Walchand Institute of Technology, Solapur
(An Autonomous Institute)

Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Choice Based Credit System (CBCS)

Structure and Syllabus
for
T. Y. B.Tech. Electronics & Computer Engineering
W.E.F. 2025-26

Dr. Mrs. M. A. Nirgude
Dean Academics

HEAD
Electronics Department
Walchand Institute of Technology
SOLAPUR-413006.

WALCHAND INSTITUTE OF TECHNOLOGY W I T SOLAPUR (AUTONOMOUS)

Department of Electronics Engineering

Vision

- To be a distinguished centre for nurturing the holistic development of competent young engineers in the Electronics and Information Technology fields.

Mission

- **M1:** To inculcate and stimulate Electronics & Computer proficiency amongst students through quality education and innovative educational practices.
- **M2**: To create engineering professionals with social consciousness
- **M3:**To foster technical skills of students through creativity and critical thinking
- **M4**: To enhance soft skills set of students which is crucial for career success through effectual training

Electronics and Computer Engineering

Program Educational Objectives (PEOs)

- Graduates will have a successful professional career in Electronics & Information Technology fields.
- Graduates will Leverage his fundamental knowledge to pursue higher education and will continue his professional development in Electronics & Information Technology fields.
- Graduates will Exhibit professional ethics, team spirit and effective communication skills to be successful leader and manager with a holistic approach.
- Graduates will be sensitive to ethical, societal & environmental issues while conducting his professional work.

Knowledge and Attitude Profile (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)	
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis: Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Engineering Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and The Society(World):** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities, relevant to the professional engineering practice.
PO 7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning difference
PO 10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO 11	**Life-long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

1. **Algorithms** : Graduate will able to develop, realize and validate algorithms for different electronic systems and programming applications
2. **Systems:** Graduate will able to develop, implement and test different electronic systems and computer applications
3. **Self Learning**: Graduate with his sound fundamentals is prepared to comprehend applications of the Electronics and Computer engineering through self learning mode

Electronics and Computer Engineering

Legends Used	
L	Lecture Hours / week
T	Tutorial Hours / week
P	Practical Hours / week
FA	Formative Assessment
SA	Summative Assessment
ESE	End Semester Examination
ISE	In Semester Evaluation
ICA	Internal Continuous Assessment
POE	Practical and Oral Exam
OE	Oral Exam
MOOC	Massive Open Online Course
HSS	Humanity and Social Science
NPTEL	National Programme on Technology Enhanced Learning
F.Y.	First Year
S.Y.	Second Year
T.Y.	Third Year
B. Tech.	Bachelor of Technology

Electronics and Computer Engineering

Course Code Format

2	1	E	C	U/P	2	C	C	1	T/L
Year of Syllabus revision		Program Code		U-Under Graduate P-Post Graduate	Semester No./ Year1/2/3/…8	Course Type		Course Serial No1-9	T-Theory, L-Lab session A-Tutorial P-Programming

Program Code	
EC	Electronics and Computer Engineering
Course Type	
BS	Basic Science
ES	Engineering Science
HU	Humanities & Social Science
MC	Mandatory Course
CC	Core Compulsory Course
SN*	Self-Learning N* *indicates the serial number of electives offered in the respective category*
EN*	Core Elective **N*** *indicates the serial number of electives offered in the respective category*
ON*	Open Elective **N*** *indicates the serial number of electives offered in the respective category*
SK	Skill Based Course
SM	Seminar
MP	Mini project
PR	Project
IN	Internship
MD	Multidisciplinary Minor
EM	Entrepreneurship/Economics/Management Courses

FP	Community Engagement Project / Field Project
AE	Ability Enhancement Course
VE	Value Education Course
IK	Indian Knowledge System
VS	Vocational & Skill Enhancement Course
RM	Research Methodology
HN	Honors' Degree Course
HR	Honors Research
Sample Course Code	
23ECU3CC1T	Database Management Systems

Electronics and Computer Engineering

B. Tech. Semester V

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/ POE	ISE	ICA	
23ECU5CC1T	Database Management Systems	2	-	-	2	60	-	40	-	100
23ECU5CC2T	Machine Learning	3	-	-	3	60	-	40		100
23ECU5CC2A	Machine Learning (Tutorial)	-	1	-	1	-	-	-	25	25
23ECU5CC3T	Embedded Systems	2	-	-	2	60	-	40	-	100
23ECU5EN*4T	Program Elective Course I	3	-	-	3	60	-	40	-	100
23ECU5IK5T	Indian Knowledge System II – Vedic Mathematics	2	-	-	2	-	-	50		50
23##U5MD6T	Multidisciplinary Minor III	3	-	-	3	60	-	40	-	100
23MCU5OE7T	Open Elective III (MOOC)	-	-	-	2	50	-	-	-	50
	Sub Total	**15**	**1**	**-**	**18**	**350**		**250**	**25**	**625**
Laboratory Courses										
23ECU5CC1L	Database Management Systems Lab	-	-	2	1	-	-	-	25	25
23ECU5CC3L	Embedded Systems Lab	-	-	2	1	-	25	-	25	50
23ECU5EN*4L	Program Elective Course I Lab	-	-	2	1	-	-	-	25	25
23ECU5CC8P	Programming with Java	1	-	2	2	-	50	25	25	100
	Sub Total	**1**	**-**	**8**	**5**		**75**	**25**	**100**	**200**
	Grand Total	**16**	**1**	**8**	**23**	**350**	**75**	**275**	**125**	**825**

Electronics and Computer Engineering

B. Tech. Semester VI

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/ POE	ISE	ICA	
23ECU6CC1T	Design and Analysis of Algorithm	3	-	-	3	60	-	40	-	100
23ECU6CC2T	Data Analytics	2	-	-	2	60	-	40	-	100
23ECU6CC3T	VLSI Design	2	-	-	2		-	50	-	25
23ECU6E*4T	Program Elective Course II	3	-	-	3	60	-	40	-	100
23ECU6EN*4A	Program Elective Course II (Tutorial)	-	1	-	1	-	-	-	25	25
23ECU6E*5T	Program Elective Course III	3	-	-	3	60	-	40	-	100
23ECU6EN*5A	Program Elective Course III (Tutorial)	-	1	-	1	-	-	-	25	25
23##U6MD6T	Multidisciplinary Minor IV	2	-	-	2	60	-	40	-	125
	Sub Total	**15**	**2**	**-**	**17**	**300**	**-**	**250**	**50**	**600**
Laboratory Courses										
23ECU6PC1L	Design and Analysis of Algorithm Lab	-	-	2	1	-	-	-	25	25
23ECU6PC2L	Data Analytics Lab	-	-	2	1	-	25	-	25	50
23ECU6PC3L	VLSI Design Lab	-	-	2	1	-	25	-	25	50
23##U6MD6L	Multidisciplinary Minor IV Lab	-	-	2	1	-	-	-	25	
23ECU6VS7L	Mini Project	1	-	2	2	-	-	-	50	50
	Sub Total	**1**	**-**	**10**	**6**	**50**		**-**	**150**	**200**
	Grand Total	**16**	**2**	**10**	**23**	**350**		**225**	**200**	**800**
Third Year (Sem V and Sem VI)		**34**	**3**	**18**	**46**	**600**	**125**	**550**	**325**	**1625**

Note:

- N*indicates the serial number of electives offered in the respective category
- ##indicates program code of offering Programme
- Internal Continuous Assessment (ICA): ICA shall be a continuous process based on the performance of the student in assignments, class tests, quizzes, attendance and interaction during theory and lab sessions, journal writing, report presentation, etc., as applicable.

- **List of Program Elective I**

List of Program Elective I (Semester –V)	
Course Code	**Course Title**
23ECU5E14T	Digital Signal Processing
23ECU5E24T	Cloud Computing

- **List of Program Elective II**

List of Program Elective II (Semester –VI)	
Course Code	**Course Title**
23ECU6E14T	Image Processing
23ECU6E24T	Control Systems

- **List of Program Elective III**

List of Program Elective III (Semester –VI)	
Course Code	**Course Title**
23ECU6E15T	Automotive Electronics
23ECU6E25T	Artificial Intelligence

- **For 23##U5OE7T: Open Elective III (MOOC) in Semester V:**

1. Students are required to enroll in one of the courses of a minimum duration of 8 weeks offered on the SWAYAM/NPTEL platform. The list of courses will be finalized and released by Board of Studies each year.
2. List of MOOCs will be provided by the department depending on the availability of the courses in that semester under NPTEL / Swayam or Other recognized MOOC Platforms as per suggestions by the BoS.
3. Students may enroll for the course in Semester IV or V. They must complete all assignments and appear for the certification examination conducted by SWAYAM/NPTEL.
4. Students must pass the examination by the end of Semester V. The marks earned by the student in final assessment of this MOOC will be appropriately scaled and transferred to **Open Elective III (MOOC)** in Semester V.

- **For Courses offered during Semester VIII for A.Y. 2026-27**

Sr. No	*Course Code*	*Option I*	*Option -II*
1	23ECU8CC1T	MOOC Certification*	'Mobile Communication and Computing' course offered by the department during Semester VIII in Self Learning / Online mode and successfully passing ESE for the same.
2	23ECU8EN*2T	MOOC Certification*	'Program Elective VI' course offered by the department during Semester VIII in Self Learning / Online mode and successfully passing ESE for the same. Computer Architecture: Mechatronics

* Student has to complete this MOOC in any semester of – V, VI, VII or VIII. In semester VIII, the marks earned by the student in final assessment of this MOOC will be appropriately scaled and transferred for 23ECU8CC1T and / or 23ECU8E32T along with the required credits.
The list of approved MOOCs will be finalized and released by Board of Studies each year.

- **Multidisciplinary Minor (MDM) Courses**

Sr. No.	MDM Program	MDM I (Sem III)	MDM II (Sem IV)	MDM III (Sem V)	MDM IV (Sem VI)	MDM V (Sem VII)
1	Information Technology	Principles Of Operating Systems	Web Technology (UI/ UX)	Software Engineering Principles	DevOps	Cyber Security
2	Mechanical and Automation Engineering	Manufacturing Processes and Mechanisms	Machine Drawing and 3D Modeling	Automotive Engineering and Robotics	Additive Manufacturing	Thermal Engineering
3	Civil Engineering	Smart Buildings	Geoinformatics	Environmental Impact Assessment	Infrastructural Systems	Disaster Preparedness and planning

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5CC1T : Database Management Systems

Teaching Scheme		**Examination Scheme**	
Lectures	2 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	3	**ICA**	25 Marks

Introduction:

Database management has transitioned from a specialized application to a key element of modern computing systems, making knowledge of database systems crucial in nearly every engineering field. This course is designed to introduce beginners to the essential concepts of database management, covering the fundamentals of database modelling and design, as well as the languages and models used in database management systems.

Course Prerequisite:

Students shall have adept knowledge of basic data structures, computer organization, and a high-level programming language such as C, C++ or Java.

Course Objectives:

1. To introduce the fundamentals of computerized databases and Database Management Systems (DBMS).
2. To describe the data modelling concepts, specifically the Entity-Relationship (ER) model and relational data model,
3. To demonstrate use of Structured Query Language (SQL) to retrieve, modify, and maintain data in a database.
4. To emphasize important of normalization in databases.
5. To familiarize concurrency control and transaction management.

Course Outcomes:

After completing this course, the student will be able to -

1. Describe the concepts of database systems and roles of database users and administrators.
2. Design Entity-Relationship diagrams using appropriate constraints and convert them into relational schemas.
3. Construct and execute SQL queries using DDL, DML and DCL commands to retrieve and manipulate data in a relational database.
4. Apply normalization techniques to relational schemas and improve the database design.
5. Explain the transaction properties and implement basic concurrency control techniques using lock based protocols in database systems.

Unit – I	**Introduction to Database Management Systems**	**02 Hours**
Database- Overview of database systems, system applications, the purpose of database systems, view of data, database languages, and database architectures. Roles of database users and administrators and history of database systems.		
Unit – II	**Entity-Relationship Model and Design Process**	**05 Hours**
Overview of the design process and ER model. Constraints in ER modeling, ER diagrams, weak entity sets, and extended features converting ER diagrams to relational schemas.		
Unit – III	**Relational Model and SQL Essentials**	**08 Hours**
Relational model: structure, schema, and keys. Relational algebra: Basic operations: select, project, union, set difference, rename and cartesian product. Advanced operations: Join, Division, and Intersection. SQL Basics: Introduction to SQL: Definition, Syntax, and Structure. SQL Data Types, SQL Commands: DDL, DML, DCL, TCL. Basic SQL clauses- select, from, where, group by, having, order by, etc., the basic structure of SQL queries, additional basic operations, set operations, NULL values, aggregate functions, nested sub-queries, modification of the databases, join operations, views, integrity constraints, authorization.		
Unit – IV	**Database Normalization, Indexing and Hashing Techniques**	**08 Hours**
Features of good relational designs and atomic domains. Normal forms: 1NF, 2NF, 3NF, BCNF. Functional dependency theory and normalization. Basic concepts of indexing and hashing. Ordered indices: B tree and B+ tree and multiple key access. Static and dynamic hashing and comparison with indexing.		
Unit – V	**Transaction Management and Concurrency Control**	**07 Hours**
Transaction: concepts and properties (ACID), states of transaction and implementation of atomicity and durability. Concurrency control: serializability, recoverability testing of serializability, lock-based protocol: locks, granting of locks, two-phase locking protocol, time stamp-based protocols, validation-based protocols, deadlock handling.		

Internal Continuous Assessment (ICA)

ICA shall consist of minimum eight experiments and one mini-project based on following

1. Implementation of basic SQL DDL commands.
2. Implementation of SQL DML commands.
3. Draw E-R diagram for any specific database application.
4. Write simple queries in SQL on the schema created for a specific application.
5. Write SQL queries using aggregates, grouping, and ordering statements for given scenario.
6. Apply SQL- stored procedures, functions and triggers.
7. Convert the created database into 1NF, 2NF, 3NF and BCNF.
8. Write a program to implement dynamic hashing on the database previously created.
9. Write a program to simulate log based protocol using immediate database modification.
10. Develop an ER model, prepare a database schema, execute queries to retrieve data for given problem

Text Books
1. Fundamentals of Database Systems (7th Edition) by RamezElmasri, Shamkant B. Navathe. Publisher: Pearson. 2. Database system concepts by Peter Rob, Carlos Coronel (Cengage Learning) ninth edition.
Reference Books
1. Database System Concepts by Silberschatz, Korth and Sudarshan (6th Edition) Publisher: Tata McGraw Hill Education 2. Database Management Systems by Ramkrishnan Gehreke (Tata McGraw Hill) third edition. 3. Principles of Database Systems by J. D. Ullman (Galgotia Publications) 4. Advanced Database Management System by Rini Chakrabarti, Shilbhadra Dasgupta (Dreamtech Press Publication).

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5CC2T : Machine Learning

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Tutorial	1 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

Machine learning is concerned with the computer programs that have the ability to automatically learn and improve from experience without being explicitly programmed. ML is the fuel that drives the new age digital world. This course provides a foundational understanding of few preliminary machine learning models of supervised and unsupervised learning as well as demonstrates how these models can solve variety of complex problems.

Course Prerequisite:

Student should have basic knowledge of probability theory, statistic and python programming.

Course Objectives:

1. To make student comprehend basics of machine learning
2. To introduce to students' preliminary models for supervised learning
3. To introduce to students' preliminary models for unsupervised learning
4. To give student overview of various complex problems that can be solved using machine learning models.

Course Outcomes:

After completing this course, student will be able to -

1. Explain the fundamental concepts of machine learning.
2. Evaluate the performance of machine learning models using standard metrics.
3. Implement basic supervised learning models to solve classification and regression problems.
4. Apply unsupervised learning techniques for clustering and pattern discovery.
5. Explore and discuss the use of machine learning methods in various application areas

Unit – I	**Introduction to Machine Learning**	**09 Hours**

Types of ML - supervised, unsupervised, reinforcement, steps in ML, types of data in ML, exploring structure of data, data quality and remediation, features, feature transformation, feature subset selection..

Unit – II	**Modelling and Evaluation**	**06 Hours**

Introduction, Selecting a Model, Training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model

Unit – III	**Supervised Learning : Classification**	**07 Hours**
Introduction, Examples of Supervised Learning, Common Classification Algorithms-Naïve Bayes classifier- Bayes theorem, Handling continues numeric features in Bayes classifier, k-Nearest Neighbors (k-NN), Decision tree, Random Forest model, Support Vector Machine		
Unit – IV	**Supervised Learning: Regression**	**06 Hours**
Introduction, Examples of regression, Common regression algorithms-Simple Linear regression, Multiple linear regression, Assumptions in regression analysis, Main Problems in regression analysis, Polynomial regression model, logistic regression model.		
Unit – V	**Unsupervised Learning**	**07 Hours**
Introduction, Applications of Unsupervised learning, Clustering , different types of clustering techniques,, finding patterns using association rule, Apriori algorithm		
Unit – VI	**Applications of Machine Learning**	**05 Hours**
Overview of applications of machine learning for classification, regression, clustering in the area of image / video processing, speech processing, recommendation systems etc		

Internal Continuous Assessment (ICA)

ICA consists of minimum eight tutorials requiring students to implement and validate machine learning models using Python or any other machine learning toolkits based on following:

1. Data preprocessing and feature engineering
2. Supervised Learning - Classification with k-NN and Naive Bayes
3. Decision trees and random forests
4. Linear & logistic regression
5. Unsupervised learning - Clustering and association rules
6. Real-world ML Applications (Image processing, recommendation systems)

Text Books

1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson
2. Machine Learning, Tom M. Mitchell, McGraw Hill (India) Pvt Ltd
3. Machine Learning For Dummies by John Paul Mueller , Luca Massaron (Published by For Dummies; First edition)

Reference Books

1. Introduction to Machine Learning, Alpaydin, Ethem, The MIT Press
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer

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23ECU5CC3T: Embedded Systems

Teaching Scheme		**Examination Scheme**	
Lectures	2 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	3	**ICA**	25 Marks
		OE	25 Marks

Introduction:

This course provides a thorough introduction to the architecture of ARM7TDMI core-based microcontroller. The course also introduces assembly and C programming for microcontroller and enables student to write programs addressing high level programming skills and also interfacing with different peripherals. The real time operating system concepts are also introduced.

Course Prerequisite:

Student has completed a course in microcontroller and its interfacing and has an adept knowledge of assembly language and C language programming. Student also has knowledge of interfacing techniques and working of different peripherals.

Course Objectives:

1. To make student aware of hardware and software architecture of embedded system
2. To make student learn architecture of ARM7TDMI core and its programming.
3. To make student learn interfacing of different peripherals with microcontroller LPC2148.
4. To make student learn architecture of real time operating system and its services.

Course Outcomes:

After completing this course, student will be able to -

1. Describe hardware and software architecture of embedded system.
2. Describe ARM7TDMI core architecture and write program for different applications.
3. Interface different peripherals with microcontroller.
4. Apply different services of real time operating system in embedded programming.

Unit – I	**Introduction to Embedded System**	**05 Hours**

Concept of embedded system**,** RISC and ARM design philosophy, embedded system hardware, embedded system software and data acquisition system.

Unit – II	**ARM7 Core Fundamentals**	**10 Hours**

ARM7TDMI core programmer's model: data types, processor modes, registers, exceptions, memory format support, unaligned access support, pipeline concept, core extensions and ARM7TDMI instruction set: data processing instructions, branch instructions, load/store instructions, software interrupt instruction, program status register instructions, and ARM addressing modes.

Unit – III	LPC2148 Architecture and Interfacing	10 Hours
LPC 2148: Architecture Overview, pin connect block, pin function select registers, GPIO ports, GPIO registers, on chip peripherals timers and ADC, interfacing of peripherals LEDs, DC motor, LCD .		
Unit – IV	**Real Time Operating System Concepts**	**05 Hours**
Concepts of real time operating system, need of RTOS, comparison of traditional and embedded OS, foreground/background systems, multitasking, tasks, context switching, kernel structure, schedulers, mailboxes, task management, time management, inter-task communication, interrupts, clock tick.		

Internal Continuous Assessment (ICA) :

ICA shall consist of minimum eight experiments and one mini-project based on following

1. Programs on arithmetic and logical operations.
2. Programming of on chip peripherals. .
3. Interfacing LEDs, LCD, motors& Keypad, etc.
4. RTOS programming: Semaphore, Mailbox implementation, Task creations.

Text Books

1. ARM System Developers Guide, Andrew Sloss, Elsevier.
2. Micro C/OS-II: The Real Time Kernel, Jean J Labrose, CMP Books.
3. ARM System On Chip Architecture, Steve Furber, Addison-Wesley.

Reference Books

1. ARM7TDMI based microcontroller's datasheet.
2. Embedded systems software primer, David Simon, Pearson.
3. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill India.

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5E14T : Program Elective I - Digital Signal Processing

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/Week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

The signal for processing is mathematically modelled as a function or a sequence of numbers that represents the state or behaviour of a physical system. Examples includes speech, audio, image and video in multimedia systems, electrocardiograms in medical systems, electronic radar waveforms in military applications etc. Signal processing is concerned with the representation, transformation, and manipulation of signals and the information they contain. For example, we may wish to remove the noise in speech to make it clear, or to enhance an image to make it more natural. Signal processing is one of the fundamental techniques to construct modern information systems. The course includes the concept and the classification of discrete-time signal, representations of signals, discrete frequency transform, representations and analysis of systems, and filter designs.

Course Prerequisite :

Student shall have mathematical background of Fourier Transform.

Course Objectives:

1. To make student understand processing of signals in frequency domain using mathematical transforms
2. To make student understand the methods for realization of discrete time systems.
3. To make student understand the design methods for digital IIR & FIR filters.

Course Outcomes:

After completing this course, student will be able to

1. Classify signals and describe the concept of frequency in continuous-time and discrete-time domains
2. Analyze discrete-time signals and linear time-invariant systems using their properties and solve difference equations to determine system responses.
3. Analyze discrete-time signals and systems in the frequency domain using Discrete Fourier Transform (DFT) and efficiently compute DFT using FFT algorithms.
4. Realize the discrete time FIR and IIR systems using structures.
5. Design digital filters for processing of discrete time signals.

Unit – I	**Introduction to DSP**	**07 Hours**
Signals, systems and signal processing, basic elements of a digital signal processing system, advantages of digital over analog signal processing, classification of signals, the concept of frequency in continuous-time and discrete-time signals, analog -to-digital conversion		
Unit – II	**Discrete Time Signals & Systems**	**06 Hours**
Discrete-time signals, discrete-time systems, analysis of discrete-time linear time-invariant systems, discrete-time systems described by difference equations.		
Unit – III	**Frequency analysis of Signals and Systems**	**07 Hours**
The discrete Fourier transform (DFT), DFT as a linear transformation, circular convolution, efficient computation of the DFT: FFT algorithms, radix-2 FFT algorithms.		
Unit – IV	**Implementation of Discrete Time Systems**	**07 Hours**
Structures for realization of discrete time systems, structures for FIR filters: direct form, cascade form, structures for IIR filters: direct form, cascade form & parallel form.		
Unit-V	**FIR Filter Design**	**07 Hours**
Characteristics of practical frequency selective filters, FIR filter design using windowing & frequency sampling method.		
Unit-VI	**IIR Filter Design**	**06 Hours**
IIR filter design by Impulse invariant technique, IIR filter design by bilinear transformation, digital Butterworth filters.		

Internal Continuous Assessment (ICA)

ICA consists of minimum seven practical using Python/ MATLAB based on following

1. Discrete-Time Signals and Systems
2. Frequency analysis of signals using DFT
3. Efficient Computation of DFT Using FFT
4. Implementation of Discrete-Time systems
5. FIR filter design using Windowing method
6. FIR filter design using Frequency sampling method
7. IIR filter design using Impulse Invariant technique

Textbooks:

1. Digital Signal Processing – Principles, Algorithms and applications, John G Proakies, Prentice Hall India
2. Digital Signal Processing–Practical Approach, Ifeachor E.C. & Jervis B.W., Pearson Education
3. Discrete Time Signal Processing, A.V. Oppenheim & R.W. Schalfer, John Wiley

Reference books:

1. Digital Signal Processing, S Salivahanan, A Vallavaraj & C Gnanapriya,Tata McGraw Hill
2. Scientist and Engineering Guide on Digital Signal Processing, Steven W. Smith, California Technical Publishing, California.
3. Digital Signal Processing Fundamental sand applications, LiTan, Academic Press.

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5E24T : Program Elective I- Cloud Computing

Teaching Scheme		**Examination Scheme**	
Lectures	**3 Hours/week**	**ESE**	**60 Marks**
Practical	**2 Hours/Week**	**ISE**	**40 Marks**
Credits	**4**	**ICA**	**25 Marks**

Introduction:

Cloud Computing is a dominating paradigm in computing that offers on-demand access to a shared pool of configurable computing resources, such as networks, servers, storage, applications, and services, over the internet. It enables organizations to rapidly scale their IT infrastructure, reduce costs, and increase agility by leveraging the power of virtualization, automation, and resource pooling. By learning this subject, students gain skills and knowledge that are highly sought after by employers across various industries, making them more competitive in the job market. By learning cloud computing concepts and skills, student's future-proof their careers and position themselves for success in a rapidly evolving technological landscape.

Course Prerequisite:

Students should have a strong understanding of computer science fundamentals, including data structures, algorithms, operating systems, networking, web technologies and database systems.

Course Objectives:

1. To analyze the fundamental concepts and architectural components of cloud computing, including virtualization, service models, deployment models and scalability.
2. To evaluate different cloud computing platforms and providers based on their features and different parameters.
3. To critically assess the challenges and risks associated with cloud computing.
4. To collaborate effectively in multidisciplinary teams to solve complex problems and address ethical, social, and environmental issues related to the adoption.
5. To evaluate and leverage to cloud services offered by leading providers, including AWS, Google Cloud, and Azure, for diverse application scenarios.

Course Outcomes:

After completing this course, student will be able to –

1. Analyze various cloud service and deployment models to assess their impact on scalability, elasticity, and resilience in cloud environments.
2. Illustrate the role of virtualization technologies and hypervisors in managing cloud infrastructure performance and security.
3. Elaborate cloud security strategies and compliance measures with respect to threats, data privacy, and regulatory requirements like GDPR and HIPAA.
4. Compare the features, pricing models and performance benchmarks of major cloud service providers to identify suitable platforms for diverse application needs.

Unit – I	**Principles and Components of Cloud Computing**	**08 Hours**
Introduction to Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid), Cloud Infrastructure Components (Servers, Storage, Networking), Scalability, Elasticity, and Resilience in Cloud Computing		
Unit – II	**Virtualization in Cloud Computing**	**06 Hours**
Introduction to Virtualization and Hypervisors, Types of Hypervisors (Type 1, Type 2), Virtual Machine (VM) Management, Hypervisor Security and Performance Considerations, Impact of Hypervisors on Cloud Computing Infrastructure.		
Unit – III	**Security Risks and Compliance in Cloud Computing**	**08 Hours**
Cloud Security Fundamentals, Threats and Vulnerabilities in Cloud Environments, Identity and Access Management (IAM), Data Encryption and Privacy, Regulatory Compliance (GDPR,HIPAA, PCI DSS), Cloud Security Best Practices and Tools		
Unit – IV	**Cloud Service Providers**	**10Hours**
Overview of Cloud Service Providers (AWS, Azure, Google Cloud, etc.), Comparison of Service Offerings, Pricing Models (on-demand, reserved, spot instances), and SLAs (for uptime, performance, and support), Performance Benchmarks and Reliability Metrics (latency, throughput, and availability), Case Studies and Use Cases for Different Cloud Providers.		
Unit – V	**Cloud Services for Developers**	**10Hours**
Introduction to Developer Services in cloud, Compute Services (AWS Lambda, Google App Engine, Azure Functions), Storage Services (Amazon S3, Google Cloud Storage, Azure Blob Storage), Database Services(Amazon RDS, Google Cloud SQL, Azure SQL Database), Networking Services (Amazon VPC, Google Cloud Virtual Network, Azure Virtual Network), Developer Tools and SDKs (AWS CLI, Google Cloud SDK, Azure CLI), Case Studies'		

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 8 experiments based on AWS Academy Certification course syllabus and Infosys Springboard course assignments-

1. AWS and Google cloud setup and configuring various services – Students shall learn to setup the cloud services for various use cases.
2. Develop a small project using AWS Serverless services like API Gateway, Lambda, Dynamodb etc.
3. It is recommended that with a group of 4/5 students, few lab sessions shall be utilized for carrying out a small project.
4. Students must submit AWS Cloud Academy Cloud Certification and Infosys Springboard Course Certificate by the end of semester.

Textbooks:

1. "Cloud Computing: Principles and Paradigms" by RajkumarBuyya, James Broberg, and Andrzej M. Goscinski, Edition: 1st Edition, Publication: Wiley, 2012
2. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and ZaighamMahmood, Edition: 1st Edition, Publication: Prentice Hall, 2014
3. "Cloud Computing for Dummies", by Judith Hurwitz , Daniel Kirsch, Edition: 2 nd Edition, Publication: Wiley, 2020

Reference Books:

1. "Cloud Native Patterns: Designing Change-tolerant Software" by Cornelia Davis, Edition: 1st Edition, Publication Reilly Media, 2019
2. AWS Documentation : URL- https://docs.aws.amazon.com/
3. Google Cloud Documentation: URL - https://cloud.google.com/docs/
4. Azure Cloud Documentation: URL- https://learn.microsoft.com/en-us/azure/cloud-services.

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5IK5T: Indian Knowledge System II – Vedic Mathematics

Teaching Scheme		**Examination Scheme**	
Lectures	2 Hours/week	**ESE**	-
Practical/Tutorial	-	**ISE**	50 Marks
Credits	2	**ICA**	-

Introduction:

Vedic Mathematics is a super-fast way of calculation. There are just 16 Sutras or Word Formulae which solve all known mathematical problems in the branches of Arithmetic, Algebra, Geometry, and Calculus. They are easy to understand, easy to apply, and easy to remember.

Course Prerequisite:

Student shall have knowledge of basic mathematics.

Course Objectives:

1. Introduce students to the foundational principles and principles of Vedic Mathematics.
2. Developmental calculation skills and enhance number sense.
3. Promote problem-solving abilities through mental and arithmetic techniques.
4. Build confidence in handling mathematical calculations quickly and accurately.
5. Foster interest in mathematics by making it more approachable and engaging.

Course Outcomes:

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

1. Describe history and evolution of Vedic mathematics.
2. Perform Vedic arithmetic calculations with speed and accuracy.
3. Apply various Multiplication and Division methods to solve problems.
4. Calculate powers and roots of a number.
5. Solve simultaneous and quadratic equations.

Unit – I	**Introduction of Vedic Mathematics**	**05 Hours**

History and Evolution of Vedic Mathematics, Introduction of Basic Vedic Mathematics Techniques in Multiplication (Special Case, Series of 9, Series of 1 etc), Tables etc., Comparison of Standard Methods with Vedic Methods, sixteen sutras.

Unit – II	**Vedic Arithmetic Operations**	**05 Hours**

Various techniques to carry out basic operations covering Addition, Subtraction, Multiplication, Division, Complements and Bases, Vinculum number, General multiplication (Vertically Cross-wise).

Unit – III	**Multiplication and Division**	**05 Hours**
Multiplications by numbers near base, Verifying answers by use of digital roots, Divisibility tests, Division of numbers near base, Comparison of fractions.		
Unit – IV	**Power and Roots**	**10 Hours**
Applications of Vinculum, Different methods of Squares (General method, Base method, Duplex method etc.), Square roots, Cubes, Cube roots, General division		
Unit – V	**Vedic Algebra**	**05 Hours**
Simultaneous Equations, Quadratic Equations		

Text Books

1. Vedic Mathematics Made Easy by Bhatiya Dhaval ,Jaico Publishing House
2. Vedic Mathematics for students taking Competitive Examinations by Thakur Rajesh Kumar, Unicorn Books 2015 or Later Edition
3. Power of Vedic Mathematics with Trigonometry by Gupta Atul, Jaico Books
4. Magical World of Mathematics (Vedic Mathematics) by V. G. Unkalkar, Vandana Publishers, Bangalore
5. Vedic Math Genius by Kenneth Williams, Inspiration Books, England

Reference Books

1. Vedic Mathematics: Sixteen Simple Mathematical Formulae From The Vedas by Jagadguru Swami Sri Bharati Krishna Tirthaji Maharaja published by MotilalBanarsidassPublishersPvt. Ltd., Delhi
2. Lilavati: A Treatise Of Mathematics Of Vedic Tradition by Krishnaji Shankara Patwardhan published by MotilalBanarsidass Publishers Pvt. Ltd., Delhi
3. Vertically And Crosswise By A. P. Nicholas, K. R. Williams, J. Pickles, Inspiration Books, Scotland

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Electronics and Computer Engineering), Semester-V

23ECU5CC8P: Programming with Java

Teaching Scheme		**Examination Scheme**	
Lectures	1 Hour/week	**POE**	50 Marks
Practical	2 Hours/week	**ISE**	25 Marks
Credits	2	**ICA**	25 Marks

Introduction:

Java is a widely used, platform-independent, and object-oriented programming language that is essential for building secure, scalable, and high-performance applications. It is extensively used in web development, enterprise applications, mobile development (Android), cloud computing, and IoT solutions. Learning Java equips students with the skills required for modern software development, enhances their problem-solving abilities, and prepares them for industry-level programming.

Course Prerequisite:

Students should have prior knowledge of basic programming in C, C++, or Python, along with Object-Oriented Programming (OOP) concepts such as classes, objects, inheritance, and polymorphism. Familiarity with data structures (arrays, stacks, queues), basic file handling, and problem solving skills will help in understanding JAVA efficiently.

Course Objectives:

1. To understand Java programming fundamentals, including syntax, control structures, and data types.
2. To apply object-oriented programming concepts using abstraction, polymorphism, inheritance, and interfaces in Java.
3. To implement exception handling, multithreading, and file handling for robust application development.
4. To explore Java Collections Framework and GUI programming for building interactive applications.
5. To develop real world applications using Java programming concepts and best coding practices

Course Outcomes:

After completing this course, student will be able to –

1. Apply the Java's syntax, structure, and execution flow and implement control statements loops and arrays for problem solving.
2. Apply abstract class, interface and polymorphism to design modular programs and use inner classes and packages to organize Java applications efficiently.
3. Perform runtime errors handling using Java's exception-handling mechanism and perform advanced string manipulations utilizing wrapper classes.
4. Develop multithreaded applications with synchronization techniques and implement file operations including reading/writing and serialization.
5. Use Java Collections Framework to manage and manipulate data structures efficiently.

Unit – I	**Introduction to Java and Basics**	**04 Hours**
Introduction to Java: Features, History, JDK, JVM, JRE, Java Program Structure: Writing, Compiling, and Running a Java Program, Data Types, Variables, and Operators, Control Statements: If-Else, Switch, Loops (For, While, Do-While), Arrays in Java.		
Unit – II	**Advanced Object-Oriented Programming in Java**	**04 Hours**
Class and Object in Java, Abstract Classes and Methods, Interfaces and Multiple Inheritance in Java, Polymorphism in Java: Method Overriding, Method Overloading, Inner Classes and Anonymous Classes, Packages and Access Modifiers (Public, Private, Protected, Default).		
Unit – III	**Exception Handling, Strings, and Wrapper Classes**	**03 Hours**
Exception Handling: Try, Catch, Finally, Throw, Throws,Built-in and User-defined Exceptions. String Handling: String Class, String Buffer, String Builder, Wrapper Classes and Auto boxing / Un boxing.		
Unit – IV	**Multithreading and File Handling**	**04 Hours**
Multithreading in Java: Thread Lifecycle, Creating Threads (Extending Thread Class, Implementing Runnable), Synchronization and Inter-Thread Communication, File Handling in Java: Reading/Writing Files, Buffered Reader, File Writer, Serialization.		
Unit – V	**Java Collections Framework**	**03 Hours**
Collection Framework: List (Array List, Linked List), Set (Hash Set, Tree Set), Map (Hash Map, Tree Map)		

Internal Continuous Assessment (ICA):

ICA shall consist of minimum eight experiments and one mini-project based on following

1. Write and execute a simple Java program using variables, operators, and control statements.
2. Implement loops (for, while, do-while) for basic problem-solving (e.g., factorial, prime numbers)
3. Implement 1D and 2D arrays for data storage and manipulation (e.g., matrix operations).
4. Create Java programs using functions (methods) and recursion.
5. Develop a program demonstrating the use of abstract classes and methods.
6. Implement multiple inheritance using interfaces in Java.
7. Implement method overloading and method overriding in Java.
8. Demonstrate the use of inner classes and anonymous classes.
9. Write a Java program to handle user-defined exceptions (e.g., invalid input exception).
10. Implement file handling to read and write data from a text file.
11. Develop a Java program to create threads using Thread class and Runnable interface. Implement thread synchronization and inter-thread communication.
12. Implement Array List and Linked List for dynamic data storage.
13. Use Hash Set and Tree Set to store unique elements and perform operations.
14. Implement Hash Map and Tree Map to store and retrieve key-value pairs.
15. Demonstrate Queue (Priority Queue, Linked List Queue) operations.

Text Books
1. Java: The Complete Reference, Author: Herbert Schildt, Publication: McGraw Hill, Edition: 12th Edition (2021) 2. Core Java Volume I – Fundamentals, Author: Cay S. Horstmann, Publication: Pearson Education, Edition: 11th Edition (2022) 3. Head First Java, Authors: Kathy Sierra, Bert Bates, Publication: O'Reilly Media, Edition: 2nd Edition (2005) (Still relevant for beginners) 4. Effective Java, Author: Joshua Bloch, Publication: Pearson Education, Edition: 3rd Edition (2018)
Reference Books
1. Java Programming for Core and Advanced Learners, Authors: Sagayaraj, Dennis, Karthik, Gajalakshmi, Publication: Universities Press, Edition: 1st Edition (2018) 2. Java SE Documentation (Oracle), The official reference for Java language, APIs, and libraries. https://docs.oracle.com/en/java/javase/ 3. Java Tutorials (Oracle), Covers Java fundamentals, OOP, data structures, concurrency, and more, https://docs.oracle.com/javase/tutorial/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Third Year B.Tech. (Electronics and Computer Engineering), Semester-VI

23ECU6CC1T : Design And Analysis Of Algorithm

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

The Design and Analysis of Algorithms course is fundamental for understanding how to solve complex computational problems efficiently. It helps students analyze the performance of different algorithms, select the most suitable approach for a given problem, and optimize solutions for real-world applications. Mastering algorithmic strategies such as Divide and Conquer, Greedy, Dynamic Programming, and Graph Algorithms is crucial in fields like Artificial Intelligence, Data Science, and Competitive Programming. This course builds problem-solving skills essential for software development, research, and technical interviews.

Course Prerequisite :

Students should have a solid foundation in Data Structures (Arrays, Linked Lists, Stacks, Queues, Trees, and Graphs) and basic Mathematical Concepts (Logarithms, Recursion, and Probability). Proficiency in at least one programming language (C++ Java or Python) is required to implement algorithms effectively.

Course Objectives:

1. To analyse algorithm efficiency using asymptotic notations and solve recurrence relations for time complexity evaluation.
2. To implement and compare different algorithmic paradigms, including Divide and Conquer, Greedy, Dynamic Programming, and Backtracking.
3. To apply graph algorithms for real-world problems, such as shortest path, spanning trees, network flow, and strongly connected components.
4. To develop algorithmic solutions with optimized performance for complex computational problems in diverse domain

Course Outcomes:

After completing this course, student will be able to –

1. Analyse algorithm efficiency using asymptotic notation and recurrence relations, and apply divide and conquer strategies to solve computational problems.
2. Apply advanced data structures such as AVL trees, heaps, and disjoint sets for efficient data organization and manipulation.
3. Analyse and differentiate between greedy and dynamic programming strategies to design optimal algorithms for combinatorial and optimization problems.
4. Apply backtracking, branch and bound, and classical graph algorithms to solve path, scheduling, and optimization problems effectively.

Unit – I	**Introduction to Algorithm Analysis and Divide & Conquer**	**10 Hours**
Characteristics of Algorithms, Time and Space Complexity, Asymptotic Notations: Big-O, Big-Theta, Big-Omega. Mathematical Analysis: Worst, Best, and Average Cases, Recurrence Relations: Substitution, Recursion Tree, Master's Theorem. Divide and Conquer Approach: Merge Sort, Quick Sort (Design & Analysis), Strassen's Matrix Multiplication, Closest Pair of Points Problem.		
Unit – II	**Advanced Data Structures**	**08 Hours**
Binary Search Trees (BST) – Operations (Insertion, Deletion, Searching, Traversal), AVL Trees – Rotations, Height Balancing, Complexity Analysis, Binary Heap – Min-Heap, Max-Heap, Heapify, Heap Sort, Disjoint Set -Union-Find Operations and Applications.		
Unit – III	**Greedy and Dynamic Programming Techniques**	**12 Hours**
Greedy Strategy: Activity/Job Selection Problem, Huffman Coding (Data Compression), Job Scheduling with Deadlines. Dynamic Programming (DP): Principle of Optimality, Knapsack Problem (0/1 and Fractional), Matrix Chain Multiplication, Floyd-Warshall Algorithm for All-Pairs Shortest Path, When to use Greedy vs. Dynamic Programming.		
Unit – IV	**Backtracking, Branch & Bound, Graph Algorithms**	**12 Hours**
Backtracking: Definition, Use Cases, and Efficiency Analysis, N-Queens Problem, Graph Colouring Problem, Hamiltonian Cycle Detection. Branch and Bound Approach: Solving 0/1 Knapsack Problem, Travelling Salesman Problem (TSP). When to use Backtracking vs. Dynamic Programming. Graph Algorithms:DFS, BFS, MST: Kruskal's and Prim's Algorithms, Shortest Paths: Dijkstra's, Bellman-Ford.		

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 8 to 10 lab experiments (using C or Python) based on above concepts.

1. Write and compare Merge Sort and Quick Sort implementations (time analysis on inputs of various sizes).
2. Implement and visualize Strassen's algorithm for matrix multiplication.
3. Implement Min-Heap and Max-Heap; perform heap sort.
4. Compare performance of heap sort vs. quick sort on similar input sizes.
5. Solve 0/1 Knapsack using both DP and Greedy; compare results
6. Implement Floyd-Warshall for All-Pairs Shortest Paths
7. Write dynamic programming solution for matrix chain multiplication
8. Implement Prim's and Kruskal's algorithms
9. Implement Dijkstra's and Bellman-Ford algorithms
10. Solve N-Queens and Graph Colouring problems using backtracking

Textbooks:
1. Fundamentals of Computer Algorithms, Horowitz, Sahni&Rajasekaran, (Galgotia Publications) 2. Fundamental of Algorithm, Gilles Brassard, Paul Bratley (Pearson Publication) 3. Introduction to Algorithms, Thomas Cormen (Pearson Publication)
Reference books:
1. Introduction to Design and Analysis of Algorithm, Goodman (McGrawhi11) 2. Design and analysis of algorithms, Aho, Hopfcraft and Ullman (Addison wesley) 3. Design & Analysis of Algorithms, Sharma, Khanna Publishing House, N.Delhi 4. Design & Analysis of Algorithms, S. Sridhar, Oxford

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Third Year B.Tech. (Electronics and Computer Engineering), Semester-VI

23ECU6CC2T: Data Analytics

Teaching Scheme		**Examination Scheme**	
Lectures	2 Hours/week	**ESE**	60 Marks
Practical	2 Hours/Week	**ISE**	40 Marks
Credits	3	**ICA**	25 Marks
		POE	25 Marks

Introduction:

The information in the world doubles every 20 months. Important data sources are business and industrial processes, text and structured data bases, image and biomedical data. Many applications show that data analytics can provide huge benefits. We need models and algorithms to collect, preprocess, analyse, and evaluate data, from various fields such as statistics, system theory, machine learning, pattern recognition, or computational intelligence. This basic course is designed to provide the most important methods and algorithms for data analytics. This course focuses on the understanding of the basic concepts of data analytics, which will allow student to keep pace and to actively contribute to the advancement of the growing field of data analytics.

Course Prerequisite :

Student must have completed a fundamental course in Machine Learning. He shall have adept knowledge of algorithms and data structures, database management systems and a high-level programming language preferably Python or R. Student shall also have basic knowledge of algebra and geometry.

Course Objectives:

1. To make student realize the concept of data and its types
2. To introduce to student various data and types
3. To introduce to students' different statistical descriptors associated with data
4. To make student understand data similarity and dissimilarity measures for different data types
5. To make student understand how the data can be pre-processed in order to improve the quality of the data
6. To present student 'big picture' of data analytics applications and expose him to contemporary data analytics and business analytics applications

Course Outcomes:

After completing this course, student will be able to –

1. Evaluate importance of data in modern era
2. Illustrate various data types with their attributes
3. Evaluate basic statistical descriptors associated with data
4. Calculate similarity and dissimilarity measures for different data types
5. Analyse the methods used for preprocessing of the data and feature extraction process
6. Present case studies for data analytics and business analytics applications and can design simple steps for new data analytics application

Unit – I	**Knowing Data**	**04 Hours**

What is data, what we can do with data, data processing and analytics flow, data matrix, patterns, attributes, data - geometric, algebraic and probabilistic view

Unit – II	**Data Objects and Attribute Types**	**06 Hours**

Non-dependency-oriented data, dependency-oriented data, quantitative multidimensional data, categorical and mixed attribute data, binary and set data, text data, time-series data, discrete sequences and strings, spatial data, spatiotemporal data, network and graph data

Unit – III	**Basic Statistical Descriptions of Data**	**04 Hours**

Measuring the central tendency, measuring the dispersion of data, boxplots, and outliers, variance and standard deviation, univariate analysis, multivariate analysis, graphic displays of basic statistical descriptions of data - quantile plot, quantile–quantile plot, histograms, scatter plots and data correlation

Unit – IV	**Measuring Data Similarity and Dissimilarity**	**06 Hours**

Data matrix versus dissimilarity matrix, proximity measures for nominal attributes, proximity measures for binary attributes, Minkowski distance, proximity measures for ordinal attributes, dissimilarity for attributes of mixed types

Unit – V	**Data Pre-processing**	**06 Hours**

Data pre-processing: an overview, data cleaning, data integration, data transformation and data discretization, feature extraction, data type portability, data cleaning, sampling, dimensionality reduction

Unit – VI	**Applications of Data Analytics**	**04 Hours**

Revision of supervised and unsupervised learning models, Applications - data mining, exploratory data analysis, frequent pattern mining, clustering, classification, outlier detection, business analytics

Internal Continuous Assessment (ICA)

ICA shall consist of minimum eight experiments and one mini-project based on following

1. Program based on different data types and its use
2. Program based on statistical description of data using box plots, histograms, and scatter plots.
3. Program based on central tendency and dispersion
4. Program based on visualization techniques for analyzing univariate data with mixed attribute types.
5. Use of Python libraries to visualize and analyze a statistical description of data using Q-Q plots.
6. Program based on patterns and relationships identification using EDA techniques and Python libraries.
7. Program based on outlier detection and data cleaning using Python.
8. Implementation of a basic data processing pipeline from raw data to cleaned output using Python.

Textbooks:

1. A General Introduction to Data Analytics, João Mendes Moreira, João Mendes Moreira, Tomas Horvath, JohnWiley & Sons, Inc
2. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, Elsevier
3. Data Mining and Analysis- Fundamental Concepts and Algorithms, Mohammed J. Zaki,Wagner Meira Jr., Cambridge University Press
4. Data Mining: The Textbook by Charu C. Aggarwal, Springer Publisher
5. Data Analytics, Anil Maheshwari, McGraw Hill Education (India) Pvt. Ltd.

Reference books:

1. Statistical Analysis of Financial Data in R by Rene Carmona ,Springer, 2014.
2. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glenn J. Myatt, John Wiley Publishers, 2014.
3. Python Data Science Handbook – Essential Tools for working with Data: Jake VanderPlas, Orielly

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Electronics and Computer Engineering), Semester-VI

23ECU6CC3T: VLSI Design

Teaching Scheme		**Examination Scheme**	
Lectures	2 Hours/week	**OE**	25 Marks
Practical	2 Hours/Week	**ISE**	25 Marks
Credits	3	**ICA**	25 Marks

Introduction:

This course provides a thorough introduction to hardware description language (VHDL). The course intends to cover VHDL modeling and simulation of various combinational and sequential circuits. The course also introduces the architectures field programmable gate arrays and Implementation of simple circuits on FPGA. CMOS logic design is also covered.

Course Prerequisite :

Student shall have basic knowledge of Digital Logic Design, Basic Electronics.

Course Objectives:

1. To introduce VHDL programming for digital circuit design.
2. To understand CMOS logic design principles for VLSI circuits.
3. To provide hands-on experience in VHDL coding, simulation, and FPGA

Course Outcomes:

After completing this course, student will be able to -

1. Design and simulate digital circuits using VHDL.
2. Analyze and design CMOS logic circuits.
3. Implement VHDL-based designs on FPGA
4. Compare CMOS and FPGA-based digital design

Unit – I	**Introduction to VLSI Design**	**04 Hours**

Evolution of VLSI Technology, VLSI Design Flow – Specification, RTL Design, Synthesis, Fabrication, ASIC, FPGA & Full-Custom vs Semi-Custom Design

Unit – II	**VHDL Programming Basics**	**08 Hours**

Introduction to VHDL: Entity, Architecture, Data Types, operators, multi valued logic, transport and inertial delays, Behavioral, Dataflow, and Structural Modeling, Combinational Circuits: Multiplexer, Decoder, ALU, Sequential Circuits: Flip-Flops, Counters, Shift Registers, Simulation using Model Sim /Xilinx Vivado.

Unit – III	CMOS Logic Design	08 Hours
CMOS Inverter Characteristics: Noise Margins, Power Dissipation, Design of Basic Logic Gates using CMOS, Combinational & Sequential CMOS Circuits, Introduction to Power Optimization Techniques.		
Unit – IV	**FPGA Implementation**	**06 Hours**
FPGA Architecture Overview, Synthesis & Implementation of VHDL Code on FPGA, Case Study: Implementation of a Digital System (e.g., ALU, FSM)		

Internal Continuous Assessment (ICA)

ICA shall consist of minimum eight experiments and one mini-project based on following

1. Writing Basic VHDL Code (AND, OR, NOT, XOR Gates)
2. Simulation of Combinational Circuits (Multiplexer, Comparator)
3. Sequential Circuit Design (Counters, Shift Registers)
4. CMOS Logic Simulation: Inverter & NAND Gate in LTspice
5. FPGA Implementation of ALU or a Simple Processor Module

Textbooks:

1. CMOS VLSI Design: A Circuits and Systems Perspective – Neil H. E. Weste & David Harris
2. VHDL: Programming by Example – Douglas L. Perry
3. Digital Systems Design using VHDL, Charles H Roath, Lizy John, Cengage Learning

Reference books:

1. A VHDL Primer , Jayaram Bhasker
2. Fundamentals of Digital Logic with VHDL Design, Stephan Brown and Z Vranesic, TMH
   Xilinx FPGA Documentation & Tutorials

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Electronics and Computer Engineering), Semester-VI

23ECU6E14T :Program Course II- Control Systems

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Tutorial	1 Hour/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

This course provides a thorough introduction to the fundamentals of control systems. The course covers transfer function and mathematical modelling of electrical systems. The course intends the study of stability analysis of the closed loop systems using various mathematical and graphical methods along with necessary compensation techniques to evaluate the performance of electrical systems. Analysis of the linear time invariant single input & single output control system in time domain and frequency domain is included.

Course Prerequisite:

Mathematical background for finding system transfer function and its mathematical model, knowledge of Laplace transform, inverse Laplace transform and electrical circuit simplification method is necessary.

Course Objectives:

1. To make student classify the control system and represent it mathematically.
2. To introduce various control system components used in feedback control system.
3. To make student understand time domain and frequency domain analysis to evaluate system performance.
4. To introduce student different methods to determine the system stability.
5. To introduce student different types of compensators & controllers

Course Outcomes:

After completion of this course, student will be able to

1. Classify the control system and represent it mathematically.
2. Explore different control system components of feedback control system..
3. Analyze system performance using time domain and frequency domain analysis.
4. Apply different techniques to determine the system stability.
5. Evaluate different compensators and controllers.

Unit – I	**Basics of Control Systems and Mathematical Modelling**	**08 Hours**

Classifications of control systems, open loop and closed loop control system, liquid level control system, servo mechanism, transfer function and related terminologies, mathematical modeling of electrical system, transfer function of electrical system, transfer function using block diagram reduction techniques, signal flow graph and Mason's gain formula.

Unit – II	**Control System Components**	**05 Hours**
Working principle, construction, types and applications of following control system components- stepper motor, AC and DC servomotor, synchro, potentiometer and tacho generator, transfer function of field controlled & armature controlled DC		
Unit – III	**Time Response Analysis**	**08 Hours**
Introduction, standard test signals, analysis of first order system, analysis of second order system , time domain specifications of second order system, steady state error and error constants of type 0 , type 1 and type 2 systems.		
Unit – IV	**Stability of System and Root Locus**	**09 Hours**
Introduction**,** concept of stability, necessary conditions for stability, Hurwitz stability criterion , Routh's stability criterion, construction of root locus and stability analysis using root locus		
Unit – V	**Frequency Domain Analysis**	**07 Hours**
Frequency domain specifications- Bode plots, Determination of Frequency domain specifications and transfer function from the Bode plot – Phase margin and Gain margin, Stability Analysis from Bode Plots, Polar Plots.		
Unit – VI	**Compensators & Controllers**	**05Hours**
Need of compensator, lag compensators, lead compensators and lag-lead compensator and their design in the frequency domain, proportional controllers, PI controllers and PID controllers.		

Internal Continuous Assessment (ICA) :

ICA shall consist of minimum 08 tutorials based on following:

1. Mathematical modeling of electrical systems.
2. Transfer function by using block diagram reduction technique.
3. Transfer function by using Mason's gain formula.
4. Analysis of first order and second order system.
5. Time domain specification of second order system.
6. Stability Analysis using Routh-Hurwitz criterion
7. Stability analysis using Root Locus.
8. Polar plot
9. Bode plot.

Text Books

1. Control Systems Engineering, I. J. Nagrath& M Gopal, 5th Edition, New Age International Publication.
2. Control Systems Principals and Design, M Gopal, 3rd Edition, Tata McGraw Hill Education Private Limited.
3. Control Systems Engineering, Rajiv Gupta, Wiley INDIA Private Limited.

Reference Books
1. Modern Control Engineering, K.Ogata, 3rd edition, Pearson Education. 2. Feedback & Control Systems, Schaum's Outline Series, Tata McGraw Hill Education Private Limited. 3. Feedback control problems using MATLAB, Dean Fedric and Joe Chow, Thomson learning.

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Electronics and Computer Engineering), Semester-VI

23ECU6E24T : Program Elective Course II - Image Processing

Teaching Scheme		**Teaching Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Tutorial	1 Hour/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

With the rapid advancement of digital technology, image processing has evolved into a critical field with applications spanning across biometrics, medical imaging, remote sensing, autonomous systems, and industrial diagnostics. Over the past few decades, the field has matured significantly, driven by the explosion of the internet and computational advancements. This course provides a comprehensive introduction to digital image processing, focusing on fundamental concepts, key algorithms, and practical techniques. Students will explore image enhancement, restoration, segmentation, feature extraction, and compression techniques, along with their implementation in real world applications.

Course Prerequisite:

Student shall have strong background in mathematics, matrix theory, signal processing, and programming (MATLAB/Python) will find it easier to grasp Digital Image Processing concepts.

Course Objectives:

1. To understand the fundamentals of digital image processing
2. To study various image transformation techniques
3. To learn and apply image enhancement and restoration techniques in spatial and frequency domains.
4. To explore image segmentation and feature extraction methods.
5. To understand and implement image compression techniques

Course Outcomes:

After completing this course, student will be able to –

1. Describe the fundamental concepts and steps of digital image processing, and apply basic Image processing operations.
2. Apply discrete image transformation techniques such as Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT), and Wavelet Transform for image analysis and processing tasks.
3. Implement various image enhancement and image restoration techniques in both spatial and frequency domains
4. Analyze and perform image segmentation and feature extraction techniques for object identification.
5. Apply various image compression algorithms.

Unit – I	**Fundamentals of Digital Image Processing**	**07 Hours**
Fields of use of digital image processing, fundamental steps in digital image processing, Image acquisition ,sampling & quantization, image representation, spatial & intensity resolution, neighborhood, connectivity of pixels, distance measurement, matrix operations, spatial operations, and basics of transform domain, color models & color conversion		
Unit – II	**Image Transforms**	**07 Hours**
Need for image transforms, Discrete Fourier transform, discrete cosine transforms, wavelet transform, Eigen analysis ,singular valued composition (SVD),principal component analysis (PCA).		
Unit – III	**Image Enhancement**	**06 Hours**
Point processing: contrast stretching, histogram equalization, log and power-law transformations, Spatial filtering: smoothing and sharpening filters, Frequency domain filtering: low-pass, high-pass, and band-pass filtering, Unsharp masking, high-boost filtering, and homomorphic filtering, Color image enhancement.		
Unit – IV	**Image Restoration and Reconstruction**	**07Hours**
Image degradation model, Noise models (Gaussian, salt-and-pepper, speckle, etc.),Noise reduction techniques (mean, median, adaptive filters),Inverse filtering, Wiener filtering, Blind deconvolution Morphological processing and operations		
Unit – V	**Image Segmentation and Feature Extraction**	**07 Hours**
Edge detection: Sobel, Prewitt, Laplacian, and Canny operators, Region-based segmentation: region growing, region splitting & merging, Thresholding techniques (global, adaptive, Otsu's method), Feature extraction: shape-based, texture-based, and color-based features, Principal Component Analysis (PCA) for feature reduction.		
Unit – VI	**Image Compression**	**07Hours**
Need for image compression, Lossless compression techniques: Run-Length Encoding (RLE), Huffman Coding, Arithmetic Coding, LZW, Lossy compression techniques: Transform coding (JPEG, JPEG 2000), Vector Quantization (VQ)and Basics of video compression (MPEG standards)		

Internal Continuous Assessment (ICA) :

ICA shall consist of minimum 08 tutorials based on following:

1. Program based on basic image properties
2. Program based on change in the resolution and image quality
3. Program based on DCT and IDCT
4. Program for histogram enhancement and contrast stretching
5. Program for image sharpening
6. Program for image restoration
7. Program for image segmentation
8. Program for edge detection
9. Program for feature extraction
10. Program for image compression

Text Books and Reference Books

1. Digital Image Processing;R.C.Gonzalez,R.E.Woods;2nd Edition;PearsonEducation
2. Digital Image Processing using MATLAB ;R.C.Gonzalez,R.E.Woods;2nd Edition; Pearson Education
3. Digital Image Processing & Computer Vision; MilmanSonka, Vaclav Hlavac, RogerBoyle; Cengage Learning Digital Image Processing-An Algorithmic Approach; MadhuriA.Joshi; Prentice Hall of India Pvt Ltd

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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23ECU6E15T : Programme Elective Course III - Automotive Electronics

Teaching Scheme		Examination Scheme	
Lectures	**3 Hours/week**	**ESE**	**60 Marks**
Tutorial	**1 Hours/Week**	**ISE**	**40 Marks**
Credits	**4**	**ICA**	**25 Marks**

Introduction:

The automotive sector has emerged as one of the major application areas for electronics engineering. This program specific elective is designed with two objectives, first objective is to introduce basic automotive aspects like working of engine and power train and other is exposing the student with electronics technology pertinent to the automotive sector like sensors, actuators control and communication.

Course Prerequisite:

Students shall have knowledge of basic two stoke and four stroke IC engines, hydraulics and pneumatics. Students also pose some background for transducers, electronic circuit design, microprocessors / microcontrollers and control systems.

Course Objectives:

1. To introduce the basics of automobile dynamics and automobile electronic systems
2. To introduce available automotive sensors, actuators and their interface with microcontroller.
3. To provide an overview of automotive communication protocols and diagnostics systems
4. To make students aware of reliability, safety, and smartness related to automobiles

Course Outcomes:

After completing this course, student will be able to –

1. Describe fundamental concepts of automobile dynamics and identify basic electronic systems used in automotive design
2. Explain various automotive sensors and actuators and explain their interfacing with microcontroller
3. Describe major automotive communication protocols and explain the working of diagnostic systems used in vehicles
4. Explain concepts of reliability, safety features, and smart technologies used in modern automobiles.

Unit – I	**The Basics of Electronic Engine Control**	**06 Hours**
Electronic Engine Control- Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance.		
Unit – II	**Automotive Sensors and Actuators**	**08 Hours**
Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor. Actuators- Solenoid, Fuel Injector, EGR Actuator, Ignition System		
Unit – III	**Digital Engine Control Features**	**06 Hours**
Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System-Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.		
Unit – IV	**Automotive Networking**	**07Hours**
Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System-Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.		
Unit – V	**Vehicle Motion Control**	**06 Hours**
Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Antilock Brake System (ABS)		
Unit – VI	**Automotive Diagnostics and Future Automotive Electronic Systems**	**07 Hours**
Occupant Protection Systems -Accelerometer based Air Bag systems. Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar Warning Systems, Low tire pressure warning system, Heads Up display, Voice Recognition Cell Phone dialing, Automatic driving Control.		

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 08 tutorials based on the following topics:

1. Exhaust emissions, fuel economy, and the concept of an electronic engine control system
2. Air/fuel ratio, spark timing, and exhaust gas recirculation (EGR) affect engine performance.
3. Automotive actuators, including solenoids, fuel injectors, EGR actuators, and ignition systems within vehicle control systems
4. Sensors in automotive control systems and study the working principles of various sensors such as airflow rate sensor, MAP sensor, position sensors
5. Fuel control modes, exhaust gas recirculation (EGR) control, and electronic ignition control including closed-loop ignition timing and spark advance correction schemes
6. Integrated engine control systems covering secondary air management, evaporative emissions control, automatic system adjustment, and onboard system diagnostics
7. Typical and digital cruise control systems, including digital speed sensors, throttle actuators, system configuration, and the fundamentals of Antilock Braking System (ABS)
8. Modern automotive technologies including occupant protection systems like accelerometer-based airbag systems, alternative fuel engines, electric and hybrid vehicles

Textbooks:

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.
3. Mechatronics: Integrated Mechanical and Electronic System, K.P. Ramchandran, G.K. Vijayraghavan, M.S. Balsundaram Wiley India, 2010

Reference Books:

1. Automotive Electronics Handbook, Robert Bosch, John Wiley and Sons
2. Automotive Electricity and Electronics, James D Halderman, PHI Publication

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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23ECU6E25T : Programme Elective Course III - Artificial Intelligence

Teaching Scheme		**Examination Scheme**	
Lectures	**3 Hours/week**	**ESE**	**60 Marks**
Tutorial	**1 Hours/Week**	**ISE**	**40 Marks**
Credits	**4**	**ICA**	**25 Marks**

Introduction:

This course presents a basic introduction to the techniques used in developing artificial intelligent systems. It is a walkthrough to problem spaces and search algorithms, knowledge representation, reasoning, logic programming and applications of artificial intelligence

Course Prerequisite:

Student shall have fundamental knowledge of algorithms

Course Objectives:

1. To make student understand various problem solving methods through search techniques
2. To make student understand the various methods for knowledge representation and reasoning
3. To make student understand the various methods for decision making
4. To make student comprehend learning and knowledge acquisition concepts

Course Outcomes:

After completing this course, student will be able to -

1. Analyze the characteristics and behaviors of various intelligent agents to determine their suitability for different problem-solving scenarios.
2. Apply different search algorithms such as A*, AO*, and evolutionary search to solve complex problems efficiently.
3. Illustrate the use of specific knowledge representation techniques (e.g., first-order logic, ontologies and Bayesian networks) for reasoning in intelligent systems.
4. Apply effective decision-making strategies based on utility theory, game theory, and probabilistic reasoning for AI-based applications.

Unit – I	**Fundamentals of Artificial Intelligence**	**06 Hours**

Foundations, scope, problems, and approaches of AI, intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents.

Unit – II	**Problem-Solving Through Search**	**07 Hours**

Forward and backward, state-space, blind, heuristic, problem-reduction, A, A, AO, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Unit – III	**Knowledge Representation and Reasoning**	**07 Hours**
Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; first order logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.		
Unit – IV	**Representing and Reasoning with Uncertain Knowledge**	**07 Hours**
Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, and sample applications.		
Unit – V	**Decision-Making**	**06 Hours**
Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.		
Unit – VI	**Learning and Knowledge Acquisition**	**07 Hours**
A bird's eye view, scalability issues and the streaming scenario, a stroll through some application scenarios.		
Unit – VII	**AI Today and Beyond: A Philosophical Outlook**	**03 Hours**
Philosophical foundations, AI: the present and future.		

Internal Continuous Assessment (ICA):

ICA shall consist of minimum 08 tutorials based on the following topics.

1. Intelligent agents
2. Problem solving through search
3. First order logic
4. Bayesian networks
5. Decision and game theory
6. Statistical learning
7. Q-learning.

Textbooks:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Prentice Hall
2. A First Course in Artificial Intelligence, Deepak Khemani, McGraw Hill Education (India)
3. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.

Reference Books:

1. Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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23ECU6VS7L: Mini Project

Teaching Scheme		**Examination Scheme**	
Lectures	1 Hours/week	**ICA**	50 Marks
Practical	2 Hours/week		
Credits	2		

Introduction:

This course is designed to give third year Electronics and Computer Engineering students hands-on experience in designing and implementing a mini project in their area of interest. Students will work in a small group of three to identify a project idea, conduct background research, and develop a project proposal. The course will cover various aspects of project development including project planning, design, implementation, testing, documentation, and presentation. Students will also learn important project management skills such as teamwork, communication, and time management.

Course Prerequisite:

Students are expected to have a solid foundation in electronics and computer engineering concepts, including programming, circuits, and microcontrollers. Prior knowledge of courses in digital electronics, microprocessor systems and various programming languages will help in versatile implementation.

Course Objectives:

1. To enable students to gain hands-on experience in designing and implementing a mini project in their area of interest.
2. To enhance students' skills in testing and debugging a project to meet desired specifications.
3. To prepare students for future engineering projects, where they will need to manage a team, communicate effectively, and implement a project to create solution to problem statement.
4. To provide an opportunity for students to showcase their engineering skills and creative thinking by presenting their projects to the class and a panel of judges.
5. To promote critical thinking, problem-solving, and creativity in the context of a practical engineering project

Course Outcomes:

After completing this course, the student will be able to -

1. Identify a problem related to industry and society
2. Describe strategy or methodology to solve the problem undertaken.
3. Select appropriate hardware and software tools to solve problems
4. Test and debug a project to achieve output with desired specifications.
5. Document a project effectively and present it effectively and professionally

Unit – I	**Introduction to Electronic Design Automation(EDA)**	**02 Hours**
PCB designing concepts, PCB designing flow chart, different EDA tools		
Unit – II	**Embedded system design using Arduino and ESP 32**	**02 Hours**
Arduino basics, ESP -32 basics, development environments: Arduino IDE , interfacing of display, sensors and actuators.		
Unit – III	**Communication protocols and IoT Applications with ESP 32**	**03 Hours**
I2C, SPI, MQTT , Bluetooth and Wi-Fi communication, building IoT projects with ESP32 and cloud platforms		
Unit – IV	**Prototype IoT Projects with the ESP32 Microcontroller**	**05 Hours**
Sensor Integration and Interfacing with Arduino using Virtual simulator, understanding of electronic systems and programming logic.		

Guidelines:

Throughout the course, students will work in small groups to identify a project idea, conduct background research, and develop a project proposal. They will then plan and implement their project, and test and debug it to ensure it meets the desired specifications. Students will document their project effectively and present it clearly and professionally to the class and a panel of judges.

The knowledge related to new control-boards, sensors and innovative hardware available in the market will be given during lecture hour.

By the end of the course, students will have gained valuable experience in project development and management, enhancing their creativity and engineering skills.

1. Project group shall consist of maximum 3 students.
2. Students can choose project topics in the fields mentioned in (not limited) in the following table

Hardware Based	Software Based
Internet of Things (IoT)	Computer Vision
Robotics	Artificial Intelligence
Embedded Systems	Mobile Application Development
Biomedical Engineering	Web Development

   Students are encouraged to select a domain or field that aligns with their interests and expertise, and that addresses a real-world problem or need.
3. Students are encouraged to undertake industry collaborated topics for mini projects
4. Undertaking Innovative Product development ideas will be appreciated

Assessment Guidelines:

Below scheme is recommended for assessment of mini project–

Hardware Based		Software Based	
1. Selection of the project and pre circuit testing,	20%	1.Algorithm design, UI / UX, Database Design	20%
2.Circuit design, simulation, PCB and assembly	30%	2. Software Low Level Design, UML, ER diagrams	30%
3.Results/Output from final assembly	10%	3. Results/Output from final Demonstration	10%
4.Miniproject presentation seminar	20%	4. Mini Project presentation seminar	20%
5.Project Report	20%	5.Project Report	20%