



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE100704

Course / Subject Name: Block chain Technology

w. e. f. Academic Year:	2023-24
Semester:	6th
Category of the Course:	Open Elective – 3

Prerequisite:	Cryptography
Rationale:	Blockchain helps to manage and secure data as a record with their digital relationships in a decentralized manner. With blockchain technology, there is no need for a central authority and two parties can securely conduct communication with one another at a faster pace. Blockchain makes the Transaction transparent by keeping the chain of records.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Explain different types of Blockchain	Understand
2	Describe Consensus algorithms for decentralized network architecture	Apply
3	Explain the support of Blockchain technology in a cryptocurrency or Digital currency.	Apply
4	Use the Blockchain technology for given application	Apply

CO PO Mapping													
Course Outcome (CO)	Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Explain different types of Blockchain	3	2	-	-	2	-	-	-	-	1	-	1
CO2	Describe consensus algorithms for decentralized network architecture	3	2	2	-	2	-	-	-	-	1	-	1
CO3	Explain the support of Blockchain technology in cryptocurrency/digital currency	3	2	2	1	2	-	-	-	-	1	-	2



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CO PO Mapping													
Course Outcome (CO)	Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO4	Use Blockchain technology for a given application	3	3	3	2	3	1	-	-	2	2	2	3

CO PSO Mapping				
Topic	Course Outcome (CO)	PSO1 (Domain Knowledge)	PSO2 (Problem Analysis & Design)	PSO3 (Modern Tools & Application)
1. Explain different types of Blockchain	CO1: Understand public, private, consortium, and hybrid blockchain types	✓	✓	
2. Describe Consensus algorithms for decentralized network architecture	CO2: Analyze PoW, PoS, DPoS, PBFT, etc. in decentralized networks	✓	✓	
3. Explain the support of Blockchain in cryptocurrency or digital currency	CO3: Demonstrate the role of blockchain in digital/cryptocurrency systems	✓		✓
4. Use Blockchain technology for a given application	CO4: Apply blockchain solutions in use cases like supply chain, healthcare, etc.		✓	✓

Teaching and Examination Scheme:

Hours per Week			Course Credits	Examination Marks				150
L	T	P		Theory Marks		Practical Marks		
				E	M	I	V	
2	0	2	3	60	40	20	30	



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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE103405

Course / Subject Name: Computer Organization & Architecture

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain solution, Components of Blockchain, Block in Blockchain, The Technology Blockchain Types and 1 Consensus Mechanism: Introduction, Decentralization and Distribution, Types Hours 06 of Blockchain, Consensus Protocol Cryptocurrency – Bitcoin, Altcoin, Token: Introduction, Bitcoin and the cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrency, Cryptocurrency usage	6	21
2.	Public Blockchain System: Introduction, Public Blockchain, Popular public Blockchain, The Bitcoin 2 Blockchain, Ethereum Blockchain Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart contracts, Types 07 of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry	7	25
3.	Private Blockchain System: 3 4 Introduction, Key characteristics of Private Blockchain, Private Blockchain Examples, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault	5	17
4.	Consortium Blockchain Introduction, Key characteristics of Consortium Blockchain, Hyperledger platform, Overview of Ripple, Overview of Corda	5	17
5.	Applications of Blockchain: Introduction, Blockchain in Education, Blockchain in Healthcare	3	10
6.	Limitations and Challenges of Blockchain 03 Blockchain Implementation – Limitation, Challenges	2	1
	Total	28	100



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Program Name:

Engineering Level: UG

Course / Subject Code: BE100704

Course / Subject Name: Block chain Technology

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

Blockchain Technology By Chandramouli Subramanian, Asha George, Abhilash K A and Meena Karthikeyan , Universities Press Publication
Blockchain Blueprint for a New Economy, By Melanie Swan, O'Reilly Publication
Blockchain For Dummies By Tiana Laurence, Wiley Publication

Suggested Course Practical List:

- 1) Ethereum – With respect to Ethereum, carry out following :
 - Install Geth Client & Configure Ethereum Nodes
 - Manage Accounts and Account states.
 - Enable Mining and checking balance in Ether
 - Setting up Metamask and Testing Fund Transfer – work with Ethereum Ecosystem
- Add Parameters to Cryptocurrency
- Check Balance Before Transfer
- Adding Transfer Event for Logging
- 2) Hyperledger - With respect to Hyperledger, carry out following :
 - Installing Hyperledger Fabric(latest version)
 - Build Network with Network configuration
 - Hyperledger Fabric Demo
- 3) Corda - With respect to Corda, carry out following :
 - Corda – Setting up the Environment
 - Building the Corda Network



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Level: UG

Course / Subject Code: BE103405

Course / Subject Name: Computer Organization & Architecture

List of Laboratory/Learning Resources Required:

Introduction to Blockchain and Cryptography
Setting up a Private Ethereum Blockchain
Smart Contract Development using Solidity
Deploying Smart Contracts on Testnet
Blockchain Wallets and Transactions
Consensus Mechanism Demonstration (PoW, PoS)
Hyperledger Fabric Setup and Chaincode Deployment
Interacting with Blockchain via Web3.js
Case Study: Cryptocurrency Implementation

Suggested Project List:

Project: Study and Comparison of Blockchain Types
Project: Consensus Mechanisms in Blockchain
Project: Blockchain in Cryptocurrency and Digital Currencies
Project: Blockchain-based Application Development

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SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104701

Course/Subject Name:– Wireless Communications

w.e.f.Academic Year:	2024-25
Semester:	7 th Semester / 4 th Year (IT)
Category of the Course:	PCC

Prerequisite:	Analog and Digital Communication.
Rationale:	The course will provide fundamental knowledge and awareness about recent trends of wireless communication systems and Networks. In this course, emphasis is also given for building foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			TotalCredits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1	Introduction to Wireless Communication System: Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), WirelessLocalAreaNetwork(WLAN),BluetoothandPersonal Area Networks.	3	10
2	TheCellularConcept-SystemDesignFundamentals: Cellular system, Hexagonal geometry cell and concept offrequency reuse, Channel Assignment Strategies Distance tofrequency reuse ratio, Channel & co-channelinterferencereduction factor, S/I ratio consideration and calculation for Minimum Co- channel and adjacent interference, Handoff Strategies,	10	20



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Course/ Subject Code: BE104701

Course/Subject Name:– Wireless Communications

	UmbrellaCellConcept,ImprovingCoverage & Capacity in Cellular System- cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antennasystemdesignconsiderations.		
3	Mobile Radio Propagation Model, Small Scale Fading and diversity: Large scale path loss:- Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflectionmodel, Diffraction, Scattering, Link budget design, Max. Distance Coverageformula,Empiricalformulafor path loss, Indoor and outdoor propagation models, Small scale multipath propagation,Statistical for models multipathfading channels and diversity techniques in brief.	06	10
4	Multiple Access Techniques: Introduction, Comparisons ofmultiple Access StrategiesTDMA,CDMA, FDMA, OFDM, CSMA Protocols.	07	20
5	Wireless Systems: GSM system architecture, Radio interface, Protocols, Localizationand calling, Handover, Authentication and security in GSM, GSM speechcoding,Conceptofspreadspectrum,ArchitectureofIS-95CDMAsystem, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMAfeatures,CDMA2000cellulartechnology,GPRS systemarchitecture.	10	20
6	RecentTrends: Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWBRadio,WirelessAdhocNetworkandMobilePortability,Securityi ssuesand challenges in a Wireless network.	09	20
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	20	15	5



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Course/ Subject Code: BE104701

Course/Subject Name:– Wireless Communications

Where R:Remember; U:Understanding; A:Application, N:Analyze and E:Evaluate C:Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the basics of wireless communication and propagation of radio signals.	Apply
2	Understand the basic concepts of cellular system and design requirements.	Understand
3	Design mobile radio propagation model.	Apply
4	Differentiate multiple access techniques.	Understand
5	Compare various wireless communication systems and networks.	Apply
6	Understand the basics of wireless communication and propagation of radio signals.	Understand

Course Outcome to Programme Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	3	3	3	2	2
PO-2 Problem Analysis	2	2	3	2	2
PO-3 Design/Development	1	2	3	1	2
PO-4 Investigations	-	-	2	2	1
PO-5 Modern Tool Usage	2	1	3	2	2
PO-6 Engineer & Society	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-



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Course/ Subject Code: BE104701

Course/Subject Name:– Wireless Communications

PO-8 Ethics	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-
PO-10 Communication	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-
PO-12 Lifelong Learning	-	-	-	-	-
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO-1 Programming Skills	2	2	3	2	2
PSO-2 Analytical Ability	2	3	3	3	2
PSO-3 Software Tools Use	2	2	3	3	3

References/Suggested Learning Resources:

(a) Books:

- Wireless Communication, TheodoreS.Rappaport, Prenticehall.
- Wireless CommunicationsandNetworking, VijayGarg,Elsevier.
- Wireless digital communication, KamiloFeher,PHI.
- MobileCommunicationsEngineering, WilliamC.Y.Lee,McGrawHillPublications.
- MobileandpersonalCommunicationsystemandservicesbyRajpandya,IEEEpress(PHI).
- Wireless Communications-T.L.Singh-TMH.
- Adhoc Mobile Wireless network,C.K.ToH Pearson.



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Course/ Subject Code: BE104701

Course/Subject Name:– Wireless Communications

(b) Open source software and website:

Students may use SCILAB, MATLAB, NETSIM, NS2 and NPTL Videos, MIT open course website, VirtualLabs(Source: <http://www.vlab.co.in>)

Suggested Course Practical List:

Experiments and Problems will be based on Concept of GSM, Cellular System Design Concepts, WiFi, - MAX, Zig bee standard, Multipath propagation Environment and its parameter and loss measurement, Adhoc N/Ws & Protocols, Software Defined Radio, UWB Radio, GPRS etc.

- Experiments based on MATLAB OR SCILAB Write a MATLAB/ SCILAB Program/s based— on
 - 1 Free space Propagation Model & Frequency Selective Fading Model
 - 2 GroundReflection (Two-ray) Model
 - 3 Diffraction(Knife-Edge) Model
 - 4 Large-scaleEmpirical models
 - 5 Small-scaleEmpirical models
 - 6 CellularSystems
 - 7 WirelessLANs
- Experiments based on GSM (Using Wireless Communication Trainer)
 - Study the implementation of –GMSK modulation, OQPSK detection.
 - Observe phase response of Tx and Rx and Spectrum of Tx and Rx.
 - Measure the BER value
 - GSM AT Commands Experiments based on CDMA (Using Wireless Communication Trainer)
 - Study the performance of DS-CDMA system under multi-path condition for single user case
 - Using RAKE receiver with MRC method and EGC method
 - Observation of SNR vs BER curve for two different combining techniques. Experiments based on OFDM (Using Wireless CommunicationTrainer)



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Course/Subject Name:– Wireless Communications

- Study OFDM system synchronization requirement
 - Observe the performance of Schmidl-Cox algorithm used for timing acquisition and fractional freq offset estimation
 - Integer Frequency offset estimation

List of Laboratory/Learning Resources Required:

DSO, CRO, Signal Generators, Spectrum Analyzers, GSM, GPRS, GPS, CDMA Trainer Kits, Mobile Communication & WirelessCommunication Trainer Kits etc.

Suggested Project List:

- Simulation of Free Space and Multipath Fading Models in MATLAB/SCILAB
 - Tools: MATLAB/SCILAB
- Design and Analysis of GSM Network Architecture
 - Tools: GSM Trainer Kit / Simulation
- Comparative Study of Multiple Access Techniques (TDMA, CDMA, OFDM)
 - Tools: MATLAB or NS2
- Development of Wi-Fi Network Simulation using NS2/NETSIM
 - Tools: NS2 / NETSIM
- CDMA System under Multipath with RAKE Receiver Implementation
 - Tools: Wireless Communication Trainer



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104702

Course/Subject Name:– Software Project Management

w.e.f.Academic Year:	2024-25
Semester:	7 th Semester / 4 th Year (IT)
Category of the Course:	PCC

Prerequisite:	Fundamentals of Software Engineering
Rationale:	Today's world is a digital world driven by software of varying sizes and complexity. Understandably, the effectiveness and efficiency of the work done nowadays, primarily depends on the quality of the software(s) being employed. The quality of the software relies on the way it is managed during its development as well as maintenance.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			TotalCredits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1	Introduction to Software Project Management (SPM): Rationale, Software Projects Vs other types of Projects, Contract Management and Technical Project Management, Activities Covered by SPM, Plans, Methods and Methodologies, Categorizing Software Projects, Project Charter, Stakeholders, Setting Objectives, Project Success and Failure, Management Control, Project Management Life Cycle, Traditional versus Modern Project Management Practices.	4	10
2	Project Planning: Tasks in Project Planning; Work Breakdown Structures (WBS), Planning Methods, Selecting Project Approach, SDLC, Software Processes and Process Models, Choice of Process Models, A Generic Project Model, Software Cost Estimation; COCOMO Model; Budgeting.	6	15
3	Project Scheduling, Monitoring & Control: Scheduling Techniques, Program Evaluation and Review Technique (PERT), Gantt Chart, Critical Path Method (CPM),	7	15



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104702

Course/Subject Name:– Software Project Management

	Automated Tools. Project Status Reporting; Project Metrics; Earned Value Analysis(EVA); Project Communication Plan & Techniques; Steps for Process Improvement.		
4	Risk Management: Concepts of Risks and Risk Management; Risk Management Activities; Effective Risk Management; Risk Categories; Aids for Risk Identification; Potential Risk Treatments; Risk Components and Drivers; Risk Prioritization.	6	15
5	Configuration Management: Software Configuration Management (SCM) – Baselines, Software Configuration Items (SCI), SCM Process, Identification of Objects in the Software Configuration, Version Control, Change Control, Configuration Audit, Status Reporting, Goals of SCM.	4	10
6	Quality Assurance: Software Quality Assurance Activities, Software Qualities, Software Quality Standards – ISO Standards for Software Organization, Capability Maturity Model (CMM), Comparison between ISO 9001 & SEI CMM, Other Standards.	6	15
7	Software Re-engineering: Software Maintenance Problems, Redevlopment vs. Reengineering, Business Process Reengineering, Software Reengineering Process Model, Technical Problems of Reengineering.	6	15
8	Project closure: Project Closure Analysis, Case Study of Software Company's ProjectClosure Analysis Report.	3	5
Total		42	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	30	25	15	15	5

Where R:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104702

Course/Subject Name:– Software Project Management

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Describe and determine the purpose and importance of a software project and project management practices	Understand
2	Compare project approaches for given software project and identify risk factors.	Understand
3	Estimate and evaluate project cost and schedules and determine risk management approaches.	Understand
4	Define and evaluate quality assurance measures.	Apply
5	Implement a project to manage project schedule, expenses and resources with the application of suitable project management tool	Apply

Course Outcome to Programme Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	2	3	3	2	2
PO-3 Design/Development	2	2	2	2	3
PO-4 Investigations	-	2	2	2	2
PO-5 Modern Tool Usage	1	2	2	1	3
PO-6 Engineer & Society	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-
PO-8 Ethics	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-



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Course/Subject Name:– Software Project Management

PO-10 Communication	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-
PO-12 Lifelong Learning	-	-	-	-	-
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO-1 Programming Skills	2	2	2	2	3
PSO-2 Analytical Ability	3	3	3	3	2
PSO-3 Software Tools Use	2	2	2	2	3

References/Suggested Learning Resources:

(a) Books:

- 1) Bob Hughes and Mike Cotterell, “Software Project Management”, Tata McGraw Hill, 4th edition, 2006
- 2) Walker Royce, “Software Project Management”, Pearson Education, 2005
- 3) Kieron Conway, “Software Project Management”, Dreamtech Press, 2001
- 4) S. A. Kelkar, “Software Project Management”, PHI Publication, 15th edition, 2013.
- 5) Roger S. Pressman, “Software Engineering – A Practitioner’s approach”, Tata McGraw Hill, 2009
- 6) Ramesh, ”Managing Global software Projects”, Tata McGraw Hill, 2001

(b) Open source software and website:

1. www.rspa.com/spi
2. www.sei.cmu.edu



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Course/Subject Name:– Software Project Management

Suggested Course Practical List:

Case Study:

Stage 1: Selection of case study topics and formation of small working groups of 3-5 students per group. Students engage with the cases, read through background material provided in the session and work through an initial set of questions to deepen the understanding of the case. Sample Project closure analysis report is given to the students to study.

Stage 2: The groups are expected to perform closure analysis report for their own semester project

Stage 3: Each group prepares a short 2 – 5 page report on their results and a 10 min oral presentation of their project closure analysis.

Apart from case student students will perform at the following exercises:

1. Prepare SRS for given software project
2. Compare SDLC models for the given project
3. Estimate project cost and prepare project schedule
4. Evaluate risk management approaches suitable for the project
5. Design test suite to ensure software quality

List of Laboratory/Learning Resources Required:

● Software Tools:

- Microsoft Project / OpenProj / GanttProject
- Lucidchart / Draw.io (for WBS and Gantt/PERT diagrams)
- Excel (for budget estimation, EVA calculation)
- GitHub (for SCM practices)
- Trello/Jira (for agile project tracking)

● Hardware/Systems:

- Desktop PCs / Laptops with project tools installed
- Internet access for research, tools, and SEI-CMM case studies

● Documents/Templates:



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Course/Subject Name:– Software Project Management

- Sample SRS template
- Sample project closure report
- Risk register template
- Test plan & QA checklist templates

Suggested Project List:

- College Management System:
 - Develop WBS, cost estimation (COCOMO), schedule (Gantt), and closure report.
- Online Examination System:
 - Full project lifecycle including risk identification, quality planning, and closure.
- E-commerce Platform for Local Businesses:
 - Project scheduling (PERT/CPM), budgeting, and communication planning.
- Bug Tracker System for Software Companies:
 - Configuration management practices using Git, risk categorization.
- Library Automation System:
 - Prepare SRS, test plan, estimate cost, evaluate QA measures.



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104703

Course/Subject Name:– Agile Development and UI/UX design

w.e.f.Academic Year:	2024-25
Semester:	7 th Semester / 4 th Year (IT)
Category of the Course:	PCE

Prerequisite:	Basic understanding of Software Development Life Cycle (SDLC) and Human-Computer Interaction (HCI) concepts is beneficial but not mandatory.
Rationale:	Agile software development methodology helps software development teams to have high degree of collaboration with the clients, providing more opportunities for the team to truly understand the client's vision hence significantly improve the quality of their software at each release. The developers can adapt to changes quickly. UX is important in fulfilling the user's needs

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			TotalCredits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	0	3	60	40	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1	AGILE DEVELOPMENT: Agile Practices, Overview of Extreme Programming, Planning, Testing, Refactoring.	7	15
2	AGILE DESIGN. What Is Agile Design?, SRP: The Single-Responsibility Principle, OCP: The Open-Closed Principle, LSP: The Liskov Substitution Principle, DIP: The Dependency-Inversion Principle, ISP: The Interface-Segregation Principle.	11	30
3	UX and UX Design, The Wheel:UX Processes, Lifecycle, Methods and Techniques, Scope, rigor, complexity and Project perspective,Agile	7	15



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Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104703

Course/Subject Name:– Agile Development and UI/UX design

	lifecycle Processes and the Funnelmodel of Agile UX.		
4	The nature of UX design, Bottom up versus Top-down DesignGenerative Design :ideation,sketching,critiquing Prototype candidate design	7	15
5	UX evaluation methods and techniques Empirical UX evaluation :UX goals , metrics and Targets Analytic UX evaluation:Data collection methods and Techniques	7	15
6	Connecting Agile UX with Agile Software Engineering	3	10
	Total	42	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	40	25	15	10	5

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the practices and philosophies of agile methods.	Understand
2	Examine the User experiences and User designs with empirical and analytic evaluations.	Understand
3	Demonstrate the connection between UX design with Agile software Development.	Understand
4	Use an agile UX design and Agile software development method as per the need of the project.	Understand



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Course/Subject Name:– Agile Development and UI/UX design

Course Outcome to Programme Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	2	2	2	3	-
PO-2 Problem Analysis	1	3	3	3	-
PO-3 Design/Development	2	2	3	3	-
PO-4 Investigations	-	2	2	2	-
PO-5 Modern Tool Usage	1	2	2	3	-
PO-6 Engineer & Society	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-
PO-8 Ethics	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-
PO-10 Communication	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-
PO-12 Lifelong Learning	-	-	-	-	-
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO-1 Programming Skills	1	2	2	3	-



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Course/Subject Name:– Agile Development and UI/UX design

PSO-2 Analytical Ability	2	3	3	3	-
PSO-3 Software Tools Use	1	2	2	3	-

References/Suggested Learning Resources:

(a) Books:

- 1) Agile Software Development, Principles, Patterns, and Practices: International Edition by Robert C.Martin, Pearson Publication
- 2) The UX Book Agile UX Design for a Quality User Experience By Rex Hartson, Pardha S. Pyla, Morgan Kaufman publication
- 3) Designing Interfaces Patterns for Effective Interaction Design By Jenifer Tidwell,
Charles Brewer, Aynne Valencia-Brooks · 2020 O'reilly

(b) Open source software and website:

- <https://www.figma.com> – UX/UI Design
- <https://miro.com> – Agile design thinking
- <https://uxdesign.cc> – UX case studies and methods
- <https://usability.gov> – Government UX research resource
- <https://trello.com> – Agile task management
- <https://agilealliance.org> – Agile principles and practices

List of Laboratory/Learning Resources Required:

- Software Tools:



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Course/ Subject Code: BE104703

Course/Subject Name:– Agile Development and UI/UX design

- Figma / Adobe XD (UX prototyping)
 - Miro / Draw.io (Agile storyboards, wireframes)
 - Trello / Jira (Agile boards and sprints)
 - UsabilityHub / Hotjar (UX testing, heatmaps)
 - Google Forms / Excel (for UX metric collection)
-
- Hardware/Devices:
 - Internet-enabled desktops/laptops
 - Optional: tablets/smartphones for responsive design testing



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104704

Course/Subject Name:– Graph Theory and Combinatorics

w.e.f.Academic Year:	2024-25
Semester:	7 th Semester / 4 th Year (IT)
Category of the Course:	PCE

Prerequisite:	Calculus, Linear Algebra, and comfort with mathematics
Rationale:	This course will introduce students to graph theory through foundational concepts and fundamental existential and algorithmic problems related to trees, matchings, connectivity and planarity, using proof techniques based on induction, extremal choices, and algorithms.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			TotalCredits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	0	3	60	40	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1	Introduction to Graph Theory: Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, de Bruijn sequences, Planar Graphs, Hamilton Paths and Cycles, Graph Colouring, and Chromatic Polynomials	11	30
2	Trees: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Weighted Trees and Prefix Codes, Planar duality, Spanning trees in planar graphs	05	10
3	Optimization and Matching: Transport Networks – Max-flow, Min-cut Theorem, Matching's, Hall's marriage theorem, Optimal matching's, The stable matching problem,	06	20
4	Fundamental Principles of Counting : The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition, The Catalan Numbers	05	10



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104704

Course/Subject Name:– Graph Theory and Combinatorics

5	The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials	05	10
6	Generating Functions: Introductory Examples, Definition and Examples – Calculational Techniques, Partitions of Integers, the Exponential Generating Function, the Summation Operator	05	10
7	Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation, The Method of Generating Functions	05	10
Total		42	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	20	15	5

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand and apply the basic concepts of graph theory, including Eulerian trails, Hamiltonian cycles, bipartite graphs, planar graphs, and Euler characteristics.	Apply
2	Use permutations and combinations to solve counting problems with sets and multisets	Understand



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104704

Course/Subject Name:– Graph Theory and Combinatorics

3	Apply the inclusion/exclusion principle	Apply
4	Compute a generating function and apply them to solve a variety combinatorial problems	Understand
5	formulate problems in terms of graphs and apply the theorems and algorithms taught in the course to solve them	Apply
6	Set up and solve a linear recurrence relation	Understand

Course Outcome to Programme Outcome (CO-PO) Mapping

CO-PO Mapping						
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6
PO-1 Basic Engg Knowledge	3	2	2	3	3	2
PO-2 Problem Analysis	2	2	3	2	3	2
PO-3 Design/Development	-	-	-	-	2	-
PO-4 Investigations	-	-	-	-	2	2
PO-5 Modern Tool Usage	-	-	-	-	1	1
PO-6 Engineer & Society	-	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-	-
PO-8 Ethics	-	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-	-
PO-10 Communication	-	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-	-



SWAMINARAYANUNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE104704

Course/Subject Name:– Graph Theory and Combinatorics

	-	-	-	-	-	-
PO-12 Lifelong Learning						
CO-PSO Mapping						
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6
PSO-1 Programming Skills	3	-	-	2	3	-
PSO-2 Analytical Ability	3	3	3	3	3	3
PSO-3 Software Tools Use	1	-	-	2	2	2

References/Suggested Learning Resources:

(a) Books:

- 1) J. A. Bondy and U. S. R. Murty, Graph Theory with Applications
- 2) Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education, 2004
- 3) B Bollobás, Graph theory, An Introductory Course.
- 4) B Bollobás, Modern Graph Theory, Springer - 1998
- 5) D Jungnickel, Graphs, Networks and Algorithms

(b) Open source software and website:

- **NetworkX** (Python Library) – <https://networkx.org>
- **Graphviz** – <https://graphviz.org>
- **SageMath** – <https://www.sagemath.org>
- **Desmos Graphing Calculator** – <https://www.desmos.com/calculator>
- **Khan Academy – Discrete Math** – <https://www.khanacademy.org>



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

w. e. f. Academic Year:	2025-26
Semester:	7 th IT
Category of the Course:	Professional Elective -5

Prerequisite:	To dive into the world of Virtual Reality (VR) and Augmented Reality (AR), you'll need a blend of technical skills, creative tools, and a curious mindset.
Rationale:	Virtual Reality (VR) and Augmented Reality (AR) lies in their transformative ability to enhance how we experience, learn, work, and interact with the world.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Demonstrate understanding and design of VR/AR technology relates to human perception and cognition.	Understand
2	Ability to design 3D interaction techniques.	Apply
3	Demonstrate understanding of fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR .	Apply
4	Demonstrate in sights to key application areas for VR/AR	Understand
5	Able to create applications of VR to the conduct of scientific research, training, and industrial design.	Understand

Course Outcomes (COs)	PO1Engineering knowledge	PO2Problem analysis	PO3Design/development	PO4Investigations	PO5Modern tool usage	PO6- PO12(Brief mention where relevant)
CO1: Demonstrate understanding and design of VR/AR technology as it relates to human perception and cognition	✓	✓	✓		✓	PO8 (Ethics in design), PO9 (Teamwork for interdisciplinary VR/AR)
CO2: Ability to design 3D interaction techniques	✓	✓	✓		✓	PO6 (Social impact), PO7 (Environment/safety)



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

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Course Outcomes (COs)	PO1Engineering knowledge	PO2Problem analysis	PO3Design/development	PO4Investigations	PO5Modern tool usage	PO6- PO12(Brief mention where relevant)
CO3: Demonstrate understanding of fundamental computer vision, computer graphics, and HCI techniques related to VR/AR	✓	✓	✓	✓	✓	PO12 (Lifelong learning)
CO4: Demonstrate insights into key application areas for VR/AR	✓	✓	✓	✓	✓	PO7 (Environment & Sustainability), PO8
CO5: Able to create applications of VR to the conduct of scientific research, training, and industrial design	✓	✓	✓	✓	✓	PO9 (Team projects), PO10 (Communication), PO11 (Project management)

CO PSO Mapping			
Course Outcomes (COs)	PSO1Apply computing knowledge to solve complex problems.	PSO2Design and develop software systems for real-world applications.	PSO3Research and innovation in emerging technologies.
CO1: Demonstrate understanding and design of VR/AR technology in relation to human perception and cognition.	✓	✓	✓
CO2: Ability to design 3D interaction techniques.	✓	✓	✓



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

CO PSO Mapping			
Course Outcomes (COs)	PSO1 Apply computing knowledge to solve complex problems.	PSO2 Design and develop software systems for real-world applications.	PSO3 Research and innovation in emerging technologies.
CO3: Demonstrate understanding of fundamental computer vision, computer graphics, and HCI techniques related to VR/AR.	✓	✓	✓
CO4: Demonstrate insight into key application areas for VR/AR.		✓	✓
CO5: Able to create VR applications for scientific research, training, and industr			

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction of Virtual Reality: Introduction, Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Virtuality and Immersion, Current trends and state of the art in immersive technologies, developing platforms and consumer devices. Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping ,Colour theory , Simple 3D modelling ,Illumination models ,Reflection models, Shading algorithms	7	14
2.	Interactive Techniques in Virtual Reality: Introduction, From 2D to 3D, 3D space curves, 3DboundaryrepresentationGeometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.	7	22
3.	Visual Computation in Virtual Reality: Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in bet weening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions ,projectiles ,simple pendulum ,springs ,Flight dynamics of an aircraft.	7	20
4.	Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays In educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	8	10
5.	Multiple Models of Input and Output Interface in Virtual Reality: Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, modeling virtual world, Physical simulation, VR toolkits, Introduction to VR ML, Input-- Tracker, Sensor, Digital Glove, Movement Capture, Video-basedInput,3D Menus&3DScanneretc.Output --Visual/Auditory/Haptic Devices.	8	10
6.	Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.	5	8
	Total	42	100



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Burdea, G.C. and P. Coiffet, Virtual Reality Technology, Second Edition, Wiley IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. John Vince, "Virtual Reality Systems", Pearson Education Asia, 2007.
5. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.
6. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
7. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley 2016
8. Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles & Practice, Pearson Education India, 2016
9. Kent Norman (Ed), Wiley Handbook of Human Computer Interaction, Wiley 2017
10. Andy Field, "Discovering Statistics Using SPSS", SAGE Publications Ltd., 2009

(b) Open source software and website Virtual Reality (VR).

1. aframe.io
2. OpenVR on GitHub
3. OpenXR SDK
4. Jahshaka.com

Augmented Reality (AR)

1. github.com/jeromeetienne/ar.js
2. ARToolKit on GitHub
3. mixare.org
4. holokit.io
5. openar.fi

Suggested Course Practical List:

1. Developing architecture of a house using Virtual Reality.
2. Perform CRO based experiment using Virtual Reality.
3. Undertaking qualitative analysis of Chemistry using Virtual Reality.
4. Carry out assembly/disassembly of an engine using Virtual Reality.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality

5. Explore human anatomy using Virtual Reality.
6. Simulation of circulation of blood in heart.
7. Simulation of Flight/Vehicle/Space Station.
8. Building Electronic circuit using Virtual Reality, given basic electronic components.
9. Developing concept of Virtual class room

List of Laboratory/Learning Resources Required:

1. Unity
2. Unreal Engine
3. ARCore / ARKit
4. Vuforia
5. WebXR / A-Frame

Suggested Project List:

- | | |
|---------------------------------|---|
| 1. VR Maze Game | Navigate a 3D maze using a VR headset. Great for learning spatial design. |
| 2. VR Art Gallery | Create a virtual museum where users can walk through and view artwork. |
| 3. VR Roller Coaster | Simulate a thrilling ride with motion dynamics and physics. |
| 4. VR Meditation App | Build a calming environment for guided meditation. |
| 5. VR Language Learning | Teach languages through immersive scenarios and voice interaction. |
| 6. VR Escape Room | Design a puzzle-based escape game in a virtual environment. |
| 7. VR Science Lab | Let users conduct virtual experiments in physics, chemistry, or biology. |
| 8. VR Fitness App | Guide users through workouts in a gamified VR space. |
| 9. VR Tour Guide | Offer 360° tours of historical or cultural landmarks. |
| 10. VR Cooking Simulator | Simulate a kitchen where users can prepare virtual meals. |

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering Level: UG

Course / Subject Code: BE104705

Course / Subject Name: Virtual and Augment Reality



SWAMINARAYAN UNIVERSITY

Level: UG

Course / Subject Code: BE104706

Course / Subject Name: Pattern Recognition

w. e. f. Academic Year:	2025-26
Semester:	7 th IT
Category of the Course:	Professional Elective -5

Prerequisite:	Pattern recognition is a foundational concept in fields like machine learning, data science, computer vision, and even human cognition.
Rationale:	Pattern recognition is at the heart of intelligent decision-making and automation.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1.	Know the major approaches in statistical and syntactic pattern recognition.	Understand
2.	Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis	Understand
3.	Become aware of the theoretical issues involved in pattern recognition system design such as the curse of dimensionality.	Understand
4.	Apply pattern recognition techniques in practical problems	Apply
5.	Know the major approaches in statistical and syntactic pattern recognition.	Understand

CO PO Mapping

CO No.	Course Outcome	Related POs	Justification
CO1	Know the major approaches in statistical and syntactic pattern recognition.	PO1, PO2	PO1: Applies fundamental knowledge of mathematics and computing; PO2: Analyzes problems using recognized methods.
CO2	Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.	PO1, PO2, PO4	PO1: Involves mathematical theory; PO2: Identifies appropriate models; PO4: Conducts analysis based on theory.
CO3	Become aware of the theoretical issues involved in pattern recognition system design such as the curse of dimensionality.	PO1, PO2, PO11	PO2: Understands system limitations; PO11: Demonstrates awareness of broader implications and design trade-offs.
CO4	Apply pattern recognition techniques in practical problems.	PO1, PO2, PO3, PO5	PO3: Designs solutions; PO5: Applies tools to solve practical problems.



SWAMINARAYAN UNIVERSITY

Level: UG

Course / Subject Code: BE104706

Course / Subject Name: Pattern Recognition

CO PO Mapping			
CO No.	Course Outcome	Related POs	Justification
CO5	Know the major approaches in statistical and syntactic pattern recognition. <i>(same as CO1, possibly a repetition?)</i>	PO1, PO2	Duplicate of CO1 — consider merging.

CO PSO Mapping			
Course Outcomes	PSO1	PSO2	PSO3
CO1: Know statistical and syntactic pattern recognition	✓	✓	
CO2: Understand Bayes classifier, LDA	✓		✓
CO3: Theoretical issues like curse of dimensionality	✓		✓
CO4: Apply techniques in practical problems	✓	✓	✓

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

Suggested Specification Table with Marks (Theory):

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



SWAMINARAYAN UNIVERSITY

Level: UG

Course / Subject Code: BE104706

Course / Subject Name: Pattern Recognition

References/Suggested Learning Resources:

(a) Books:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4/e, Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
5. Robert J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
6. Tom Mitchell, Machine Learning, McGraw-Hill
7. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.

(b) Open source software and website:

Popular Open Source Software

1. **PatternPy**: A Python package for high-speed pattern recognition in trading analysis. Great for spotting chart patterns like Head & Shoulders or Support & Resistance. Explore on GitHub
2. **PRTools**: A MATLAB toolbox for pattern recognition, widely used in academic research. Offers a variety of classifiers and preprocessing tools
3. **Tesseract OCR**: An open-source optical character recognition engine that uses pattern recognition to detect text in images
4. **Armadillo**: A fast C++ library for linear algebra and scientific computing, useful for machine learning and pattern recognition tasks
5. **audioFlux**: A deep learning library for audio and music analysis, feature extraction, and pattern recognition
6. **TA-Lib Python**: A wrapper for the TA-Lib technical analysis library, often used in financial pattern recognition

Websites & Platforms

1. **PATN.org**: Offers a comprehensive software package for multivariate pattern analysis. It's user-friendly and has been applied across disciplines like ecology, psychology, and socio-economics. Visit PATN
2. **OpenPR GitHub**: A hub for open-source projects supported by the National Laboratory of Pattern Recognition in China. Includes tools like Caffe and L2-Net. Explore OpenPR
3. **SourceForge**: Hosts dozens of open-source pattern recognition projects, from OCR engines to statistical analysis tools. Browse SourceForge
4. **LibHunt**: Lists top-rated pattern recognition projects across languages like Python, C++, and Rust. Check LibHunt



SWAMINARAYAN UNIVERSITY

Level: UG

Course / Subject Code: BE104706

Course / Subject Name: Pattern Recognition

5. **Kaggle Datasets:** While not software, Kaggle offers open datasets ideal for training and testing pattern recognition models. Explore Kaggle

Suggested Course Practical List:

List of Laboratory/Learning Resources Required:

1. **scikit-learn** – For implementing classifiers like SVM, k-NN, and decision trees.
2. **OpenCV** – For image-based pattern recognition.
3. **TensorFlow / PyTorch** – For building neural networks and deep learning models.

Suggested Project List:

1. solve a real-world problem using pattern recognition techniques, such as:
 - Handwritten digit recognition
 - Facial expression classification
 - Intrusion detection in networks
2. **Statistical Pattern Classification**
 - Implement Bayes classifier and evaluate performance on synthetic datasets.
3. **Nearest Neighbour Classification**
 - Apply k-NN on datasets like Iris or MNIST and analyse accuracy.
4. **Decision Trees & Random Forests**
 - Build classifiers using decision trees and ensemble methods.
5. **Support Vector Machines (SVM)**
 - Train SVMs with linear and non-linear kernels on real-world data.
6. **Dimensionality Reduction**
 - Apply PCA, LDA, and t-SNE to visualize high-dimensional data.
7. **Clustering Techniques**
 - Use k-means, hierarchical clustering, and DBSCAN on unlabelled data.
8. **Neural Networks for Pattern Recognition**
 - Build and train shallow neural networks for classification tasks.
9. **Pattern Recognition in Time-Series Data**
 - Detect patterns in stock prices, ECG signals, or speech data.

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SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE104707

Course / Subject Name: Computer vision

w. e. f. Academic Year:	2025-26
Semester:	7 th IT
Category of the Course:	Professional Elective -5

Prerequisite:	About giving machines the ability to understand the visual world, which is essential for intelligent interaction, autonomy, and decision-making in the real world
Rationale:	Computer Vision exists because humans see the world visually—and machines need to do the same to interact meaningfully with it.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1.	Learn fundamentals of computer vision and its applications.	Understand
2.	Understand the basic image processing operations to enhance ,segment the images.	Understand
3.	Understand the analyzing and extraction of relevant features of the concerned domain problem.	Analyze
4.	Understand and apply the motion concepts and its relevance in real time applications.	Apply
5.	Apply the knowledge in solving high level vision problems like object recognition, image classification etc.	Apply

CO PO Mapping												
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓										
CO3	✓	✓	✓		✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							✓

Explanation of PO Mapping (for key POs)

- **PO1 (Engineering Knowledge):** All COs are based on core concepts of computer vision, requiring foundational engineering knowledge.
- **PO2 (Problem Analysis):** CO2 to CO5 require analyzing problems like image enhancement, feature extraction, and object detection.
- **PO3 (Design/Development of Solutions):** Involves designing computer vision pipelines and solutions.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE104707

Course / Subject Name: Computer vision

- **PO4 (Investigation of Complex Problems):** CO4 and CO5 involve applying motion analysis and solving complex real-time vision problems.
- **PO5 (Modern Tool Usage):** Image processing and machine learning libraries/tools (e.g., OpenCV, TensorFlow) are essential.
- **PO12 (Lifelong Learning):** CO5 encourages adapting to evolving technologies in computer vision and AI.

Program Specific Outcomes (PSOs)

Let's assume the following **PSOs** for a Computer Science or related engineering program:

- **PSO1:** Apply the knowledge of computing fundamentals, mathematics, and domain knowledge to solve real-world problems.
- **PSO2:** Design and develop intelligent systems using modern tools and techniques for solving domain-specific problems.
- **PSO3:** Engage in continuous learning to adapt to emerging technologies in computing

CO PSO Mapping			
CO \ PSO	PSO1	PSO2	PSO3
CO1	✓	✓	
CO2	✓	✓	
CO3	✓	✓	
CO4	✓	✓	
CO5	✓	✓	✓

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE104707

Course / Subject Name: Computer vision

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Overview of computer vision and its applications : Image Formation and Representation :Imaging geometry ,radiometry ,digitization ,cameras and Projections , rigid and affine transformation.	7	15
2.	Image Processing: Pixel transforms, color transforms , histogram processing , histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening ,blurring and noise removal.	9	20
3.	Feature detection: edge detection, corner detection, line and curve detection , active contours , SIFT and HOG descriptors , shape context descriptors , Morphological operations	7	15
4.	Segmentation: Active contours, split & merge, watershed, region splitting, region merging , graph-Based segmentation, mean shift and model finding, Normalized cut	6	10
5.	Camera calibration: camera models; intrinsic and extrinsic parameters; radial lens distortion; direct parameter calibration; camera parameters from projection matrices; orthographic, weak perspective, affine and perspective camera models.	5	10
6.	Motion representation: the motion field of rigid objects; motion parallax; optical flow , the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation	4	10
7.	Motion tracking: statistical filtering; iterate destination; observability and linear systems; the Kalman filter	4	10
8.	Object recognition and shape representation: alignment, appearance-based methods, invariants, image eigen spaces .	4	10
	Total	46	100



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE104707

Course / Subject Name: Computer vision

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Computer Vision: Algorithms and Applications, R.Szeliski, Springer, 2011.
2. Computer Vision: Algorithms and Applications, R.Szeliski, Springer, 2011.
3. Introductory techniques for 3D computer vision, E.Truccho and A.Verri, Prentice Hall, 1998.

(b) Open source software and website:

1. OpenCV.org
2. Robo flow Universe
3. GitHub - Computer Vision Topics
4. Eden AI
5. Viso.ai

Suggested Course Practical List:

1. Implementing various basic image processing operations in python/matlab/open CV: Reading image, writing image, conversion of images, and complement of an image
2. Implement contrast adjustment of an image. Implement Histogram processing and equalization.
3. Implement the various low pass and high pass filtering mechanisms.
4. Use of Fourier transform for filtering the image.
5. Utilization of SIFT and HOG features for image analysis.
6. Performing/Implementing image segmentation.
7. Implement optical flow computation algorithm.
8. Demonstrate the use of optical flow in any image processing application.
9. Object detection and Recognition on available online image datasets.
10. Character or digit or face classification project.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: UG

Course / Subject Code: BE104707

Course / Subject Name: Computer vision

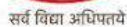
List of Laboratory/Learning Resources Required:

1. **Label Studio** – Open-source data labeling tool for images and video.
2. **Ultralytics YOLOv8** – State-of-the-art object detection and segmentation models.
3. **MediaPipe** – Google’s cross-platform framework for face, hand, and pose tracking.
4. **OpenCV** – Core library for image processing and computer vision
5. **NumPy** – For matrix operations and image representation
6. **Matplotlib / Seaborn** – For visualizing image data
7. **scikit-learn** – For traditional ML models
8. **PyTorch / TensorFlow** – For deep learning-based vision tasks

Suggested Project List:

1. **Brush up on Python and NumPy**
2. **Learn image processing techniques** using OpenCV
3. **Study ML fundamentals** and basic neural networks
4. **Dive into CNNs** and architectures like ResNet, YOLO, UNet
5. **Work on projects** like face detection, object tracking, or image classification

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Course / Subject Name: Data Compression Methods

[illegible]

- **PO1 (Engineering Knowledge):** Strongly mapped (3) for all COs as they involve technical understanding of compression algorithms and mathematical principles.
- **PO2 (Problem Analysis):** Important for identifying which compression algorithm to use in a given context (lossy/lossless).
- **PO3 (Design/Development):** Relevant where implementation or selection of algorithms is needed.
- **PO5 (Modern Tool Usage):** Applies to implementing or simulating compression techniques using tools like MATLAB, Python, or other software.
- **PO12 (Life-long Learning):** Compression technologies evolve; students should be prepared to learn new techniques over time.

CO PSO Mapping			
CO Description	PSO1	PSO2	PSO3
Understand the mathematical preliminaries involved in compression techniques	✓	✓	
Apply lossless compression algorithm to compress image, text, and audio	✓	✓	✓
Apply lossy compression algorithm considering the data and compression criteria	✓	✓	✓
Differentiate between lossless and lossy algorithms and test the suitable one for a given type of digital data	✓	✓	✓

- **PSO1:** Ability to apply fundamental concepts of mathematics, computing, and domain knowledge for solving real-world problems.
- **PSO2:** Ability to analyze, design, and implement algorithms, systems, and solutions for computational problems.
- **PSO3:** Ability to use modern tools and techniques to evaluate and optimize the performance of computing

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				(E)	(M)	(I)	(V)	
3	0	2	3	60	40	20	30	150



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Course / Subject Code: BE104708

Course / Subject Name: Data Compression Methods

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction: Compression Techniques, Modeling and Coding Mathematical Preliminaries for Loss Less Compression: Models–Physical Models, Probability Models, Markov Models. Coding – Uniquely Decodable Codes, Prefix codes	3	14
2.	Huffman coding: The Huffman Coding Algorithm–Minimum variance Huffman codes Adaptive Huffman coding–Update Procedure, Encoding Procedure, Decoding Procedure Golomb Codes Rice codes Tunstall Codes Applications of Huffman Coding–Loss less Image compression, Text compression, Audio Compression Arithmetic coding: Coding a sequence–Generating a Tag, Deciphering the Tag Generating Binary Code– Uniqueness and Efficiency of the Arithmetic code, Algorithm implementation, Integer Implementation Comparison of Huffman and Arithmetic coding Applications	12	22
3.	Dictionary Techniques: Static Dictionary–Diagram Coding Adaptive Dictionary–The LZ77 approach, The LZ78 Approach Applications–Image compression	7	20
4.	Context based Compression: Prediction with partial match (ppm)–The Basic Algorithm, The Escape symbol, Length of context, The Exclusion Principle The Burrows-Wheeler Transform–Move-to-Front Coding	5	10
5.	Loss less Image Compression: The Old JPEG Standard ,CALIC, JPEG-LS	7	10
6.	Mathematical Preliminaries for Lossy Coding: Distortion criteria – The Human Visual System, Auditory Perception Models– Probability Models, Linear System Models, Physical Models Scalar Quantization: The Quantization Problem Uniform Quantizer Adaptive Quantization–Forward adaptive, Backward Adaptive Non uniform Quantization– pdf optimized Quantization, Companded Quantization Entropy Coded Quantization – Entropy coding of Lloyd – Max Quantizer Outputs Vector Quantization: Advantages of Vector Quantization over Scalar Quantization The Linde-Buzo-Gray Algorithm Tree structured Vector Quantization Structured Vector Quantization	8	8
	Total	42	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Introduction to Data Compression–By Khalid Sayood, publication Elsevier
2. The Data Compression book By Mark Nelson, Jean Loup Gailly
3. Data Compression: The Complete Reference By David Saloman, publication Springer
4. Data Compression Methods and Theory -by JamesA.Storer

(b) Open source software and website:

1. GitHub – Compression Methods Topic: Browse public repositories implementing various compression algorithms in Python, Rust, C++, and more.
2. LibHunt – Top Data Compression Projects: Discover trending open-source projects like LZAV, Turbo Bench, and Tensor Flow-based compressors.
3. Brotli.org: Official site for Brotli, a modern lossless compression algorithm used in web browsers and CDNs.
4. Archiveteam Wiki: Comprehensive list of compression tools, formats, and archival recommendations.
5. libbsc.com: High-performance block-sorting compression library with GPU acceleration and C++ interface.

Suggested Course Practical List:

1. Given the code as sequence of characters and given the probability of characters, write a program to calculate average length of each code.
2. Write a program to generate Huffman code.
3. Write a program to generate binary code for the sequence ab ac abb, Given the frequency count of a – 37, b- 38, c-25.
4. Write a program to implement diagram coding for given text file.
5. Write a program to implement LZ77 algorithm.
6. Write a program to implement LZ78 algorithm.
7. Write a program to implement LZW algorithm.
8. Given the sequence of characters, write a program to find unique characters, and write a program to implement pma algorithm.



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Course / Subject Name: Data Compression Methods

List of Laboratory/Learning Resources Required:

1. AnalytixLabs Blog Explains compression in digital communication and big data contexts.
2. DEV Community – Big Data Compression Discusses compression trade-offs, use cases, and system-level considerations.

Suggested Project List:

1. **Run-Length Encoding (RLE) Compressor**
Build a simple tool to compress and decompress text or bitmap images using RLE.
2. **Huffman Coding Visualizer**
Create a GUI-based app that shows how Huffman trees are built and used for encoding.
3. **Text File Compressor**
Implement LZW or DEFLATE algorithms to compress .txt files and compare results.
4. **JPEG Image Compressor**
Use Discrete Cosine Transform (DCT) to compress images and analyze quality loss.
5. **MP3 Audio Compression Simulator**
Simulate psychoacoustic models to remove inaudible frequencies and compress audio.
6. **Video Frame Compression**
Apply motion prediction and transform coding to compress video sequences (e.g., using MPEG or H.264 principles).
7. **Tabular Data Compressor**
Compress CSV or Excel files using dictionary-based methods like LZ77 or BWT.
8. **Sensor Data Stream Compression**
Build a real-time compressor for IoT data using lightweight algorithms like LZ4 or Snappy.
9. **Compression Benchmarking Tool**
Compare performance (speed, ratio, memory) of different algorithms on large datasets.

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