluation. Case study using R: Call Data Record analytics, Medical Data Analysis	**11 hours**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. Steven S. Skiena, "The Data Science Design Manual", Springer 2017 Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-On Approach, VPT edition1, 2014. 2. Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013. 3. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Press (WILEY), 2012 **References:** 1. Joel Grus," Data Science from Scratch" First Edition, April 2015. 2. Gareth James, Daniela Witten, Trevor Hatie, Roberst Tibhirani , "An Introduction to Statistical Learning-with Applications in R", 2013. 3. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2nd edition. 4. R Programming for Data Science, Roger D. Peng, LeanPub, 2015.	