Department of Computer Science Engineering

M.Tech. Cyber Security
Curriculum and Syllabus

(Applicable to the students admitted from AY: 2023 onwards)

School of Engineering and Sciences
SRM University *AP*, Andhra Pradesh

Department Vision

To create technology innovators and leaders who can shape the future of society through technical, research, and entrepreneurial skills with a strong emphasis on interdisciplinary learning and collaborations.

Department Mission

1. Use effective teaching and learning pedagogies to enhance technical competency with a focus on computer science and engineering fundamentals.
2. Encourage interdisciplinary education and research by promoting the exchange of ideas among a varied community of researchers, educators, and learners.
3. Develop a substantial body of knowledge for industrial applications.
4. Create an outstanding interdisciplinary research atmosphere.
5. Instill students with effective managerial skills, fostering their development into competitive and visionary entrepreneurs.

Program Educational Objectives (PEO)

1. Develop advanced knowledge and skills in cybersecurity to address current and emerging security challenges.
2. Encourage interdisciplinary education and research by promoting the exchange of ideas among a varied community of researchers, educators, and learners.
3. Equip graduates with leadership and collaborative skills to manage and lead cybersecurity initiatives.
4. Instill ethical practices and risk management capabilities to protect digital systems and ensure societal safety.

Mission of the Department to Program Educational Objectives (PEO) Mapping

	PEO 1	PEO 2	PEO 3	PEO 4
Mission Statement 1	3	2	1	2
Mission Statement 2	2	3	2	2
Mission Statement 3	3	3	2	2
Mission Statement 4	2	3	3	3
Mission Statement 5	1	2	3	2

Program Specific Outcomes (PSO)

1. Apply, analyze, design, and implement effective cybersecurity measures and techniques to protect digital systems from evolving threats.
2. Demonstrate problem-solving and programming skills to develop innovative solutions for real-time cybersecurity challenges in industry and society.
3. Develop research, entrepreneurial, and leadership skills to address cybersecurity issues and contribute to creating a secure and ethical digital world.

Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)													
PEOs	POs										PSOs		
	Engineering Knowledge	Design Development of Solutions	Conduct Investigations of Complex Problems	Modern Tools and ICT Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork Skills	Communication Skills	Lifelong Learning	PSO 1	PSO 2	PSO 3
PEO 1	3	3	3	3	2	1	3	2	2	2	3	2	2
PEO 2	3	3	3	3	3	1	3	3	1	3	3	3	3
PEO 3	3	3	3	3	2	3	3	3	3	3	2	3	3
PEO 4	3	3	3	3	3	2	3	2	2	3	3	3	3

Category Wise Credit Distribution			
Course Sub-Category	**Subcategory Credits**	**Category Credits**	**Learning Hours**
Ability Enhancement Courses (AEC)		1	30
University AEC	-		
School AEC	1		
Value Added Courses (VAC)		1	30
University VAC	1		
School VAC	-		
Skill Enhancement Courses (SEC)		-	-
School SEC	-		
Department SEC	-		
SEC Elective	-		
Foundation / Interdisciplinary Courses (FIC)		3	90
School FIC	-		
Department FIC	3		
Core + Core Elective Including Specialization (CC)		36	1080
Core	30		
Core Elective (Inc Specialization)	6		
Minor (MC) + Open Elective (OE)	-	-	-
Research / Design / Internship / Project (RDIP)		35	1050
Internship / Design Project / Startup / NGO	3		
Internship / Research / Thesis	32		
Total		**76**	**2280**

Semester wise Course Credit Distribution Under Various Categories						
Category	**Semester**					
	I	**II**	**III**	**IV**	**Total**	**%**
Ability Enhancement Courses - AEC	0	1	0	0	1	**1**
Value Added Courses - VAC	0	1	0	0	1	**1**
Skill Enhancement Courses - SEC	2	2	0	0	4	**5**
Foundation / Interdisciplinary Courses - FIC	3	0	0	0	3	**4**
CC / SE / CE / TE / DE / HSS	18	18	0	0	36	**45**
Minor / Open Elective - OE	0	0	0	0	0	**0**
(Research/ Design/ Industrial Practice/Project/Thesis/Internship) -RDIP	0	3	17	15	35	**44**
Grand Total	**23**	**25**	**17**	**15**	**80**	**100**

Note: L-T/D-P/Pr and the class allocation is as follows.

a) Learning Hours : 30 learning hours are equal to 1 credit.

b) Lecture/Tutorial : 15 contact hours (60 minutes each) per semester are equal to 1 credit.

c) Discussion : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

d) Practical : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

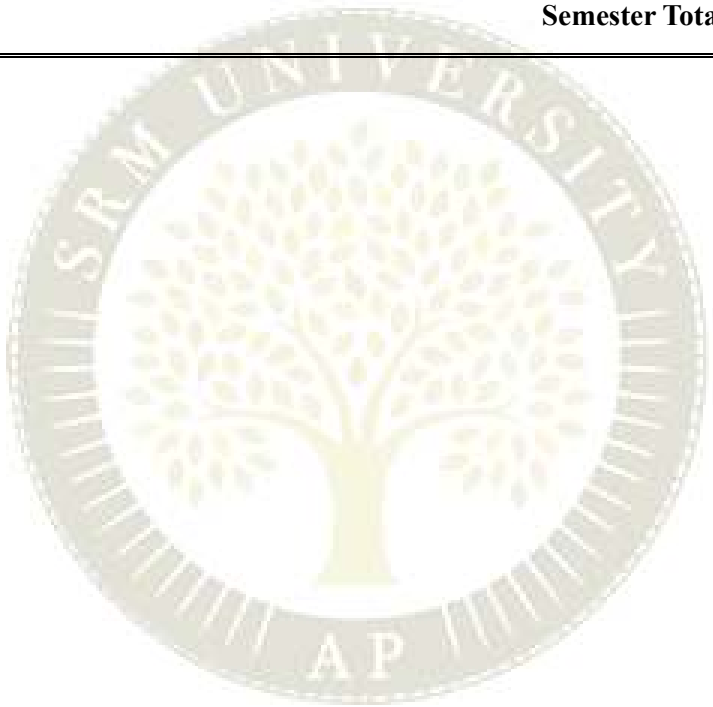
e) Project : 30 project hours (60 minutes each) per semester are equal to 1 credit.

SEMESTER - I								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	AEC	AEC 502	Research Seminar	0	0	1	1*
2	VAC	VAC	VAC 501	Community Engagement and Social Responsibility	0	0	1	1*
3	SEC	SEC	SEC 502	Design Thinking	1	0	1	2
4	FIC	FIC	FIC 507	Mathematical Foundations for Cyber Security	0	2	1	3
5	Core	CC	CYS 501	Network Security and Programming	3	0	1	4
6	Core	CC	CYS 502	Web Application Penetration Testing	3	0	1	4
7	Core	CC	CYS 503	Advanced Algorithms and Analysis	3	0	1	4
8	Core	CC	CYS 504	Applied Cryptography	3	0	1	4
9	Core	CC	CYS 505	Advanced Python Programming Lab	0	0	2	2
				Semester Total	**13**	**2**	**10**	**23**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	AEC	AEC 503	Research Seminar	0	0	1	1
2	VAC	VAC	VAC 502	Community Engagement and Social Responsibility	0	0	1	1
3	SEC	SEC	SEC 103	Entrepreneurial mindset	1	0	1	2
4	Core	CC	CYS 506	Security in Cloud Computing and IoT	3	0	1	4
5	Core	CC	CYS 507	Digital Forensics and Incident Response	3	0	1	4
6	Core	CC	CYS 508	Blockchain Technology and Applications	3	0	1	4
7	Elective	CE		Core Elective – I	3	0	0	3
8	Elective	CE		Core Elective – II	3	0	0	3
9	RDIP	RDIP	CYS 512	Project Management	0	2	1	3
				Semester Total	**16**	**2**	**7**	**25**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	CYS 509	Thesis I	0	0	14	14
2	RDIP	RDIP	CYS 510	Industrial Practice	0	0	3	3
				Semester Total	**0**	**0**	**17**	**17**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	CYS 511	Thesis II	0	0	15	15
				Semester Total	**0**	**0**	**15**	**15**



List of Core Elective								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CYS 530	Information Theory and Coding	3	0	0	3
2	Elective	CE	CYS 532	Biometric Security	3	0	0	3
3	Elective	CE	CYS 533	Intrusion Detection and Prevention Systems	3	0	0	3
4	Elective	CE	CYS 535	Software and System Security	3	0	0	3
5	Elective	CE	CYS 537	Big Data Security and Privacy	3	0	0	3
6	Elective	CE	CYS 538	Digital Watermarking and Steganography	3	0	0	3
7	Elective	CE	CYS 539	Ethical Hacking	3	0	0	3
8	Elective	CE	CYS 542	Software Vulnerability Analysis	3	0	0	3
9	Elective	CE	CYS 551	Information Security and Privacy	3	0	0	3
10	Elective	CE	AML 553	Information Retrieval	3	0	0	3
11	Elective	CE	AML 567	Soft Computing	3	0	0	3
12	Elective	CE	AML 566	Optimization Paradigms: Exploring Methods and Strategic Frameworks	3	0	0	3

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Research Seminar

Course Code	AEC 502	Course Category	AEC		L	T	P	C
					0	0	1	1
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	CSE	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

1. To learn how to write the seminars in an effective way
2. To learn what are the skills needed for presentation of science
3. To learn effective science communication

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the features and characteristics seminars and presentations.	2	80%	80%
Outcome 2	Discuss methods of the presentation.	2	65%	60%
Outcome 3	Analyse the parameters of conducting seminars	3	65%	60%
Outcome 4	Discuss the responses to Q&A sessions in seminars.	2	60%	65%
Outcome 5	Explain and Analyse conflict management during presentations and seminars.	3	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	3	2	1		3	3	2	3	1	2	2
Outcome 2	2	2	3	2	1		3	3	2	3	2	2	1
Outcome 3	2	2	3	2	1		3	3	2	3	2	2	1
Outcome 4	2	2	3	2	1		3	3	2	3	2	2	1
Outcome 5	2	2	3	2	3	3	3	3	2	3	2	2	1
Average	2	2	3	2	1	3	3	3	2	3	2	2	2

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit-I	**Research Seminar -Structure**	**5**		
	Explanation on what is a seminar and what are expected during the seminar, followed by student presentations		1,3	1,2
Unit-II	**Ways and tools of presentation in the research seminar**	**7**		
	Discussion on tools for effective presentation		1, 2	3,4,5
Unit-III	**Presentation skills**	8		
	Discussion and presentation demonstration		3	5
Unit-IV	**Handling questioning sessions of presentation**	**5**		
	How to answer the questions during the presentation. Student presentation and discussion		4,5	6
Unit-V	**Conflict management during presentation**	**5**		
	How to manage the conflicts during the presentation		1, 4, 5	6
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**			**End Review (50%)**	
		Mid-Review (50%)				
		Th	**Prac**		**Th**	**Prac**
Level 1	Remember	60%			30%	
	Understand					
Level 2	Apply	40%			70%	
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**			**100%**	

Recommended Resources

1. Tracy, B. (2008). Speak to Win: how to present with power in any situation. Amacom.
2. Anholt, R. R. (2010). Dazzle'em with style: The art of oral scientific presentation. Elsevier (ISBN: 0123694523).
3. Booth, V. (1993). Communicating in science: writing a scientific paper and speaking at scientific meetings. Cambridge University Press (ISBN: 0521429153).
4. Carter, M. (2012). Designing science presentations: A visual guide to figures, papers, slides, posters, and more. Academic Press. (ISBN: 0123859697)
5. Reynolds, G. (2011). Presentation Zen: Simple ideas on presentation design and delivery. New Riders. (ISBN: 0321811984)

Other Resources

Course Designers

1. Dr. Murali Krishna Enduri, Assistant Professor, Department of Computer Science and Engineering, SRM university AP.

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Design Thinking

Course Code	SEC 502	**Course Category**	SEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Management	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Familiarize with the principles of Design Thinking
2. Learn to apply the principles of Design Thinking
3. Apply Design Thinking to solve problems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Grasp the Concepts and process of Design Thinking	2	85%	90%
Outcome 2	Learn the process of Design Thinking	2	85%	90%
Outcome 3	Solve a problem using Design Thinking Principles	5	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3									1	3	1	3
Outcome 2	3							3		2	3	2	3
Outcome 3	3	3	3	3				3	3	3	3	3	3
Average	3	3	3	3				3	3	2	3	2	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Incubation and understanding**			1,2
	Understanding of Design Thinking & its Importance	4	1	1,2
	Importance of Design Thinking	3	1	1,2
	Pillars of Design Thinking	3	1	1,2
Unit 2	**Process – Understanding the Stages of Design Thinking**			1,2
	Stage 1- Empathy	2	2	1,2
	Stage 2 - Define	2		
	Stage 3 – Ideate	2		
	Stage 4 – Prototype	2	2	1,2
	Stage 5 – Test & Implement	2	2	1,2
Unit 3	**Application**			
	Project Work	7	3	1,2
	Viva	3	3	1,2
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (100%)**	
		CLA-1 (50%)	**CLA-2 (50%)**
Level 1	Remember	20	40
	Understand		
Level 2	Apply	30	30
	Analyse		
Level 3	Evaluate	50	30
	Create		
Total		**100%**	**100%**

Recommended Resources

1. Design Thinking – Techniques and Approaches, N. Siva Prasad

Other Resources

1. HBS – Online – Design Thinking & Innovation – course material
2. Case studies
3. Nigel Cross , Design Thinking, BERG Publishing, (2011)
4. Thomas Lockwood , Design Thinking- Integrating Innovation, Customer Experience and Brand Value, , Design Management Institute, (2009)

Course Designers

1. Satyanarayana Duvvuri, Visiting Faculty, Paari school of business, SRM University AP.

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Advanced Probability, Linear Algebra and Optimization Techniques

Course Code	FIC 504	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	Calculus, Linear Algebra, and Preliminary knowledge of MATLAB or Python	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduction of mathematical tools that are useful in developing new algorithm for machine learning.
2. Introduce the matrix method and optimization process.
3. Data analysis using the least squares classification and regression.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Analyse and analyse the large-scale computational complexity of various matrix factorization.	2	70%	75%
Outcome 2	How machine learning builds on numerical linear algebra, Optimization, and statistics.	5	70%	75%
Outcome 3	Apply the basic statistics and probability concepts.	4	70	75%
Outcome 4	Implementing the numerical methods using MATLAB/Python and analysing the numerical complexity.	6	75%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	**Program Learning Outcomes (PLO)**												
	POs										**PSOs**		
	Engineering Knowledge	Design Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2						3		2			
Outcome 2	3	3	3					3		2			
Outcome 3	3	2	3	3				3		2			
Outcome 4	3	3		3				3		3			
Average	3	2	2	3				3		2			

Course Unitization Plan

Session	Description of Topic	Contact Hours Required	CLOs Addressed	References Used
	UNIT-1 (Probability)	**6**		
1	Classical, relative frequency and axiomatic definitions of probability.	2	**CO 3**	2
2	Addition rule, multiplication rule and conditional probability.	1	**CO 3**	2
3	Total probability, Bayes' Theorem, and independence.	2	**CO 3**	2
4	Tutorial	1	**CO 3**	2
	UNIT-2 (Random Variables)	**7**		
5	Discrete, continuous, and mixed random variables, probability mass, probability density and cumulative distribution functions.	3	**CO 3**	2
6	Mathematical expectation, moments, moment generating function, Chebyshev's inequality.	3	**CO 3**	2
7	Tutorial	1	**CO 3**	2
	UNIT-3 (Linear Algebra)	**12**		
8	Finite dimensional vector spaces over a field, linear combination, linear dependence, and independence, basis, and dimension.	4	**CO 1**	1
9	Inner-product spaces, linear transformations; matrix representation of linear transformations, Projection.	3	**CO 1**	1
10	Eigen values and eigenvectors (Matrix and Transformations)	2	**CO 1**	1,3
11	Rank and nullity, inverse and linear transformation, Cayley-Hamilton Theorem.	2	**CO 1**	1,3
12	Tutorial (Python/MATLAB)	1	**CO 4**	
	UNIT-4 (Matrix Decompositions)	**10**		1,3
13	Determinant and Trace, LU-Decomposition, QR-Decomposition.	3	**CO 1, CO 2**	1,3
14	Cholesky Decomposition, Eigen decomposition and Diagonalization.	2	**CO 1, CO 2**	1,3
15	Singular Value Decomposition, Matrix Approximation and Jordan Canonical Form.	4	**CO 1, CO 2**	1,3
16	Tutorial (Python/MATLAB)	1	**CO 4**	
	UNIT-5 (Continuous Optimization)	**10**		
17	Foundations of Optimizations (Basic terminology and Definitions).	2	**CO 1, CO 2**	1
18	Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers.	4	**CO 1, CO 2**	1
19	Convex optimization and linear regression.	4	**CO 1, CO 2**	1

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Assessments (50%)
		CLA-1 (10%)	Mid-1 (20%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	30%	40%	30%	30%	40%
	Understand					
Level 2	Apply	40%	30%	30%	30%	30%
	Analyse					
Level 3	Evaluate	30%	30%	40%	40%	30%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Deisenroth, M. P., Faisal, A. A, & Ong, C. S (2020). Mathematics for Machine Learning, Cambridge University Press.
2. Ross, S. (2006). A First Course in Probability, 7th Edition, Pearson Publication.
3. Hoffman, K. M & Kunze, R. (2015) Linear Algebra, 2nd Edition, Pearson Publication.

Other Resources

1. Medhi, J. (2009). Stochastic Processes, 3rd Edition, New Age International.
2. Ross, S. M (1996). Stochastic Processes, 2nd Edition, Wiley Publication.
3. Friedberg, S. H, Insel, A. J., & Spence, L.E. (2006). Linear Algebra. 4th Edition, Pearson Publication

Course Designers

1. Dr. Tapan Kumar Hota

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Network Security and Programming

Course Code	CYS 501	Course Category	CC	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)	Cryptography and Python	Co-Requisite Course(s)	CYS 504	Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop Proficiency in Network Protocols and Socket Programming.
2. Implement and Analyze Secure Network Communications.
3. Master Advanced Network Programming Techniques.
4. Understand and Apply Network Security Measures.
5. Enhance Problem-Solving and Programming Skills in Real-World Security Challenges.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand and explain the fundamental principles of network protocols, security mechanisms, and network programming	2	70 %	65%
Outcome 2	Identify, analyze, and compare various network security protocols and their applications in real-world scenarios	2	70 %	65%
Outcome 3	Apply network programming and security principles to design and implement secure network solutions	3	70 %	65%
Outcome 4	Evaluate the performance and effectiveness of different network security mechanisms and tools in ensuring data integrity and confidentiality	4	70 %	65%
Outcome 5	Design, develop, and implement advanced network security systems and troubleshooting tools for real-world network environments	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3									3
Outcome 2	3	2		3	2							1	2
Outcome 3	3	2	3	3	2							2	2
Outcome 4	3	3		3	3			1					3
Outcome 5	3		3	3	3			2				2	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	OSI Model, TCP & UDP Introduction, TCP Connection Establishment and Format	1	1, 2	1, 2
	TCP Buffer Sizes, Limitations, Standard Internet Services, and Protocol Usage by Common Internet Applications	1	1, 2	1, 2
	Introduction to Sockets: Address Structures, Value-Result Arguments	1	1, 3	1, 2
	Byte Ordering and Manipulation Functions, Related Functions in Sockets	1	1, 3	1, 2
	Elementary TCP Sockets: Socket, Connect, Bind, Listen, Accept, Fork, Exec Functions, Concurrent Servers	1	1, 3	1, 2
	Close Function and Related Functions in TCP and UDP Sockets	1	1, 3	1, 2
	Elementary UDP Sockets: Socket, Bind, Send, Receive, and Close	1	1, 3	1, 2
Unit II	Overview of Link Layer Devices and Types of LANs	1	2, 4	1, 2
	Error Detection and Correction Techniques	1	2, 4	1, 2
	Random Access Protocols (MAC) and Their Application in LANs	1	2, 4	1, 2
	Public-Key Authentication Protocols: RSA, ECC, and Their Role in Network Security	1	2, 4	1, 2
	Symmetric-Key Authentication Protocols: AES, DES, 3DES	1	2, 4	1, 2
	Diffie-Hellman Key Agreement: Understanding and Implementation	1	2, 4	1, 2
	Pretty Good Privacy (PGP) Overview and Practical Applications	1	2, 4	1, 2
	Digital Signatures: Concepts, Algorithms, and Applications	1	2, 4	1, 2
	Certificate Authority: Role in Secure Communication and Validation	1	2, 4	1, 2
Unit III	Socket Options: getsockopt and setsockopt Functions	1	3, 5	1, 2
	Socket States and Generic Socket Options (IPv6, TCP, ICMPv6)	1	3, 5	1, 2
	Advanced I/O Functions: Socket Timeouts, recv, send Functions	1	3, 5	1, 2
	readv, writev Functions, recvmsg, sendmsg Functions, Ancillary Data	1	3, 5	1, 2
	How Much Data Is Queued? Analysis of Socket Behavior	1	3, 5	1, 2
	Sockets and Standard I/O: How to Use with Sockets and File Descriptors	1	3, 5	1, 2
	T/TCP: TCP for Transactions - Understanding Transactional TCP	1	4, 5	1, 2
	Elementary Name and Address Conversions, DNS and gethostbyname	1	4, 5	1, 2
	Resolver Options, Function and IPv6 Support in DNS	1	4, 5	1, 2
	Raw Socket Creation: Sending and Receiving Raw Packets	1	4, 5	1, 2
	Ping Program: How it Works and its Role in Network Diagnostics	1	4, 5	1, 2
	Traceroute Program: Tracing Routes in Network Communication	1	4, 5	1, 2
	BSD Packet Filter (BPF) and Data Link Provider Interface for Raw Socket Operations	1	4, 5	1, 2
Unit IV	IPSEC: Security Associations (SA), Authentication Header (AH), and Encapsulating Security Payload (ESP)	1	4, 5	1, 2
	Internet Key Exchange (IKE) Protocol Overview and Configuration	1	4, 5	1, 2
	Wireshark Analysis: IP Packet Tracing and Analysis	1	4, 5	1, 2
	IPsec Tunneling: Creating Secure Tunnels for Communication	1	4, 5	1, 2
	Virtual Private Network (VPN): VPN Technology, Types, and Configurations	1	4, 5	1, 2
	Secure Network Architecture: Designing Secure Networks with VPNs	1	4, 5	1, 2
	VPN System Over WebSockets: Implementation of VPNs in Modern Web Architecture	1	4, 5	1, 2
	Transport Layer Security (SSL/TLS): SSL and TLS Protocols, Certificate Authorities	1	4, 5	1, 2
Unit V	Firewalls: Need, Characteristics, Types, and Locations	1	2, 4	1, 2
	Firewall Configuration: Static vs. Dynamic Firewalls, ACLs, and Stateful Inspection	2	2, 4	1, 2
	Electronic Mail Security: PGP, S/MIME, DNSSEC Overview and Configuration	2	2, 4	1, 2

	Domain Keys Identified Mail (DKIM) for Email Authentication and Integrity	1	2, 4	1, 2
	Access Control Policies: Role-Based (RBAC), Attribute-Based (ABAC), and Mandatory Access Control (MAC)	2	2, 4	1, 2
	Total Contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Develop a TCP client/server application for sending encrypted message	2	3, 4	1, 3
2	Develop a UDP client/server application	2	3, 4	1, 3
3	Develop a multiprotocol server with TCP and UDP and 2 clients	2	3, 4	1, 3
4	Write a program to implement MAC-based authentication	2	2	1, 3
5	Develop a mechanism to set up a security channel using Diffie-Hellman Key Exchange between client and server	2	2	1, 3
6	Develop a mechanism to implement internal and external error control using symmetric and public key	2	3	1, 3
7	Write a TCP client-server program where the server configures socket options (SO_REUSEADDR, SO_RCVTIMEO, etc.)	2	3	1, 2
8	Create a client-server program where the client sends a message using sendmsg() with ancillary data	2	3	1, 2
9	Implement a simplified ping program using raw sockets to send and receive ICMP echo request/reply packets	2	3	1, 2
10	Set up and configure a VPN using OpenVPN to understand VPN architecture, secure tunneling, and encryption	2	4	1, 2
11	Implement a VPN system over WebSockets to explore how VPN traffic can bypass firewall restrictions	2	4	1, 2
12	Implement a one-way SSL to a web app	2	4	1, 2
13	Explore various aspects of firewall with UFW	2	4	1, 2
14	Implement Role-Based Access Control (RBAC) to manage access to resources based on user roles	2	2	1, 2
15	Explore the flexibility of Attribute-Based Access Control (ABAC) by controlling access based on user, resource, and environmental attributes	2	2	1, 2
	Total Lab Hours	**30**		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	20%	10%	15%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyse				
Level 3	Evaluate	30%	30%	40%	35%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. UNIX Network Programming, by W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Pearson Education
2. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition
3. UNIX Network Programming, 1st Edition, - W. Richard Stevens. PHI.
4. Perlman, Radia, Charlie Kaufman, and Mike Speciner. Network security: private communication in a public world. Pearson Education India, 2016.

Other Resources

Course Designers

Web Application Penetration Testing

Course Code	CYS 502	Course Category	CC		L	T	P	C
					3	0	1	4
Pre-Requisite Course(s)	Web Technology	Co-Requisite Course(s)	CYS 501	Progressive Course(s)				
Course Offering Department	CSE	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

1. Develop Expertise in Web Application Security.
2. Acquire Proficiency in Web Application Attack Techniques.
3. Implement Robust Web Application Security Measures.
4. Utilize Penetration Testing Tools and Frameworks.
5. Perform a Comprehensive Penetration Testing and Vulnerability Assessment.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand key concepts of web application security and penetration testing methodologies	2	70 %	65%
Outcome 2	Identify common web vulnerabilities, including OWASP Top 10 risks and their countermeasures.	2	70 %	65%
Outcome 3	Apply appropriate tools and techniques to identify, exploit, and mitigate web application vulnerabilities.	3	70 %	65%
Outcome 4	Analyze web security incidents and propose effective mitigation strategies for real-world scenarios	4	70 %	65%
Outcome 5	Evaluate the effectiveness of security frameworks and design custom solutions for complex security challenges	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3							3	1	1
Outcome 2	3	2		3	2					1	2	2	1
Outcome 3	3	2	3	3	2					2	2	3	3
Outcome 4	3	3	1	3	3			1			3	2	3
Outcome 5	3	3	2	3	3			2		2	3	3	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	Web Fundamentals: HTML Basics	1	1	1,2
	HTTP 1.0 and 1.1 Overview	1	1	1,2
	Client-side Scripting Overview	1	1, 2	1,2
	Client-side Scripting: Techniques	1	1, 2	1,2
	Server-side Scripting Overview	1	1, 2	1,2
	Server-side Scripting Techniques	1	1, 2	1,2
	Webserver Architecture: Windows Overview	1	1	1,2
	Webserver Architecture: Linux Overview	1	1	1,2
	IIS and LAMP Servers	1	1	1,2
	Network Topologies and DMZ	1	1	1,2
UNIT II	Introduction to Web Applications	1	2	1,2
	Web Application Hacking Techniques Overview	1	2	1,2
	Detailed Web Application Hacking Techniques	1	2	1,2
	Overview of Browsers for Security Testing	1	3	1,2
	Browser Extensions and Security Implications	1	3	1,2
UNIT III	OWASP Top 10: Introduction and Risks	1	2, 3	1,2
	Injection Attacks	1	2, 3	1,2
	Broken Authentication	1	2, 3	1,2
	Sensitive Data Exposure	1	2, 3	1,2
	Security Misconfiguration	1	2, 3	1,2
	Detection Evasion Techniques	1	3, 4	1,2
	Countermeasures for IIS and Apache	1	3	1,2
	Multifactor Authentication Mechanisms	1	3	1,2
UNIT IV	Advanced Session Analysis Techniques	1	2, 4	1,2
	Session Hijacking and Fixation	1	2, 4	1,2
	Cross-Site Scripting (XSS) Introduction	1	3	1,2
	Advanced XSS Techniques	1	3	1,2
	SQL Injection Techniques	1	2, 3	1,2
	Buffer Overflow Attacks	1	4	1,2
	Canonicalization Attacks	1	4	1,2
	Input Validation and Encoding Techniques	1	3, 4	1,2
	Input Validation Countermeasures	1	3, 4	1,2
	Tools: Metasploit Usage	1	3, 5	1,2
	Tools: Wireshark Usage	1	3, 5	1,2
UNIT V	VulnHub Virtual Machine Exploitations	1	5	1,2

	VAPT Steps: Target Recon	1	5	1,2
	Scanning Techniques	1	5	1,2
	Service Enumeration	1	5	1,2
	Vulnerability Identification	1	5	1,2
	Exploitation Techniques	1	5	1,2
	Post-Exploitation: Owning	1	5	1,2
	Post-Exploitation: Privilege Escalation	1	5	1,2
	Post-Exploitation: Pivoting	1	5	1,2
	Issues in Post-Exploitation	1	5	1,2
	Course Review and Practical Insights	1	1-5	1,2
	Total Contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Securing Web Applications using Keytool & OpenSSL	2	1, 2	1, 3
2	Implement a One-Way SSL to a Web App	2	1, 2	1, 3
3	System Fingerprinting using Nmap, Netcat, WhatWeb, Wappalyzer	3	2, 3	1, 3
4	Inspecting the Cookie Protocol	2	2, 4	1, 3
5	Burp Suite	2	2, 3	4
6	OWASP ZAP	2	2, 3	1, 3
7	XSS Attacks and Mitigations	3	3, 4	1, 2
8	Simple SQL Injection Scenario	2	3, 4	1, 2
9	Database Enumeration through SQL Injection	2	3, 4	1, 2
10	Defending against Inadequate Password Policies	2	4, 5	1, 2
11	Session Hijacking Techniques	2	3, 4	1, 2
12	Local File Inclusion (LFI) and Remote File Inclusion (RFI)	3	3, 5	1, 2
13	WSDL Scanning and Attacks on SOAP Services	3	5	1, 2
	Total Lab Hours	**30**		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	20%	10%	15%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyse				
Level 3	Evaluate	30%	30%	40%	35%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Learning Nessus for Penetration Testing, by Himanshu Kumar
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2ed
3. Mastering Modern Web Penetration Testing by Prakhar Prasad
4. Burp Suite Essentials by Akash Mahajan
5. Rtfm: Red Team Field Manual by Ben Clark
6. Practical Network Scanning: Capture network vulnerabilities using standard tools by AjaySingh Chauhan
7. Nmap: Network Exploration and Security Auditing Cookbook by Paulino Calderon Pale
8. Blue Team Field Manual (RTFM) by Ben Clark

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Advanced Algorithms and Analysis

Course Code	CYS 503	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	Algorithms and Data Structures	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the basics of Python programming.
2. To learn I/O Operations, Basic image processing using Python.
3. To learn the basic data analysis using Python.
4. To learn Extending and Embedding Python.
5. To learn and implement projects.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	To understand the basics of Python programming.	1	70 %	65%
Outcome 2	To apply /O Operations and basic image processing techniques.	3	70 %	65%
Outcome 3	Manage large amounts of data by applying data science techniques.	4	70 %	65%
Outcome 4	Manage Embedding Python.	5	70 %	65%
Outcome 5	Able to manage and analyse data using data analytics.	2	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)												
CLOs	**Engineering Knowledge**	**Design /Development of solutions**	**Conduct Investigations of Complex Problems**	**Modern Tool Usage**	**The Engineer and Society**	**Environment and Sustainability**	**Ethics**	**Individual and Teamwork**	**Communication**	**Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	3	3	2	3		1		1		3	2	1
Outcome 2	3	3	3	3	3		1		1		2	2	2
Outcome 3	3	3	3	3	3		1		1		3	3	3
Outcome 4	3	3	3	3	3		1		1		2	3	2
Outcome 5	3	3	3	3	3				1		3	3	3
Average	**3**	**3**	**3**	**3**	**3**		**1**		**1**		**3**	**3**	**2**

Course Unitization Plan Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1		**12**		
1	1. Write a Python program to do the following operations: Library: NumPy i) Create multi-dimensional arrays and find their shape and dimension ii) Create a matrix full of zeros and ones iii) Reshape and flatten data in the array iv) Append data vertically and horizontally v) Apply indexing and slicing on an array vi) Use statistical functions on the array - Min, Max, Mean, Median, and Standard Deviation vii) Compute the determinant of an array 2. Write a program to count the numbers of characters in the string and store them in a dictionary data structure	6+6	1	1
Unit 2	3. Write a program to perform the addition, and subtraction of two 3 X 3 matrices 4. Demonstrate Basic date and time classes, Different time formats, converting between formats, Formatting dates and times, and Parsing date/time information.	**12**	**2**	**1**
Unit 3	5. Build a program that creates a scatter plot of two variables from a dataset using Matplotlib, with each point color-coded based on a third categorical variable. 6. Write a Python program to read the file contents and do the following operations i) Print each word of a file in reverse order. ii) Print each line of a file in reverse order. Sample Input: Python Programming Sample Output: Programming Python iii) Display the content without whitespaces.	**12**	3	1
Unit 4	7. Create a class ATM and define ATM operations to create an account, deposit, check_balance, withdraw and delete an account. Use a constructor to initialize members. 8. Write a Python program to handle the run time errors while doing file handling operations.	**12**	4	1
Unit 5	9. Write a Python program to create and raise user-defined exceptions. 10. Write a Python program to implement Pandas Series with labels.	**12**	**5**	**1**
	Total contact hours	**60**		

Learning Assessment - Practical

Question Difficulty	Bloom's Level of Cognitive Task	Continuous Learning Assessments (50%)		End Semester Exam (50%)
		Lab Performance (40%)	Record / Observation Note (10%)	
Level 1	Remember	50%	40%	30%
	Understand			
Level 2	Apply	30%	40%	50%
	Analyse			
Level 3	Evaluate	20%	20%	20%
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Python, W. (2005). Introduction to Python.
2. Kamthane, A. N., & Kamthane, A. A. (2018). Programming and Problem Solving with Python. McGraw-Hill Education.
3. Beazley, D., & Jones, B. K. (2013). Python cookbook: Recipes for mastering Python 3. " O'Reilly Media, Inc.".

Other Resources

1. Luciano, R. (2015). Fluent Python: Clear, concise, and effective programming. Sebastopol, CA, United States: OŔeilly Media.

Course Designers

1. Dr. Rajiv Senapati, Assistant Professor, Department of Computer Science & Engineering, SRM University AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Applied Cryptography

Course Code	CYS 504	Course Category	CC		L	T	P	C
					3	0	1	4
Pre-Requisite Course(s)	Cryptography and Python	Co-Requisite Course(s)		Progressive Course(s)				
Course Offering Department	CSE	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

1. Develop proficiency in cryptographic concepts, encryption, key management, and protocols.
2. Understand mathematical principles like number theory and discrete logarithms.
3. Gain practical skills to design, implement, and analyze cryptography.
4. Assess cryptographic systems' strengths, weaknesses, and real-world applications.
5. Explore advanced techniques like zero-knowledge proofs and identity-based cryptography.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe key management, cipher modes, and the differences between symmetric and asymmetric cryptography	2	70 %	65%
Outcome 2	Analyze and evaluate mathematical principles, algorithms like RSA, DES, and elliptic curves, and their security implications.	3	70 %	65%
Outcome 3	Implement cryptographic algorithms and protocols such as hash functions, digital signatures, and encryption modes for data protection	4	70 %	65%
Outcome 4	Assess the strengths and weaknesses of various cryptographic systems and compare encryption techniques based on application needs.	5	70 %	65%
Outcome 5	Design cryptographic protocols like zero-knowledge proofs, blind signatures, and oblivious transfers for secure communication.	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3									3
Outcome 2	3	2		3	2							1	2
Outcome 3	3	2	3	3	3							2	2
Outcome 4	3	3		3	2	1		1					3
Outcome 5	3		3	3	3	3		2				2	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Key Length and Key Management	1 hour	1, 2	1, 2
	Electronic Codebook (ECB) Mode, Block Replay, and Cipher Block Chaining (CBC) Mode	1 hour	1, 2	1, 2
	Stream Ciphers: Self-Synchronizing and Synchronous Stream Ciphers	1 hour	1, 2	1, 2
	Cipher Modes: Cipher-Feedback (CFB), Output-Feedback (OFB), and Counter (CTR) Mode	2 hours	1, 2	1, 2
	Choosing a Cipher Mode and Algorithm Selection	1 hour	1, 2	1, 2
	Public-Key vs. Symmetric Cryptography, Communication Channel Encryption	1 hour	1, 2	1, 2
	Data Encryption for Storage, Hardware vs. Software Encryption	1 hour	1, 2	1, 2
	Compression, Encoding, Encryption Detection, Hiding/Destroying Information	1 hour	1, 2, 3	1, 2
Unit II	Pseudo-Random Sequence Generators and SEAL	1 hour	2, 3,	1, 2
	Feedback with Carry Shift Registers (FCSRs)	1 hour	2, 3	1, 2
	Stream Ciphers Using FCSRs and Nonlinear-Feedback Shift Registers	2 hours	2, 3	1, 2
	System-Theoretic Approach to Stream Cipher Design	1 hour	2, 3, 4	1, 2
	Secure Hash Algorithm (SHA)	1 hour	2, 3, 4	1, 2
	One-Way Hash Functions Using Symmetric Block Algorithms	1 hour	2, 3, 4	1, 2
	Using Public-Key Algorithms for Hashing	1 hour	2, 3, 4	1, 2
Unit III	Information Theory and Complexity Theory	2 hours	2, 3, 4	1, 2
	Number Theory Basics: Factoring and Prime Number Generation	2 hours	2, 3, 4	1, 2
	Discrete Logarithms in Finite Fields	1 hours	2, 3, 4	1, 2
	Data Encryption Standard (DES) and Historical Ciphers: Lucifer, Madryga, NewDES, GOST	2 hours	2, 3, 4	1, 2
	Double and Triple Encryption, Key Shortening (CDMF), and Whitening	2 hours	2, 3, 4	1, 2
Unit IV	RSA and Pohlig-Hellman Cryptosystems	1 hour	3, 4, 5	1, 2
	McEliece and Elliptic Curve Cryptosystems	2 hours	3, 4, 5	1, 2
	Digital Signature Algorithms (DSA) and Signature Schemes	2 hours	3, 4, 5	1, 2
	Feige-Fiat-Shamir and Guillou-Quisquater Protocols	2 hours	3, 4, 5	1, 2
	Diffie-Hellman Key Exchange and Station-to-Station Protocol	2 hours	3, 4, 5	1, 2
	Shamir's Three-Pass Protocol	1 hour	3, 4, 5	1, 2
Unit V	Foundations and Protocol Building Blocks	1 hours	4, 5	1, 2
	Basic and Intermediate Protocols	2 hours	4, 5	1, 2
	Advanced Protocols	1 hour	4, 5	1, 2
	Zero-Knowledge Proofs and Zero-Knowledge Proofs of Identity	2 hours	4, 5	1, 2
	Blind Signatures and Identity-Based Public-Key Cryptography	2 hours	4, 5	1, 2
	Oblivious Transfer and Oblivious Signatures, Esoteric Protocols	1 hour	4, 5	1, 2
	Total Contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Implementation of symmetric cipher algorithm (AES and RC4)	2	1, 2	1, 3
2	Random number generation using a subset of digits and alphabets	1	2, 4	1, 3
3	Implementation of RSA-based signature system	2	3, 5	1, 3
4	Implementation of Subset sum	2	2, 3	1, 3
5	Authenticating the given signature using MD5 hash algorithm	1	3, 5	1, 3
6	Implementation of Diffie-Hellman algorithm	2	1, 3	1, 3
7	Implementation of Goldwasser-Micali probabilistic public key system	2	3, 4	1, 2

8	Implementation of Rabin Cryptosystem (Optional)	2	4, 5	1, 2
9	Implementation of Kerberos cryptosystem	2	2, 3	1, 2
10	Firewall implementation and testing	2	1, 4	1, 2
11	Implementation of a trusted secure web transaction	2	2, 5	1, 2
12	Cryptographic Libraries - Sun JCE/Open SSL/Bouncy Castle JCE	2	1, 3	1, 2
13	Digital Certificates and Hybrid (ASSY/SY) encryption, PKI	2	3, 4	1, 2
14	Message Authentication Codes	2	2, 4	1, 2
15	Elliptic Curve cryptosystems (Optional)	2	5	1, 2
16	PKCS Standards (PKCS1, 5, 11, 12), Cipher modes	2	1, 4	1, 2
	Total Lab Hours	**30**		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	40%			40%
	Understand				
Level 2	Apply	60%			60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C" John Wiley & Sons, Inc, 2nd Edition, 1996.
2. Wenbo Mao, "Modern Cryptography Theory and Practice", Pearson Education, 2004
3. Atul Kahate, "Cryptography and Network Security", Tata McGrew Hill, 2003.
4. William Stallings, "Cryptography and Network Security, Prentice Hall, New Delhi, 2006. 5 Bernard Menezes, "Network Security and Cryptography", Cengage Learning, New Delhi, 2010.

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Advanced Python Programming Lab

Course Code	CYS 505	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)	Python	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the basics of Python programming.
2. To learn I/O Operations, Basic image processing using Python.
3. To learn the basic data analysis using Python.
4. To learn Extending and Embedding Python.
5. To learn and implement projects.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	To understand the basics of Python programming.	1	70 %	65%
Outcome 2	To apply /O Operations and basic image processing techniques.	3	70 %	65%
Outcome 3	Manage large amounts of data by applying data science techniques.	4	70 %	65%
Outcome 4	Manage Embedding Python.	5	70 %	65%
Outcome 5	Able to manage and analyse data using data analytics.	2	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	3		1		1		3	2	1
Outcome 2	3	3	3	3	3		1		1		2	2	2
Outcome 3	3	3	3	3	3		1		1		3	3	3
Outcome 4	3	3	3	3	3		1		1		2	3	2
Outcome 5	3	3	3	3	3				1		3	3	3
Average	**3**	**3**	**3**	**3**	**3**		**1**		**1**		**3**	**3**	**2**

Course Unitization Plan Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1		**12**		
1	1. Write a Python program to do the following operations: Library: NumPy i) Create multi-dimensional arrays and find their shape and dimension ii) Create a matrix full of zeros and ones iii) Reshape and flatten data in the array iv) Append data vertically and horizontally v) Apply indexing and slicing on an array vi) Use statistical functions on the array - Min, Max, Mean, Median, and Standard Deviation vii) Compute the determinant of an array 2. Write a program to count the numbers of characters in the string and store them in a dictionary data structure	6+6	1	1
Unit 2	3. Write a program to perform the addition, and subtraction of two 3 X 3 matrices 4. Demonstrate Basic date and time classes, Different time formats, converting between formats, Formatting dates and times, and Parsing date/time information.	**12**	**2**	**1**
Unit 3	5. Build a program that creates a scatter plot of two variables from a dataset using Matplotlib, with each point color-coded based on a third categorical variable. 6. Write a Python program to read the file contents and do the following operations i) Print each word of a file in reverse order. ii) Print each line of a file in reverse order. Sample Input: Python Programming Sample Output: Programming Python iii) Display the content without whitespaces.	**12**	3	1
Unit 4	7. Create a class ATM and define ATM operations to create an account, deposit, check_balance, withdraw and delete an account. Use a constructor to initialize members. 8. Write a Python program to handle the run time errors while doing file handling operations.	**12**	4	1
Unit 5	9. Write a Python program to create and raise user-defined exceptions. 10. Write a Python program to implement Pandas Series with labels.	**12**	**5**	**1**
	Total contact hours	**60**		

Learning Assessment - Practical

Question Difficulty	Bloom's Level of Cognitive Task	Continuous Learning Assessments (50%)		End Semester Exam (50%)
		Lab Performance (40%)	Record / Observation Note (10%)	
Level 1	Remember	50%	40%	30%
	Understand			
Level 2	Apply	30%	40%	50%
	Analyse			
Level 3	Evaluate	20%	20%	20%
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Python, W. (2005). Introduction to Python.
2. Kamthane, A. N., & Kamthane, A. A. (2018). Programming and Problem Solving with Python. McGraw-Hill Education.
3. Beazley, D., & Jones, B. K. (2013). Python cookbook: Recipes for mastering Python 3. " O'Reilly Media, Inc.".

Other Resources

1. Luciano, R. (2015). Fluent Python: Clear, concise, and effective programming. Sebastopol, CA, United States: O'Reilly Media.

Course Designers

1. Dr. Rajiv Senapati, Assistant Professor, Department of Computer Science & Engineering, SRM University AP.

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Research Seminar

Course Code	AEC 503	**Course Category**		**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department		**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- Enter Data

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1				
Outcome 2				
Outcome 3				
Outcome 4				

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1													
Outcome 2													
Outcome 3													
Outcome 4													
Outcome 5													
Average													

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1				
Unit 2				
Unit 3				
Unit 4				
Unit 5				

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 20%	Mid-1 20%	CLA-2 20%	CLA-3 20%	
Level 1	Remember					
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total						

Recommended Resources

1. Enter Data

Other Resources

1. Enter Data

Course Designers

1. Enter Data

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COMMUNITY SERVICE AND SOCIAL RESPONSIBILITY

Course Code	VAC 104	**Course Category**	VAC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CEL	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Encourage initiatives that address local needs, foster self-sufficiency, and promote environmental sustainability within the community.
2. Equip participants with a deeper understanding of social issues and a sense of responsibility towards marginalized communities.
3. Inspire active participation in community service programs and foster a culture of giving back among individuals and organizations.
4. Develop and implement programs that contribute to skill development, economic empowerment, and equal opportunities for underprivileged sections of society.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Develop effective strategies for identifying and addressing community needs.	3	80%	80%
Outcome 2	Demonstrate empathy and cultural sensitivity when engaging with diverse community groups.	4	80%	75%
Outcome 3	Implement sustainable solutions and evaluate their impact on social well-being.	5	90%	85%
Outcome 4	Collaborate effectively within teams to design and lead community service projects.	6	90%	80%

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments 50%**				**End Semester Exam 50%**
		CLA-1 20%	**Mid-1 20%**	**CLA-2 20%**	**CLA-3 20%**	
Level 1	Remember	10%	10%			20%
	Understand					
Level 2	Apply		10%	10%		20%
	Analyse					
Level 3	Evaluate				10%	10%
	Create					
Total		**10%**	**20%**	**10%**	**10%**	**50%**

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Entrepreneurial Mindset

Course Code	SEC 103	Course Category	SEC	L	T	P	C
				1	0	1	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Management	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To develop the Entrepreneurial Mindset of Students.
2. To provide students an overview of different aspects of starting a business.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recall the key entrepreneurship concepts and entrepreneurial traits	1	90%	80%
Outcome 2	Identify entrepreneurial opportunities	2	80%	80%
Outcome 3	Apply entrepreneurial skills to analyze different entrepreneurial ventures.	3	70%	70%
Outcome 4	Apply entrepreneurial concepts to and develop a business model canvas	3	60%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			2				2		2	2		
Outcome 2	1	3	3	3				3			3		
Outcome 3	2	3	3	3				3		2	3		
Outcome 4	3	3	3	3				3		3	3		
Average	2	3	3	3				3		2	3		

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**2**	**1,3**	
1.	What is Entrepreneurship			
2.	Challenges Faced by Entrepreneurs			
3.	Why not entrepreneurship			
4.	Who is an Entrepreneurs (Characteristics and Myths)			
5.	Why become entrepreneurs			
6.	Entrepreneurial Traits			
7.	Significance of entrepreneurship in the economy			
8.	Types of Entrepreneurial Ventures			
Unit 2	**Entrepreneurial Orientation**	4	1,2,4	
9.	Characteristics of successful entrepreneurs			
10.	Mindset shifts: from an employee to an entrepreneur			
11.	Overcoming challenges and dealing with failures			
Unit 3	**Entrepreneurial Skills**	**4**	1,2,3,4	
12.	Innovation & Creativity			
13.	Design Thinking			
14.	Strategic Thinking			
15.	Developing a Growth Mindset			
Unit 4	**Technopreneurship**	**2**	1,2	
16.	Overview of Technopreneurship			
17.	Characteristics of a Technopreneur			
18.	Technology Trends and Disruption			
19.	Real-world Technopreneurship Examples			
Unit 5	**Entrepreneurial Opportunity & Ideation**	4	2	
20.	Difference between idea and opportunity			
21.	Opportunities in Vibrant Indian Entrepreneurial Ecosystem			
22.	Opportunity Recognition (Sources of Opportunity)			
23.	Assessing Opportunity			
24.	Opportunities and Uncertainty			
25.	Idea Generation & Market Research			
26.	Idea Selection			
Unit 6	Business Model Canvas & Pitching	2	1,4	
27.	Why BMC			
28.	Value Proposition			
29.	Customer Discovery			
30.	Customer Relationship			
31.	Channels			
32.	Key Partners			
33.	Key Activities			
34.	Key Resources			
35.	Revenue Structure			
36.	Cost Structure			
37.	From Pitch to Hitch (Pitch Deck)			

Unit 7	Startup Financing	2	1,4	
38.	Stages of Fund Raising			
39.	Startup Valuation			
40.	Mode of Investment			
41.	Shareholder's Agreement			
42.	Financial Analysis			
Total Contact Hours		**20**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (100%)**		
		CLA-1 (30%)	**CLA-2 (30%)**	**CLA-3 (40%)**
Level 1	Remember	100%	40%	
	Understand			
Level 2	Apply		60%	100%
	Analyse			
Level 3	Evaluate			
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Larry Keeley Brian Quinn Ryan Pikkel. Ten types of innovation -the discipline of building breakthroughs, John Wiley& Sons, Inc; 2013
2. Eric Ries. The lean startup how constant innovation creates radically successful businesses, Penguin Books
3. Bruce R. Barringer, R. Duane Ireland. Entrepreneurship Successfully Launching New Ventures, Pearson; 2020
4. Robert D. Hasrich, Dean A. Shepherd, Michael P. Peters, Entrepreneurship, McGraw Hill, 2020
5. Siva Prasad N. Design Thinking : Techniques And Approaches, Ane Books, New Delhi; 2023

Other Resources

1. https://www.coursera.org/specializations/innovation-creativity-entrepreneurship
2. https://www.coursera.org/specializations/wharton-entrepreneurship

Course Designers

1. Mr Aftab Alam, Assistant Professor, Paari School of Business, SRM University-AP
2. Mr Udayan Bakshi, Associate Director, Entrepreneurship and Innovation, SRM University-AP
3. Prof. Bharadhwaj S, Dean, Paari School of Business, SRM University-AP

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Security in Cloud Computing and IoT

Course Code	CYS 506	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CYS 501	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand foundational security concepts for cloud and IoT.
2. Analyze cloud and IoT security risks and vulnerabilities.
3. Implement data security strategies in cloud environments.
4. Design secure architecture for cloud and IoT solutions.
5. Evaluate legal and ethical implications in cloud security.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand key security concepts, principles, and challenges in cloud computing and IoT environments	2	70 %	65%
Outcome 2	Identify and analyze risks, threats, and compliance requirements for secure cloud deployment and IoT systems.	2	70 %	65%
Outcome 3	Apply strategies and tools for data security, identity management, and secure virtualization across cloud and IoT platforms.	3	70 %	65%
Outcome 4	Design secure solutions for cloud storage, virtualization, and IoT data dissemination using modern security practices and standards	4	70 %	65%
Outcome 5	Evaluate and recommend effective security architectures and practices for ensuring confidentiality, integrity, and availability in cloud and IoT applications.	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3							3	1	1
Outcome 2	3	2		3	2					1	2	2	1
Outcome 3	3	2	3	3	2					2	2	3	3
Outcome 4	3	3	1	3	3			1			3	2	3
Outcome 5	3	3	2	3	3			2		2	3	3	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Security Concepts: Confidentiality, Integrity, Authentication	1	1	1, 2
	Privacy, Non-repudiation, Availability, Access Control	1	1	1, 2
	Concepts in Cloud Computing (PaaS, IaaS, SaaS)	1	1	1, 2
	User Authentication in the Cloud	1	1	1, 2
	Cloud Data Security and Data Life Cycle	1	2	1, 2
	Cloud Storage Architectures	1	2	1, 2
	Volume and Object-Based Storage, Databases	1	2	1, 2
	Content Delivery Network (CDN)	1	2	1, 2
	Cloud Data Security Strategies (Encryption, Masking, etc.)	1	3	1, 2
	Objectives, Anonymization, Tokenization	1	3	1, 2
	Security Information and Event Management	1	3	1, 2
	Egress Monitoring (DLP)	1	3	1, 2
Unit II	Shared Cloud Platforms Risks and Responsibilities	1	2	1, 2
	Cloud Computing Risks by Deployment and Service Model	1	2	1, 2
	Cloud Attack Surface	1	2	1, 2
	Threats by Deployment Model	1	2	1, 2
	Cloud Security Policy Implementation Issues	1	2	1, 2
	NIST 33 Security Principles	1	1	1, 2
	Cloud Penetration Testing	1	4	1, 2
	Legal and Ethical Implications of Testing	1	5	1, 2
	Usage of Penetration Testing Tools	1	4	1, 2
Unit III	Cloud Secure Software Development Life Cycle	1	3	1, 2
	ISO/IEC 27034-1 Standards for Secure Application	1	3	1, 2
	Single Sign-On (SSO) and Federated Identity Management	1	3	1, 2
	Multifactor Authentication	1	3	1, 2
	Secure APIs	1	3	1, 2
	Tenancy Separation	1	4	1, 2
	Application Virtualization and Sandboxing	1	4	1, 2
	Runtime Application Self Protection (RASP)	1	4	1, 2
Unit IV	VM Life Cycle and Data Destruction	1	3	1, 2
	Virtualization Security Management	1	3	1, 2
	Virtual Threats and Hypervisor Risks	1	3	1, 2
	Increased Denial of Service Risks	1	4	1, 2
	VM Security Recommendations	1	4	1, 2
	Incident Response and Business Continuity	1	5	1, 2
	Examination of Modern Security Standards	1	5	1, 2
Unit V	Security Requirements in IoT Architecture	1	1	1, 2
	IoT IAM Infrastructure and Access Control	1	3	1, 2
	Privacy Preservation in IoT Environments	1	3	1, 2
	Lightweight Privacy Schemes	1	4	1, 2
	Key IoT Applications	1	4	1, 2
	IoT Security Challenges and Solutions	1	5	1, 2
	Total Contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Implement user authentication in AWS using IAM. Configure policies to enforce Multi-Factor Authentication (MFA) for all users.	2	1	1, 2
2	Encrypt a dataset before storing it in AWS S3 using Server-Side Encryption (SSE). Implement data masking for sensitive fields in the dataset.	2	2	1, 2
3	Manage the lifecycle of a dataset in AWS S3. Set up lifecycle policies for data retention and automated data deletion.	2	2	1, 2
4	Conduct a penetration test on an AWS environment using AWS Inspector. Identify and document vulnerabilities in the infrastructure.	2	4	1, 2
5	Create and implement a cloud security policy for an AWS deployment. Analyze and mitigate risks for PaaS, IaaS, and SaaS models using AWS Security Hub.	2	3	1, 2
6	Implement lifecycle management for AWS EC2 instances. Overwrite, degauss, and securely destroy instance data upon termination.	2	2	1, 2
7	Develop a secure cloud application on AWS using the Secure Software Development Life Cycle (SDLC) framework. Ensure compliance with AWS Well-Architected Framework security best practices.	2	3	1, 2
8	Securely develop and deploy APIs using AWS API Gateway. Implement tenancy separation and sandboxing using AWS Lambda.	2	4	1, 2
9	Configure Runtime Application Self Protection (RASP) for an AWS-based web application. Test its effectiveness against real-time attacks using AWS WAF.	2	5	1, 2
10	Set up an IoT IAM infrastructure using AWS IoT Core. Manage identity lifecycle and authentication credentials for IoT devices.	2	1	1, 2
11	Implement privacy preservation techniques for an IoT application using AWS IoT Core and AWS Kinesis. Use lightweight encryption schemes to protect data.	2	4	1, 2
12	Develop an incident response plan for an AWS-based e-commerce platform using AWS CloudFormation and AWS Lambda. Simulate a security breach and execute disaster recovery procedures.	2	5	1, 2
13	Perform threat modeling for an AWS virtualized environment using AWS EC2 and AWS VPC. Implement security measures to mitigate identified threats.	2	2	1, 2
14	Securely configure and manage AWS S3 buckets. Implement encryption and access control policies using AWS IAM roles and policies.	2	1	1, 2
15	Develop a Monitoring Dashboard using AWS CloudWatch to track and respond to security incidents in real-time.	2	3	1, 2
	Total Lab Hours	**30**		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	20%	10%	15%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyse				
Level 3	Evaluate	30%	30%	40%	35%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise
2. Perspective on Risks and Compliance" O'Reilly Media; 1 edition, 2009.
3. Ronald L. Krutz, Russell Dean Vines, "Cloud Security", 2010.
4. John Rittinghouse, James Ransome, "Cloud Computing" CRC Press; 1 edition, 2009.
5. J.R. ("Vic") Winkler, "Securing the Cloud" Syngress, 2011.
6. Cloud Security Alliance, "Security Guidance for Critical Areas of Focus in Cloud Computing".

Other Resources

Course Designers

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Digital Forensics and Incident Response

Course Code	CYS 507	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop Expertise in Digital Forensics and Incident Response.
2. Gain Proficiency in Collecting and Preserving Forensic Evidence.
3. Develop Effective Incident Response Strategies and Procedures.
4. Utilize Industry-Standard Forensic Tools and Frameworks.
5. Address Compliance, Legal, and Privacy Considerations in Forensics.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the principles, frameworks, and distinctions of Digital Forensics, Incident Response, and Threat Hunting comprehensively.	2	70 %	65%
Outcome 2	Apply forensic techniques and industry-standard tools to collect, preserve, and analyze digital evidence.	3	70 %	65%
Outcome 3	Analyze system, network, and application-level data to detect, contain, and respond to cyber incidents effectively.	4	70 %	65%
Outcome 4	Evaluate compliance standards, risk management strategies, and incident response plans for organizational security readiness.	5	70 %	65%
Outcome 5	Create effective forensic and incident response strategies, including data acquisition, forensic analysis, and threat containment methodologies.	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3							3	1	1
Outcome 2	3	2		3	2					1	2	2	1
Outcome 3	3	2	3	3	2					2	2	3	3
Outcome 4	3	3	1	3	3			1			3	2	3
Outcome 5	3	3	2	3	3			2		2	3	3	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Introduction to Digital Forensics & Incident Response	1	1, 2	1, 2
	Differences between Digital Forensics, Incident Response, and Threat Hunting	1	1, 2	1, 2
	Benefits of Forensics and Computer Crimes	1	1, 2	1, 2
	Forensics Evidence in Courts, Legal Concerns and Privacy Issues	1	1, 4	1, 2
	Incident Response Planning and Targeted Artifacts	1	2, 3	1, 2
	DFIR Use-Cases and Toolsets	1	3, 5	1, 2
	SANS & NIST Frameworks	1	1, 3	1, 2
Unit II	Incident Response Preparation and Response - Defining Assets and Values	1	2, 4	1, 2
	Understanding CIA (Confidentiality, Integrity, Availability)	1	2, 5	1, 2
	Risk Management and Roles and Responsibilities in Incident Response	1	2, 4	1, 2
	Creating Incident Response Plans	1	2, 5	1, 2
	Disaster Recovery Plan (DRP) and Business Continuity Plan (BCP)	1	2, 3	1, 2
	Governance, Risk, and Compliance (GRC)	1	3, 4	1, 2
	ATT&CK Framework and Compliance Standards (ISO, GDPR, HIPAA, PCI-DSS)	1	4, 5	1, 2
	SOC Operations Lifecycle - Identification, Containment, Intelligence Gathering, and Eradication	1	3, 5	1, 2
Unit III	Data Acquisition and Analysis - Storage Formats and Digital Evidence	1	2, 3	1, 2
	Determining Best Acquisition Methods and Tools	1	2, 3	1, 2
	Validating Data Acquisitions and RAID/Remote Network Acquisition Tools	1	3, 5	1, 2
	Dead and Live System Analysis, Drive Cloning, Image Mounting, Memory Dumping	1	3, 5	1, 2
	Evidence Documentation and Crime Scene Processing	1	2, 3	1, 2
	Securing Computer Incidents or Crime Scenes, Seizing and Storing Digital Evidence	1	2, 5	1, 2
	Obtaining Digital Hashes, Reviewing Cases	1	2, 3	1, 2
Unit IV	Live Forensics on Windows Systems - Artifacts Analysis (browser history, USB history, etc.)	1	3, 4	1, 2
	Windows-Specific Forensics - NTFS, ADS & MFT, File Carving, Registry Forensics, PowerShell	1	3, 4	1, 2
	Memory Analysis - Memory Structure, Analysis Tools, Volatility Framework	1	3, 5	1, 2
	Linux Forensics - Filesystems, Network Configuration, Logfile Analysis	1	3, 4	1, 2
	Identifying Persistence, Bash History, and Logfile Analysis	1	3, 5	1, 2
Unit V	Advanced Forensic Tools and Techniques - Software and Hardware	1	4, 5	1, 2
	Validating and Testing Forensic Software, Data-Hiding Techniques	1	4, 5	1, 2
	Remote Acquisitions and Email Investigations	1	4, 5	1, 2
	Network Forensics - Traffic Interception, Wireshark, Zeek NSM	1	4, 5	1, 2
	File Upload Forensics - Windows EventLog, PowerShell Logs, DF Timeline	1	3, 4	1, 2
	Threat Hunting - Collecting Indicators of Compromise, Malware Characteristics	1	3, 5	1, 2
	DFIR Simulation Labs for Practical Experience	1	5	1, 2
	Review of Advanced Techniques and Real-World DFIR Applications	1	4, 5	1, 2
	Total contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Use Autopsy or The Sleuth Kit to perform a full disk image acquisition and analysis of a Windows system	2	2, 3, 5	1, 2
2	Conduct memory forensics using Volatility to analyze a memory dump from a compromised Windows machine	2	3, 4	1, 2
3	Use FTK Imager to create a forensic image of a USB drive and analyze its contents for evidence of unauthorized activity	2	2, 3, 5	1, 2
4	Analyze Windows Registry hives using Registry Viewer to identify changes made by malware or unauthorized users	2	3, 4, 5	1, 2
5	Use Wireshark to capture and analyze network traffic, focusing on identifying suspicious activity or potential breaches	2	4, 5	1, 2
6	Perform timeline analysis using Log2timeline to reconstruct events on a compromised Linux system, focusing on file access and modification	2	2, 3, 5	1, 2
7	Utilize Ghiro to extract and analyze metadata from image files to uncover hidden information or timestamps	2	4, 5	1, 2
8	Conduct email forensics using Mailspring or Thunderbird to analyze email headers and attachments for evidence of phishing or data exfiltration	2	3, 5	1, 2
9	Use OSForensics to recover deleted files and analyze file system artifacts on a Windows machine	2	2, 3, 5	1, 2
10	Employ YARA rules to scan a file system or memory dump for indicators of known malware or suspicious patterns	2	4, 5	1, 2
11	Set up and configure Suricata or Snort as an Intrusion Detection System (IDS) to monitor network traffic and detect potential threats	2	4, 5	1, 2
12	Use Bulk Extractor to scan a disk image for artifacts such as email addresses, credit card numbers, or other sensitive information	2	3, 5	1, 2
13	Conduct smartphone forensics using ADB (Android Debug Bridge) and tools like Magnet AXIOM or Oxygen Forensic Detective to extract and analyze data from an Android device	2	4, 5	1, 2
14	Perform incident response simulation exercises using Cuckoo Sandbox to analyze suspicious files and behavior in a controlled environment	2	3, 5	1, 2
15	Perform a full forensic analysis by combining different tools (FTK Imager, Autopsy, Wireshark, etc.) to handle a live case scenario	2	2, 3, 5	1, 2

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	10%	20%	10%	15%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyse				
Level 3	Evaluate	30%	30%	40%	35%
	Create				

Total	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Jason Luttgens, Matthew Pepe, Kevin Mandia - Incident Response & Computer Forensics, 3rd edition, McGraw-Hill Education, 2014, ISBN: 0-07-179868-4 (hardcopy), 0-07-179869-2
2. Eoghan Casey - Digital Evidence and Computer Crime, 3rd edition, Academic Press, 2011, ISBN: 978-0-123-74268-1 (hardcopy), 978-0-080-92148-8
3. Brian Carrier - File system forensic analysis, 1st edition, Safari Tech Books Online, 2005, ISBN: 0-13-443954-6 (hardcopy), 0-321-26817-2
4. Neil F. Johnson, Zoran Duric, Sushil Jajodia - Information Hiding: Steganography and Watermarking - Attacks and Countermeasures, 1st edition, Springer, 2001, ISBN: 978-0-7923-7204-2 (hardcopy), 978-1-4615-4375-6
5. Rohit Tamma, Oleg Skulkin, Heather Mahalik, Satish Bommisetty - Practical Mobile Forensics, 4th Edition, Packt Publishing, 2020, ISBN: 1-83864-442-3 (hardcopy), 1-83864-752-X
6. Darren Quick, Ben Martini, Kim-Kwang Raymond Choo- Cloud Storage Forensics, 1st edition, Syngress, 2014, ISBN: 0-12-419970-4 (hardcopy), 1-306-15439-1
7. Wojciech Mazurczyk, Steffen Wendzel, Sebastian Zander, Amir Houmansadr, Krzysztof Szczypiorski - Information Hiding in Communication Networks: Fundamentals, Mechanisms, Applications, and Countermeasures, 1st edition, Wiley, 2016, ISBN: 978-1-1188-6169-1 (hardcopy), 978-1-1190-8183-8

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Blockchain Technology and Applications

Course Code	CYS 508	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CYS 504	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Comprehend blockchain technology, cryptography, and decentralized systems fundamentals.
2. Explore blockchain applications in cryptocurrency and smart contracts.
3. Analyze consensus algorithms and their real-world implications.
4. Develop practical skills using Hyperledger Fabric and Ethereum.
5. Develop blockchain-based domain-specific applications.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the fundamental principles of blockchain technology, cryptographic primitives, and consensus mechanisms.	2	70 %	65%
Outcome 2	Explain the applications of blockchain in cryptocurrencies, enterprise solutions, and cross-border payments.	2	70 %	65%
Outcome 3	Analyze various consensus models like Proof of Work, Proof of Stake, and Byzantine Fault Tolerance for different blockchain systems.	4	70 %	65%
Outcome 4	Design and develop smart contracts using platforms such as Hyperledger Fabric, Ethereum, and Ripple.	5	70 %	65%
Outcome 5	Evaluate the potential impact of blockchain technology on industries like supply chain, finance, and security.	5	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			3									3
Outcome 2	3	2		3	2							1	2
Outcome 3	3	2	3	3	2							2	2
Outcome 4	3	3	1	3	3			1					3
Outcome 5	3	3	2	3	3			2				2	3
Average	**3**	**2**		**3**									

Course Unitization Plan

Unit No.	Topic Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts	1	1, 2	1, 2
	Block in a Blockchain, Transactions, Distributed Consensus	1	1, 2	1, 2
	Public vs Private Blockchain, Cryptocurrency to Blockchain	1	1, 3	1, 2
	Permissioned Model of Blockchain, Security Aspects of Blockchain	1	2, 4	1, 2
	Basic Crypto Primitives: Hash Functions, Merkle Trees	1	1, 5	1, 2
	Digital Signature, Public Key Cryptography, Basic Cryptocurrency	1	3, 5	1, 2
UNIT II	Creation of Coins, Payments, Double Spending	1	1, 3	1, 2
	Bitcoin Scripts, Bitcoin P2P Network, Transactions in Bitcoin	1	2, 4	1, 2
	Block Mining, Block Propagation, Block Relay	1	2, 5	1, 2
	Consensus in Bitcoin Network, Proof of Work (PoW)	1	4, 5	1, 2
	Hashcash PoW, Bitcoin PoW, Attacks on PoW, Monopoly Problem	1	2, 4	1, 2
	Proof of Stake, Proof of Burn, Proof of Elapsed Time	1	3, 5	1, 2
	Life of a Bitcoin Miner, Mining Difficulty, Mining Pool	1	1, 4	1, 2
UNIT III	Permissioned Model and Use Cases	1	2, 5	1, 2
	Design Issues for Permissioned Blockchains	1	2, 3	1, 2
	Execute Contracts, State Machine Replication	1	1, 4	1, 2
	Overview of Consensus Models for Permissioned Blockchain	1	4, 5	1, 2
	Distributed Consensus in Closed Environment	1	3, 5	1, 2
	Paxos, RAFT Consensus, Byzantine General Problem	1	3, 4	1, 2
	Lamport-Shostak-Pease BFT Algorithm, BFT in Asynchronous Systems	1	4, 5	1, 2
UNIT IV	Cross Border Payments, KYC	1	3, 5	1, 2
	Food Security, Mortgage over Blockchain	1	2, 5	1, 2
	Blockchain Enabled Trade, We Trade — Trade Finance Network	1	2, 5	1, 2
	Supply Chain Financing, Identity on Blockchain	1	4, 5	1, 2
UNIT V	Hyperledger Fabric Architecture	1	2, 4	1, 2
	Identities, Policies, Membership, Access Control	1	3, 5	1, 2
	Channels, Transaction Validation	1	4, 5	1, 2
	Writing Smart Contracts Using Hyperledger Fabric	1	4, 5	1, 2
	Writing Smart Contracts Using Ethereum	1	2, 4	1, 2
	Overview of Ripple and Corda	1	3, 5	1, 2
	Total Contact Hours	**45**		

Lab Unitization Plan

Sl. No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Implement a basic blockchain using Python, where you can add blocks and transactions. Ensure each block is linked to the previous one, forming a chain.	2	1, 2	1, 2
2	Implement the SHA-256 cryptographic hash function and use it to hash transaction data. Verify that the hash is consistent and secure.	2	2, 3	1, 2
3	Create a program to sign a transaction using a private key and verify the signature using the public key to ensure authenticity.	2	2, 3	1, 2
4	Simulate the creation of Bitcoin blocks, including generating block headers, adding transactions, and linking blocks in the blockchain.	2	1, 4	1, 2
5	Develop a simulation of a Bitcoin peer-to-peer network where multiple nodes exchange blocks and validate transactions.	2	1, 4	1, 2
6	Implement the Proof of Work consensus algorithm, including difficulty adjustment, and simulate the mining process for block validation.	2	2, 3	1, 2
7	Simulate Bitcoin transactions by creating a ledger to send and receive coins, check balances, and prevent double-spending.	2	2, 4	1, 2
8	Write and deploy a simple smart contract using Solidity on the Ethereum testnet, and interact with the contract through transactions.	2	2, 3	1, 2

9	Set up a Hyperledger Fabric network with multiple organizations, create channels, peers, and deploy a basic chaincode (smart contract).	2	3, 4	1, 2
10	Implement and compare different blockchain consensus mechanisms, such as Proof of Work and Proof of Stake, in a simulated environment.	2	2, 4	1, 2
11	Implement a Merkle tree to efficiently verify the integrity of transactions within a block by generating and verifying Merkle roots.	2	2, 3	1, 2
12	Develop a permissioned blockchain using a simplified RAFT or Paxos consensus algorithm, ensuring only authorized participants can access the blockchain.	2	3, 4	1, 2
13	Simulate a blockchain-based cross-border payment system, where transactions between multiple entities are recorded and settled using smart contracts.	2	3, 5	1, 2
14	Design a supply chain management system that uses blockchain to track product movement, verify authenticity, and maintain transparency.	2	3, 5	1, 2
15	Create a decentralized identity management system using blockchain, where user identities are securely authenticated and verified using smart contracts.	2	3, 5	1, 2
	Total Lab Hours	**30**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**				**End Semester Exam (50%)**
		CLA-1 (10%)	**Mid-1 (15%)**	**CLA-2 (10%)**	**CLA-3 (15%)**	
Level 1	Remember	70%	60%	30%	30%	60%
	Understand					
Level 2	Apply	30%	40%	70%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**			**End Semester Exam (50%)**
		Experiments (20%)	**Record / Observation Note (10%)**	**Viva + Model (20%)**	
Level 1	Remember	10%	20%	10%	15%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyse				
Level 3	Evaluate	30%	30%	40%	35%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.
3. Iran Bashir "Mastering Blockchain", Second Edition Paperback, 2018.
4. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
5. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing, 1st edition, Wiley, 2016, ISBN: 978-1-1188-6169-1 (hardcopy), 978-1-1190-8183-8

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Project Management

Course Code	PGM 501	Course Category	RDIP	L	T	P	C
				0	2	1	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Mechanical Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand Project Management Principles
2. Develop Planning and Organizational Skills
3. Enhance Communication and Leadership Abilities
4. Apply Project Management Tools and Techniques

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate proficiency in applying project management principles and practices to real-world projects	1	80%	75%
Outcome 2	Create detailed project plans, schedules, and budgets, and successfully manage project execution and control processes	2	80%	70%
Outcome 3	Exhibit Team Leadership and Communication Skills	3	80%	70%
Outcome 4	Use project management software and tools to plan, monitor, and close projects	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	3	2				3		3	3	2	3
Outcome 2	3	2	3	2				3		3	3	2	3
Outcome 3	3	2	3	2				3		3	3	2	3
Outcome 4	3	3	3	2				3		3	3	3	3
Average	**3**	**2**	**3**	**2**				**3**		**3**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1.	**UNIT-I Fundamental concepts**	**8**	**1**	**1**
2	Production planning and control	2	1	1
3	New product development	1	1	1,2
	UNIT-II Plant layout	**8**		
4	Capacity planning, facility planning	2	1	1
5	Plant location and layout	2	1,2	1,2
6	Scheduling and sequencing	2	1,2	1,2
	UNIT- III Operation management	**9**		
7	CPM	3	3	1
8	Gantt chart	3	3	2
9	Work study, time study	3	3	1,2
	UNIT-IV- Material management	**10**		
10	ABC analysis, EOQ	3	3,4	1
11	Supply chain management	4	3,4	1
12	Preventive maintenance	3	3,4	2
	UNIT – V Tools	**10**		
13	Six sigma, Poka yoke, BPR, ERP, Kanban, ISO 9000,	5	3,4	2
14	JIT, TQM, FMS, Push/Pull, Kaizen, CAD CAM	5	3,4	2
Total Contact hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (20%)		CLA-1 (15%)		Midterm-1 (15%)					
		Th.		Th.		Th.		Th.		Th.	
Level 1	Remember	50%		40%		50%		45%		30%	
	Understand										
Level 2	Apply	50%		60%		50%		55%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**				**100%**	

Recommended Resources

1. Bhattacharyya, Production and Operations Management, Universal Press
2. Panneer selvam R, Production and Operations Management, Publisher: Prentice Hall of India

Course Designers

1. Prof. Prakash Jadhav, Professor, Department of Mechanical Engineering, SRM university AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Thesis - I

Course Code	CYS 509	Course Category	RDIP	L	T	P	C
				0	0	14	14
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To widen the understanding of doing research.
2. To facilitate the ideation of a thought.
3. To devise and plan ways to execute an idea.
4. To learn how to avoid plagiarism and publish one's contribution in the research community

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Conceptualize an idea	5	75%	70%
Outcome 2	Devise a plan to do the literature survey on the idea	5	75%	70%
Outcome 3	Formulate the mathematical model for the problem.	4	75%	70%
Outcome 4	Assess the relevance and societal impact of the work	5	70%	65%
Outcome 5	Write a technical paper and report on the findings.	3	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design / Development of Solutions Conduct Investigations of Complex	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			2		1	2	3	2	3	2	2	3
Outcome 2	3	2	3	3	1	1	3	3	3	3	2	1	3
Outcome 3	3	3	3	3	3	3	3	3	3	3	3	3	3
Outcome 4					3	3	3			3	2	1	3
Outcome 5	3	1	3	3			3	3	3	3	3	3	3
Average	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**

Course Unitization Plan

SL No.	Unit Name	Required Contact hours	CLOs Addressed	References Used
Unit 1	Conception of Idea	10		
	Based on interest conceive an idea	20	1,4	1
	Do a feasibility check of the project	15	1,4	1
Unit 2	Submission of Abstract of the idea	20		
	Literature survey of the related works	20	2	1,2,3,4,5
	Write an abstract of the proposed idea	10	2	1
Unit 3	Formulate the Mathematical model	35		
	Formulate the mathematical model for the considered problem	30	3	1
	Creating timeline for execution of various modules of the project.	5	3	1,6
Unit 4	Conducting Simulations and Publish results	20		
	Execution of the various modules of the project and intermediate report submission.	10	3	1
	Initiation of the process for possible publication.	20	5	2,3,4,5
Total Contact Hours		**210 Hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								External (50%)	
				Internal							
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember										
	Understand										
Level 2	Apply				70%						30%
	Analyse										
Level 3	Evaluate				30%						70%
	Create										
Total					**100%**						**100%**

Recommended Resources

1. As recommended by Advisor pertaining to student research interest.
2. https://ieeexplore.ieee.org/Xplore/home.jsp
3. https://www.sciencedirect.com/
4. www.springer.com
5. https://onlinelibrary.wiley.com/
6. Research Methodology

Other Resources

Course Designers

1. Dr. Ashu Abdul, Assistant Professor, CSE, SRM University AP
2. Dr. Murali Krishna Enduri, Assistant Professor, CSE, SRM University AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Industrial Practice

Course Code	CYS 510	Course Category	RDIP	L	T	P	C
				0	2	1	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To enable students to apply theoretical concepts learned in the classroom to real-world industrial scenarios.
2. To develop and enhance students' professional and technical skills through direct involvement in industry-specific projects
3. To expose students to industry standards, practices, and workplace culture, giving them an understanding of the professional environment in their chosen field.
4. To provide students with networking opportunities and enhance their career development prospects by building connections with industry professionals.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate the ability to apply theoretical knowledge and concepts from their academic coursework to real-world industry challenges and projects.	1	80%	75%
Outcome 2	Exhibit enhanced professional skills, including effective communication, teamwork, and project management, gained through their internship experience.	2	70%	75%
Outcome 3	Demonstrate a comprehensive understanding of industry standards, practices	3	80%	70%
Outcome 4	Develop a professional network and gain insights into career opportunities and pathways within their industry.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design / Development of Solutions Conduct Investigations of Complex Problems	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	3	2				3		3	3	2	3
Outcome 2	3	2	3	2				3		3	3	2	3
Outcome 3	3	2	3	2				3		3	3	2	3
Outcome 4	3	3	3	2				3		3	3	3	3
Average	**3**	**2**	**3**	**2**				**3**		**3**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1.	**UNIT-I Introduction to Industrial Practice and Internships**	**8**	**1**	**1**
2	Overview of industrial practice	2	1	1
3	Importance of internships in career development	1	1	1,2
	UNIT-II Industry Overview	**8**		
4	Understanding different industries and sectors	2	1	1
5	Key players and market dynamics	2	1,2	1,2
6	Ethical standards and professional behavior and Communication and teamwork in a professional setting	2	1,2	1,2
	UNIT- III Application of Theoretical Knowledge	**9**		
7	Applying theoretical knowledge to practical tasks	3	3	1
8	Techniques for effective problem-solving	3	3	2
9	Decision-making processes in industrial settings and Case studies of successful knowledge application in industry	3	3	1,2
	UNIT-IV- Professional Skill Development	**10**		
10	Effective verbal and written communication	3	3,4	1
11	Presentation skills and public speaking	4	3,4	1
12	Working effectively in teams and Roles and responsibilities within a team	3	3,4	2
	UNIT – V Industry Standards and Practices	**10**		
13	Understanding industry-specific standards, Introduction to quality management principles	5	3,4	2
14	Risk management and safety protocols and Occupational health and safety standards	5	3,4	2
Total Contact hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								External (50%)	
				Internal							
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember										
	Understand										
Level 2	Apply				70%						30%
	Analyse										
Level 3	Evaluate				30%						70%
	Create										
Total					**100%**						**100%**

Recommended Resources

1. Heizer, J., Render, B., & Munson, C. (2020). Operations Management: Sustainability and Supply Chain Management (12th ed.). Pearson.
2. Stevenson, W. J. (2018). Operations Management (13th ed.). McGraw-Hill Education.
3. Chase, R. B., Jacobs, F. R., & Aquilano, N. J. (2019). Operations and Supply Chain Management (15th ed.). McGraw-Hill Education.

Other Resources

Course Designers

1. Dr. Murali Krishna Enduri, Assistant Professor, Department of Computer Science and engineering, SRM university AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Thesis - II

Course Code	CYS 511	Course Category	RDIP	L	T	P	C
				0	0	15	15
Pre-Requisite Course(s)	CYS 509	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To widen the understanding of doing research.
2. To facilitate the ideation of a thought.
3. To devise and plan ways to execute an idea.
4. To learn how to avoid plagiarism and publish one's contribution in the research community.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Refine the conceptualized idea from Phase 1	5	75%	70%
Outcome 2	Implement the mathematical model formulated in Phase 1.	5	75%	70%
Outcome 3	Conduct the simulation analysis and extract the results	5	75%	70%
Outcome 4	Validate the results obtained with the Literature survey.	5	70%	65%
Outcome 5	Publish and present finding in reputable journals and conferences.	3	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3			2		1	2	3	2	3	2	2	3
Outcome 2	3	2	3	3	1	1	3	3	3	3	2	1	3
Outcome 3	3	3	3	3	3	3	3	3	3	3	3	3	3
Outcome 4					3	3	3			3	2	1	3
Outcome 5	3	1	3	3			3	3	3	3	3	3	3
Average	3	2	3	3	2	2	3	3	3	3	3	2	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact hours	CLOs Addressed	References Used
Unit 1	Refinement of Idea	60 hours	1	All
Unit 2	Implement the Mathematical model	50 hours		
	Optimize the mathematical model for the considered problem	15 hours	2	
	Creating timeline for execution of various module of the project.	10 hours	2	
Unit 3	Conduct the simulation analysis and extract the results	50 hours		
	Perform the experimental simulations.		3	
Unit 4	Validate the results obtained with Literature survey	20 hours	4	
Unit 5	Publish and present results and finding	20 hours	5	
Total		**225 hours**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**								**External (50%)**	
				Internal							
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember										
	Understand										
Level 2	Apply				70%						30%
	Analyse										
Level 3	Evaluate				30%						70%
	Create										
Total					**100%**						**100%**

Recommended Resources

1. As recommended by Advisor pertaining to student research interest.
2. https://ieeexplore.ieee.org/Xplore/home.jsp
3. https://www.sciencedirect.com/
4. www.springer.com
5. https://onlinelibrary.wiley.com/
6. Research Methodology

Other Resources

Course Designers

1. Dr. Ashu Abdul, Assistant Professor, CSE, SRM University AP
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Information Retrieval

Course Code	AML553	Course Category	CE	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To provide an overview of Information Retrieval.
2. To introduce students to insights into several Information retrieval topics such as – The boolean retrieval model, Vector space model, Latent semantic indexing, XML and Image retrieval model.
3. To provide comprehensive details about various Evaluation methods.
4. To provide implementation insight about the topics covered in the course.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Students will be able to understand different Information retrieval models.	2	70%	70%
Outcome 2	Students will be able to design and implement different data structures, such as an index, to allow efficient access to the information in large bodies of text.	3	70%	65%
Outcome 3	Students will be able to understand evaluation methods for different kinds of information retrieval models.	4	70%	70%
Outcome 4	Students will be able to apply, evaluate and analyze classification and clustering techniques in information retrieval.	4	70%	65%
Outcome 5	Students will be able to develop a small-scale IR system from scratch.	5	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)												
	Engineering Knowledge	Design /Development of solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	2	2							2	2	1
Outcome 2	2	3	2	2							2	2	2
Outcome 3	2	2	2	2							2	2	2
Outcome 4	2	2	2	2							2	2	2
Outcome 5	3	3	2	2							2	3	2
Average	2	2	2	2							2	2	2

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction:**	**11**		
1	Overview of Information Retrieval, Architecture of a Search Engine	2	1,2,5	1,3
2	Crawling the Web, Document Conversion, Storing the Documents, Detecting Duplicates, Noise Detection and Removal	4	1,3,5	1,3
3	Text Statistics, Document Parsing, Tokenizing, Stopping, Stemming, Phrases, Document Structure, Link Extraction, More detail on Page Rank, Feature Extraction and Named Entity Recognition, Internationalization	5	1,3,5	1
Unit 2	**Indexing, Queries and Interfaces**	**9**		
4	Ranking with Indexes Abstract Model of Ranking, Inverted indexes, Map Reduce, Query Processing: Document-at-a-time evaluation, Term-at-a-time evaluation, Optimization techniques, Structured queries, Distributed evaluation, Caching	4	1,3,5	1,2
5	Information Needs and Queries, Query Transformation and Refinement: Stopping and Stemming Revisited, Spell Checking and Query Suggestions, Query Expansion, Relevance Feedback, Context and Personalization. Displaying the Results: Result Pages and Snippets, Advertising and Search, Clustering the Results; Translation; User Behavior Analysis	5	1,3,5	1,2
Unit 3	**Retrieval Models**	**8**		
6	Retrieval Models: Overview of Retrieval Models; Boolean Retrieval, The Vector Space Model	3	1,5	1
7	Probabilistic Models: Information Retrieval as Classification, The BM25 Ranking Algorithm	1	1	1
8	Ranking based on Language Models: Query Likelihood Ranking, Relevance Models and Pseudo-Relevance Feedback	1	1	1
9	Complex Queries and Combining Evidence: The Inference Network Model, The Galago Query Language	1	1	1,2
10	Models for Web search	1	1	1,2,3
11	Machine Learning and Information Retrieval: Learning to Rank (Le ToR), Topic Models	1	1	1
Unit 4	**Evaluation, Clustering, Classification**	**10**		
12	Evaluating Search Engines: Test collections, Query logs, Effectiveness Metrics: Recall and Precision, Averaging and interpolation, focusing on the top documents. Training, Testing, and Statistics: Significance tests, setting parameter values	3	4,5	1,3
13	Classification	4	4	1,3
14	Clustering	3	4	1,3
Unit 5	**Advanced topics**	**7**		
15	Social Search: Networks of People and Search Engines: User tagging, searching within Communities, Filtering and recommending, Meta search	3	1	1,2,3
16	Beyond Bag of Words: Feature-Based Retrieval Models, Term Dependence Models, Question Answering, Pictures, Pictures of	4	1	1,2,3

	Words, etc., XML Retrieval, Dimensionality Reduction and LSI			
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**	
		CLA-1 (10%)		**Mid-1 (15%)**		**CLA-2 (10%)**		**Mid-2 (15%)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	70%		65%		40%		50%		40%	
	Understand										
Level 2	Apply	30%		35%		40%		50%		60%	
	Analyse										
Level 3	Evaluate					20%					
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Prabhakar Raghavan, and Hinrich Schuetze (2007) Introduction to Information Retrieval. Christopher D. Manning, Cambridge University Press.
2. Bruce Croft, Donald Metzler, and Trevor Strohman (2009) Search Engines: Information Retrieval in Practice. Pearson Education.
3. Baeza-Yates Ricardo and BerthierRibeiro-Neto (2011) Modern Information Retrieval. 2nd edition, Addison-Wesley.

Other Resources

1. https://web.stanford.edu/class/cs276/
2. S. Chakrabarti. Morgan-Kaufmann (2002) Mining the Web.

Course Designers

1. Dr. Niladri Sett, Assistant Professor, Dept. of Computer Science and Engineering, SRM University AP.

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Soft Computing

Course Code	AML 531	Course Category	CE	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.
2. Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.
3. Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
4. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.
5. Understand the Genetic Algorithm and able to identify the application area.
6. Understand soft computing techniques and their role in problem solving. Reveal different applications of these models to solve engineering and other problems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate the Soft Computing and Artificial Neural Networks model	3	90%	75%
Outcome 2	Describe the evolutionary computation concepts and paradigms	2	70%	65%
Outcome 3	Apply the Neural Network Concepts and Paradigms	3	80%	75%
Outcome 4	Apply the Fuzzy Systems concepts and paradigms	3	80%	75%
Outcome 5	Design solutions using genetic algorithms and compare them with traditional approaches to a given problem.	5	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

PEOs	Program Learning Outcomes (PLO)												
	POs										PSOs		
	Engineering Knowledge	Design / Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Life-long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	2							2		
Outcome 2	3	2	3	3							2		
Outcome 3	3	3	3	3							2		
Outcome 4	3	2	2	2							3		
Outcome 5	3	2	3	2							3		
Average	3	2	3	3							2		

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to Soft Computing, ANN**	**9**		
	What is computational intelligence?- Biological basis for neural networks- Biological versus Artificial neural networks	1	1	1
	Biological basis for evolutionary computation	1	1,2	1
	Behavioral motivations for fuzzy logic	1	1	1,3
	Myths about computational intelligence- Computational intelligence application areas	1	2	1,3
	Evolutionary computation	1	1	1
	computational intelligence-Adoption, Types, self-organisation and evolution	1	1,2	1
	Historical views of computational intelligence	1	1,2	1
	Computational intelligence and Soft computing versus Artificial intelligence.	1	1,2	1
	Hard computing	1	2,5	1
Unit II	Evolutionary computation concepts and paradigms	**9**		
	History of Evolutionary Computation & overview	1	2	1,3
	Genetic algorithms, Evolutionary programming & strategies	1	2	1,3
	Genetic programming	1	2	1,3
	Particle swarm optimisation	1	2	1,3
	Evolutionary computation implementations-Implementation issues	1	2	1,3
	Genetic algorithm implementation	2	2	1,3
	Particle swarm optimisation implementation.	2	2,5	1,3
Unit III	Neural Network Concepts and Paradigms	**9**		
	What are Neural Networks? Why they are useful	1	3	2
	Neural network components and terminology- Topologies	1	3	2
	Adaptation, Comparing neural networks	1	3	2
	other information Processing methods	1	3	2,3
	Stochastic- Kalman filters	1	3	2,3
	Linear and Nonlinear regression - Correlation	1	3	2,3
	Bayes classification	1	3,5	2,3
	Vector quantisation	1	3	2,3
	Radial basis functions -Preprocessing - Post-processing.	1	3,5	2,3
Unit IV	Fuzzy Systems concepts and paradigms	**9**		
	Fuzzy sets and Fuzzy logic	2	4	3,4
	Approximate reasoning	2	4	3
	Developing a fuzzy controller	2	4	3
	Fuzzy rule system implementation	3	4	3
Unit V	Performance Metrics	**9**		
	General issues	1	4	2,3
	Partitioning the patterns for training, testing, and validation- Cross-validation	2	2	1,3
	Fitness and fitness functions - Parametric and nonparametric statistics	1	3,4	2,3
	Evolutionary algorithm effectiveness metrics	1	1,4	2,3
	Receiver operating characteristic curves	1	4,5	2,3
	Computational intelligence tools for explanation facilities	1	3,4	2,3
	Case Studies for implementation of practical applications in computational intelligence	2	5	3
	Total contact hours	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (15%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	30%	30%	30%	30%	30%
	Understand					
Level 2	Apply	40%	40%	40%	40%	40%
	Analyse					
Level 3	Evaluate	30%	30%	30%	30%	30%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Russell C. Eberhart and Yuhui Shi (2007) Computational Intelligence: concepts to implementations. Morgan Kaufmann Publishers is an imprint of Elsevier.
2. Andries P. Engelbrecht (2007) Computational Intelligence: An Introduction, Second Edition. Wiley.
3. John Fulcher and Lakshmi C. Jain (2007) Computational Intelligence: A compendium, Springer.
4. David B. Fogel and Charles J. Robinson (2003) Computational Intelligence: The experts speak. Wiley – Interscience..

Other Resources

Course Designers

1. Prof Niraj Upadhayaya, Professor, Computer Science and Engineering, SRM University – AP.