Department of Computer Science

B.Sc. (Hons.) Computer Science
Curriculum and Syllabus

(Applicable to the students admitted during AY: 2022-23)

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. Instil students with effective managerial skills, fostering their development into competitive and visionary entrepreneurs.

Program Educational Objectives (PEO)

1. To enhance student's foundational knowledge and computer science concepts by improving analytical and computational approaches by understanding societal and technological challenges.
2. To promote a strongly interdisciplinary approach that integrates the study of multiple academic disciplines which can develop skills required to build careers in various emerging fields of Science.
3. To engage in the understanding of emergent computing technologies to identify and communicate innovative solution for significant problems across a broad range of application areas.

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

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

Program Specific Outcomes (PSO)

1. Apply their knowledge of computing system, algorithmic principles and mathematical foundations to develop innovative solutions to current and emerging computing problems.
2. Design, implement, and evaluate a computer-based system to meet realistic requirements.
3. Adapt new technologies, tools and methodologies to remain at the leading edge of computer science developments and practice in the profession and in the academic field.

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

Program Learning Outcomes (PLO)															
PEOs	POs												PSOs		
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
PEO 1	3	2	2	1	1	3	1	-	-	2	-	1	3	2	3
PEO 2	1	-	2	2	-	3	-	1	2	2	-	2	2	3	1
PEO 3	2	2	2	1	-	3	-	-	3	3	1	3	3	1	3

Category Wise Credit Distribution			
Course Sub-Category	**Sub-Category Credits**	**Category Credits**	**Learning Hours**
Ability Enhancement Courses (AEC)		2	60
University AEC	0		
School AEC	2		
Value Added Courses (VAC)		4	120
University VAC	4		
School VAC	0		
Skill Enhancement Courses (SEC)		14	420
School SEC	4		
Department SEC	4		
SEC Elective	6		
Foundation / Interdisciplinary courses (FIC)		28	840
School FIC	28		
Department FIC	0		
Core + Core Elective including Specialization (CC)		78	2340
Core	56		
Core Elective (Inc Specialization)	22		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		19	570
Internship / Design Project / Startup / NGO	4		
Internship / Research / Thesis	15		
Total		**160**	**4800**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	0	0	2	0	0	0	0	0	2	1
Value Added Courses - VAC	0	0	0	0	0	4	0	0	4	3
Skill Enhancement Courses - SEC	1	3	2	2	3	3	0	0	14	9
Foundation / Interdisciplinary Courses - FIC	20	8	0	0	0	0	0	0	28	18
CC / SE / CE / TE / DE / HSS	0	12	16	12	16	11	11	0	78	49
Minor / Open Elective - OE	0	0	3	3	3	3	3	0	15	9
(Research / Design / Industrial Practice / Project / Thesis / Internship) - RDIP	0	0	0	0	0	0	4	15	19	12
Grand Total	**21**	**23**	**23**	**17**	**22**	**21**	**18**	**15**	**160**	**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	FIC	S FIC	BIO 114	A Primer to Biology	3	0	0	3
2	FIC	S FIC	BIO 114L	Practical Biology	0	0	1	1
3	FIC	S FIC	CHE 115	Introduction to Chemistry	3	1	0	4
4	FIC	S FIC	CSC 108	Introduction to Computer Science and Programming Using C	3	0	0	3
5	FIC	S FIC	CSC 108L	Introduction to Computer Science and Programming Using C Lab	0	0	1	1
6	FIC	S FIC	MAT 104	Introduction to Mathematics	4	0	0	4
7	FIC	S FIC	PHY 103	Introduction to Physics	3	0	0	3
8	FIC	S FIC	PHY 103L	Introduction to Physics Lab	0	0	1	1
9	SEC	SEC	ISES 101	Industry Specific Employability Skills-I	**0**	0	**1**	1
				Semester Total	**16**	**1**	**4**	**21**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SEC	S SEC	ISES 102	Industry Specific Employability Skills-II	**0**	0	**1**	1
2	SEC	S SEC	CSC 130	Industry Standard Coding Practice-I	0	0	2	2
3	FIC	S FIC	EGL 100	Introduction to Communicative English	4	0	0	4
4	FIC	S FIC	ENV 100	Environmental Science	4	0	0	4
5	Core	CC	CSC 107	Data Structures	3	0	0	3
6	Core	CC	CSC 107L	Data Structures Lab	0	0	1	1
7	Core	CC	MAT 221	Probability and Statistics for Engineers	3	1	0	4
8	Core	CC	MAT 252	Discrete Mathematics	4	0	0	4
				Semester Total	**18**	**1**	**4**	**23**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	AEC 106	Analytical Skills for Sciences	1	0	1	2
2	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
3	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
4	SEC	D SEC	SEC 102	Digital Literacy	2	0	0	2
5	Core	CC	CSC 201	Object Oriented Programming with C++	3	0	1	4
6	Core	CC	CSC 202	Digital Electronics	3	0	1	4
7	Core	CC	CSC 203	Design and Analysis of Algorithms	3	0	1	4
8	Core	CC	CSC 204	Linear Algebra and Differential Equations	3	1	0	4
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**18**	**1**	**8**	**23**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	D SEC	SEC 107	Mathematical Modelling of Physical data	2	0	0	2
4	Core	CC	CSC 205	Computer Organization and Architecture	3	0	1	4
5	Core	CC	CSC 206	Mobile Application Development with Java	3	0	1	4
6	Core	CC	CSC 207	Database Management Systems	3	0	1	4
7	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**14**	**0**	**7**	**17**

SEMESTER - V								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	E SEC		Career Skills - I	3	0	0	3
4	Core	CC	CSC 301	Computer Networks	3	0	1	4
5	Core	CC	CSC 302	Operating Systems	3	0	1	4
6	Core	CC	CSC 303	Web Technology	3	0	1	4
7	Core	CC	CSC 304	Machine Learning	3	0	1	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**18**	**0**	**8**	**22**

SEMESTER - VI								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2
3	SEC	E SEC		Career Skills - II	3	0	0	3
4	Elective	CE		Core Elective- I	**3**	0	0	3
5	Elective	SE		Stream Elective – I	3	0	1	4
6	Elective	SE		Stream Elective - II	3	0	1	4
7	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**15**	**0**	**6**	**21**

SEMESTER - VII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE		Core/Stream Elective - III	3	0	1	4
2	Elective	CE		Core/Stream Elective - IV	3	0	1	4
3	Elective	CE		Core Elective - II	3	**0**	0	3
4	RDIP	RDIP	CSC 401	Internship	0	0	4	4
5	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**12**	**0**	**5**	**18**

SEMESTER - VIII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	CSC 402	Major Project	0	0	15	15
				Semester Total	**0**	**0**	**15**	**15**

List of Specialization Electives: Artificial Intelligence and Machine Learning								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CSC 455	Artificial Intelligence	3	0	1	4
2	Elective	CE	CSC 456	Digital Image Processing	3	0	1	4
3	Elective	CE	CSC 457	Deep Learning	3	0	1	4
4	Elective	CE	CSC 458	Principles of Soft Computing	3	0	1	4

List of Specialization Electives: Big Data Analytics								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CSC 463	Data Warehousing and Mining	3	0	1	4
2	Elective	CE	CSC 464	Applied Data Science	3	0	1	4
3	Elective	CE	CSC 465	Principles of Big Data Management	3	0	1	4
4	Elective	CE	CSC 466	Information Retrieval	3	0	1	4

List of Core Electives								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	CSC 421	Human Computer Interaction	3	0	0	3
2	Elective	CE	CSC 422	Advanced Computer Architecture	3	0	0	3
3	Elective	CE	CSC 423	Natural Language Processing	3	0	0	3
4	Elective	CE	CSC 424	Computer Graphics	3	0	0	3
5	Elective	CE	CSC 425	Advanced Data Structures and Algorithms	3	0	0	3
6	Elective	CE	CSC 426	Distributed Operating Systems	3	0	0	3
7	Elective	CE	CSC 427	Data and Web Mining	3	0	0	3
8	Elective	CE	CSC 428	Complexity Theory	3	0	0	3
9	Elective	CE	CSC 429	Software Project Management	3	0	0	3
10	Elective	CE	CSC 430	Multimedia	3	0	0	3
11	Elective	CE	CSC 431	Deep Learning	3	0	0	3
12	Elective	CE	CSC 432	Advanced Database Management Systems	3	0	0	3

13	Elective	CE	CSC 433	Fog Computing	3	0	0	3
14	Elective	CE	CSC 434	Parallel Algorithms	3	0	0	3
15	Elective	CE	CSC 435	Web Services	3	0	0	3
16	Elective	CE	CSC 436	Advances in Data Mining	3	0	0	3
17	Elective	CE	CSC 437	Social Network Analysis	3	0	0	3
18	Elective	CE	CSC 438	Recommender Systems	3	0	0	3
19	Elective	CE	CSC 439	Computational and Complexity Theory	3	0	0	3
20	Elective	CE	CSC 441	Artificial Intelligence	3	0	0	3
21	Elective	CE	CSC 442	Machine Learning on Edge Computing	3	0	0	3
22	Elective	CE	CSC 443	Mobile and wireless security	3	0	0	3
23	Elective	CE	CSC 444	Internet protocols and networking	3	0	0	3
24	Elective	CE	CSC 445	Mobile application security testing	3	0	0	3
25	Elective	CE	CSC 446	IoT security	3	0	0	3
26	Elective	CE	CSC 447	Biometric Security	3	0	0	3
27	Elective	CE	CSC 448	Cyber Law	3	0	0	3
28	Elective	CE	CSC 449	Ethical Hacking	3	0	0	3
29	Elective	CE	CSC 450	Security audit and Risk Assessment	3	0	0	3
30	Elective	CE	CSC 451	Digital Forensics and Incident Response	3	0	0	3
31	Elective	CE	CSC 452	Security Analytics	3	0	0	3
32	Elective	CE	CSC 453	Multiview Geometry	3	0	0	3
33	Elective	CE	CSE 454	Project	3	0	0	3

Career Skill Courses								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SEC	E SEC	SEC 129	Coding Skills - I	3	0	0	3
2	SEC	E SEC		Coding Skills – II	3	0	0	3

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

A Primer to Biology

Course Code	BIO 114	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understanding the importance of studying biology and the evolution of complex biomolecules and life on Earth provides a foundation for science students to appreciate the biological principles and systems that utilise many fundamental processes from other branches of natural sciences.

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 importance of studying biology and the evolution of complex biomolecules and life on Earth.	2	80%	75%
Outcome 2	Explain the structure and functions of prokaryotic and eukaryotic cells, including organelles, and recognize the diversity of life.	2	80%	70%
Outcome 3	Describe membrane transport processes, cellular respiration, energy generation, photosynthesis, enzymes, vitamins, and hormones.	2	80%	70%
Outcome 4	Describe the structure and organization of DNA and chromosomes, and comprehend the central dogma of DNA replication, transcription, and translation.	2	75%	70%
Outcome 5	Explain the principles and applications of genomics, transcriptomics, proteomics, and metabolomics.	2	75%	70%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1		1							3			3	1	2
Outcome 2	2	3								3			3	3	2
Outcome 3	2	3	2	2					1				3	2	3
Outcome 4	2	3	2	2						3		2	3	2	2
Outcome 5	2	3		3	1	2			1			3	3	2	3
Average	**1.8**	**3**	**1.7**	**2.3**	**1**	**2**			**1**	**3**		**2.5**	**3**	**2**	**2.4**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Life: Origin, composition and chemistry**	**5**		
	Origin of complex Biomolecules and primitive cells	1	1	1, 2
	Chemical basis of life	1	1	1, 2
	Importance of carbon - synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Importance of Water- synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Selectively permeable membranes	1	1	1, 2
Unit 2	**Cell Biology**	**12**		
	Prokaryotes and eukaryotes (cell structures and organelles);	2	1, 2	1, 2
	Virus- lysogenic and lytic cycles;	3	2	1, 2
	Bacteria- typical bacterial cells, bacterial gene transfer- conjugation, transformation, and transduction	3	2	1, 2
	Antibiotic resistance- an emerging threat; Microbiome	3	2	1, 2
	Cell cycle- mitosis and meiosis.	1	2	1, 2
Unit 3	**Energy harvesting reactions by life forms**	**10**		
	The importance of energy in biological systems; Gibbs free energy ($\triangle$ G);	2	1,3	1, 2
	Biological reactions: Enzymes and their equilibrium constants (Keq);	2	3	1, 2
	Energy harvesting: Chemotrophic, Phototrophic;	2	3	1, 2
	Metabolism: Glycolysis, anaerobic and aerobic cellular respiration.	2	3	1, 2
	Fate of food in cellular energy cycle.	2	3	1, 2
Unit 4	**Molecular Biology**	**9**		
	Structure of DNA and organization of chromosomes;	2	4	1, 2
	Central dogma- replication, transcription, and translation in prokaryotes.	3	4	1, 2
	Mutations, cancer and hereditary diseases.	2	4	1, 2
	Introduction to genetic manipulation- concepts of restriction digestion, cloning	2	4	1, 2
Unit 5	**Bioinformatics**	**9**		
	Biological sequences and evolution of sequencing technologies.	3	5	3
	Utilization of sequence information in personalized medicine and disease detection.	3	5	3
	Structural Biology: Biomolecular structures and their databases.	3	5	3
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%)	CLA-3 (15%)	
		Th	Th	Th	Th	Th
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Becker's World of the Cell, Global Edition, 9th Edition (2017). Jeff Hardin, Gregory Paul Lewis J. Kleinsmith. Pearson
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. SINAUER ASSOCIATES MACMILLAN.
3. Introduction to Bioinformatics (Chapman & Hall/CRC Computational Biology Series) (2006) by Anna Tramontano.

Other Resources

Course Designers

1. All Faculty Members, Department of Biological Sciences, SRM University – AP.

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

Practical Biology

Course Code	BIO 114L	Course Category	Core Course (CC)	L	T	P	C
				0	0	1	1
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Biological Sciences	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand and implement lab safety rules and proficiently handle micropipettes and pH meters for secure laboratory practices.
2. Develop skills in buffer preparation and gain familiarity with basic laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.

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 a thorough understanding of lab safety protocols and proficiently handle essential laboratory equipment, ensuring a secure working environment.	3	80%	75%
Outcome 2	Develop precision in using micropipettes and pH meters, successfully prepare buffers and growth media, and acquire skills in observing mitosis stages in onion root tips and thin plant specimens under a microscope.	3	70%	65%
Outcome 3	Gain competence in the operation and safety procedures of fundamental laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.	3	70%	65%
Outcome 4	Acquire practical expertise in culturing microorganisms from various sources (air, soil, coins, and skin), observe the preparation of growth media and plates through a demonstration, and master cell counting using a hemocytometer.	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	3		1		3	3			3	1	3
Outcome 2	3	2	3	3	3		1	1	3				3	3	2
Outcome 3	3	3	3	3	3		1		3	3			3	3	3
Outcome 4	3	2	3	3	3		1	1	3	3			3	3	2
Average	**3**	**2.3**	**3**	**3**	**3**		**1**	**1**	**3**	**3**			**3**	**2.5**	**2.5**

Course Unitization Plan

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Lab safety introduction Handling micropipettes and pH meter	5	1	1
2.	Preparation of buffers; Introduction to basic instrumentation: microscope, autoclave, spectrophotometer, centrifuge, incubators, and laminar air-flow cabinets	5	2	1
3.	Observing stages of mitosis in onion root tip. Observing thin specimens of plant samples under the microscope	5	3,4	1
4.	Preparation of growth media and plates (demonstration)	5		
5.	Culturing microorganisms from air, soil, coins, and skin	5	3,4	1
6.	Cell counting using hemocytometer	5	3,4	1
Total Contact Hours		**30**		

Learning Assessment

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	50%		50%	50%
	Understand				
Level 2	Apply	50%	100%	50%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Practical Manual of Biochemistry. Sattanathan, Padmapriya, Balamuralikrishnan.

Other Resources

1. https://amrita.edu/course/biochemistry-practical/

Course Designers

1. Dr. Anil K Suresh, Associate Professor, Department of Biological Sciences, SRM University – AP.

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

Introduction to Chemistry

Course Code	CHE 115	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.
2. To classify the states of matter and discuss their behavior and properties.
3. To explain the redox reactions and demonstrate their applications in the electrochemical cells
4. To explain the classification, nomenclature, and electronic properties of organic compounds.
5. To describe the different types of organic reactions and their purification techniques.
6. To discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, and nucleic acids and list the toxicity of the metals

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	Distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.	2	80%	85%
Outcome 2	Classify the states of matter and their behavior and properties	2	80%	80%
Outcome 3	Explain the redox reactions and demonstrate their application in the electrochemical cells.	3	80%	75%
Outcome 4	Classify electronic properties of organic compounds and reactions.	2	80%	70%
Outcome 5	Discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, nucleic acids and can list the toxicity of the metals.	2	80%	75%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	2	2		2	2	1	3	2	2	2	2	2	2
Outcome 2	2	2	2	1		2	2	1	1	3	2	2	2	2	2
Outcome 3	2	2	1	1		2	3	3	3	3	2	1	2	2	1
Outcome 4	2	3	2	2		2	2	1	3	2	2	1	2	2	3
Outcome 5	2	2	1	1		2	3	3	2	2	2	1	2	2	2
Average	2.0	2.4	1.6	1.4		2.0	2.4	1.8	2.4	2.4	2.0	1.4	2.0	2.0	2.0

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Chemical Bonding and Molecular Structure**	**8**		
	Importance and scope of chemistry (Central Science)	1	1	2
	Valence electrons, ionic bond, covalent bond, Hydrogen bond	1	1	2
	Valence bond theory	1	1	2
	The geometry of covalent molecules	1	1	
	VSEPR theory	1	1	2
	The concept of hybridization involving *s, p,* and *d* orbitals	1	1	2
	Shapes of some simple molecules	1	1	2
	Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only)	1	1	2
	Tutorial 1	3	1	2
Unit No. 2	**States of Matter**	**12**		
	Three states of matter, intermolecular interactions Gases: The behavior of gases, changes in the volume of a gas with pressure; Boyle's law	1	2	1
	Change in volume of a gas with temperature; Charles's law	1	2	1
	Gay Lussac's law, Avogadro's law, Ideal gas law	1	2	1
	Empirical derivation of gas equation, Kinetic molecular theory	1	2	1
	Deviation from ideal gas law.	1	2	1
	Liquids – Liquid State – Vapour pressure, viscosity, and surface tension	1	2	1
	Introduction to solutions, different types of solutions	1	2	1
	Raoult's Law (change of state),	1	2	1
	Constant boiling mixtures (azeotropic mixtures (distillation)	1	2	1
	Nature and different types of solids including covalent, non-covalent ionic, and metallic solids	1	2	1
	Solids and their bonding, Band theory	1	2	1
	Application of crystalline materials in electronic devices.	1	2	1
	Tutorial 2	3	1	1
Unit No. 3	**Redox Reactions**	**8**		
	Concept of oxidation and reduction, redox reactions	1	3	2
	redox reactions	1	3	2
	Oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers	1	3	2
	Applications of redox reactions	1	3	2
	Nomenclature applicable to electrochemical cells, viz., electromotive force, electrochemical series.	2	3	2
	Evolution of electrochemical cells: from voltaic cells to Li-ion battery	2	3	2
	Tutorial 3	3	3	2
Unit No. 4	**Basic Principles of Organic Chemistry**	**12**		
	General introduction, classification	1	4	3,4
	IUPAC nomenclature of organic compounds.	2	4	3,4
	Electronic displacements in a covalent bond	1	4	3,4
	Inductive effect, electrometric effect, resonance, and hyperconjugation	2	4	3,4
	Homolytic and heterolytic fission of a covalent bond	1	4	3,4
	Free radicals, carbocations, carbanions	1	4	3,4
	Electrophiles and nucleophiles	1	4	3,4
	Types of organic reactions	1	4	3,4
	Purification methods: Qualitative and quantitative analysis	2	4	3,4
	Tutorial 4	3	4	3,4
Unit No. 5	**Chemistry of Life**	**5**		
	Carbohydrates, Amino acids, peptide bonds	1	5	3,4
	Secondary and tertiary structures of proteins, enzymes, vitamins, Nucleic acids, bioinorganic chemistry	2	5	3,4
	Toxicity of heavy metals (Cu, Fe, As, Pb, Hg, Co, Cr, Cd, etc.),	2	5	3,4
	Tutorial 5	3	5	3,4
	Total Contact Hours	**60**		

Learning Assessment

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

Recommended Resources

1. Peter Atkins, & Paula, J. de. Elements of Physical Chemistry 7th Ed., Oxford University Press (2014).
2. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
3. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

Other Resources

Course Designers

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

Introduction to Computer Science and Programming Using C

Course Code	CSC 108	**Course Category**	Core Course (CC)	**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. Gain basic knowledge in C programming language.
2. Acquire knowledge on Decision making and functions in C.
3. Learn arrays, strings and pointers concept in C.
4. Understand the basics concepts of Structures, Union and File handling techniques Using C Programming.

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 C structures, enumerators, keywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	1									2	2	3
Outcome 2	3	3	2	1									3	2	3
Outcome 3	3	3	2	2									3	2	3
Outcome 4	3	3	2	2									3	2	3
Outcome 5	3	3	2	2								2	3	2	2
Average	**3**	**3**	**2**	**2**								**2**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	**INTRODUCTION TO COMPUTER SCIENCE**	**9**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer: ALU, input-output units, memory, program counter - variables and addresses - instructions: store, arithmetic, input and output	2	1	1,2
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	2	1	1,2
	Computer languages: Machine, symbolic and high-level langua Level languages	1	1	1,2
	Creating and Running Programs: Writing, editing (any editor), compiling (gcc)	1	1	1,2
	linking, and executing in Linux environment	1	1	1,2
UNIT II	**C PROGRAMMING BASICS**	**9**		
	Structure of a C program, identifiers Basic data types and sizes. Constan Variables	1	1	1,2
	Arithmetic, relational and logical operators, increment and decrement operator's	1	1	1,2
	Conditional operator, assignment operator, expressions Type conversion	1	1	1,2
	Conditional Expressions Precedence and order of evaluation, Sample Programs.	1	1	1,2
	SELECTION & DECISION MAKING: if-else, null else, nested if, way selection: switch, else-if, examples.	2	1	1,2
	ITERATION: Loops - while, do-while and for, break, continue,	1	1	1,2
	initialization and updating, event and counter controlled loops and exampl	2	1,2	1,2
UNIT III	**FUNCTIONS AND ARRAYS**	**10**		
	User defined functions, standard library functions	1	2,3	1,2
	Passing 1-D arrays, 2-D arrays to functions.	1	2,3	1,2
	Recursive functions - Recursive solutions for Fibonacci series, towers of Hanoi.	2	2,3	1,2
	C Pre-processor and header files	1	2,3	1,2
	Concepts, declaration, definition, storing and accessing elements	1	2,3	1,2
	one dimensional, two dimensional and multidimensional arrays	2	2,3	1,2
	array operations and examples, Character arrays and string manipulations	2	2,3	1,2
UNIT IV	**POINTERS**	**10**		
	Concepts, initialization of pointer variables	1	3,4	1,2
	pointers as function arguments, passing by address, dangling memory, address arithmetic	2	3,4	1,2
	character pointers and functions, pointers to pointers	2	3,4	1,2
	pointers and multi-dimensional arrays, dynamic memory management functions	2	3,4	1,2
	command line arguments	1	3,4	1,2
UNIT V	**ENUMERATED, STRUCTURE AND UNION TYPES**	**7**		
	Structures - Declaration, definition, and initialization of structures, accessing structures	1	5	2, 3, 4
	nested structures, arrays of structures, structures and functions, pointers to structures,	1	5	2, 3, 4
	self-referential structures. Unions, typedef, bit-fields, program applications	2	5	2, 3, 4
	Bit-wise operators: logical, shift, rotation, masks.	1	5	2, 3, 4

	FILE HANDLING: Concept of a file, text files and binary files, formatted I/O, file I/O operations and example programs.	2	5	2, 3, 4
	Total Hours	**45**		

Learning Assessment

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

Recommended Resources

1. Kernighan, B. W., & Ritchie, D. M. (2002). The C programming language.
2. Dey, P., & Ghosh, M. (2011). Programming in C.
3. Hanly, J. R., & Koffman, E. B. (2007). Problem solving and program design in C. Pearson Education India.
4. Bichkar, R. S., (2012) Programming with C.

Other Resources

1. Gottfried, B. S., (2016) Programming with C, McGraw Hill Education, Fourteenth reprint

Course Designers

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

Introduction to Computer Science and Programming Using C Lab

Course Code	CSC 108L	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	CSC 108	**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Learn and understand C programming basics and paradigm.
2. Acquire knowledge on decision making and functions in C.
3. Acquire knowledge on decision making, loop concept, control statements, arrays, string and functions using C.
4. Learn basics of Structures, Union, and File handling concepts in C.

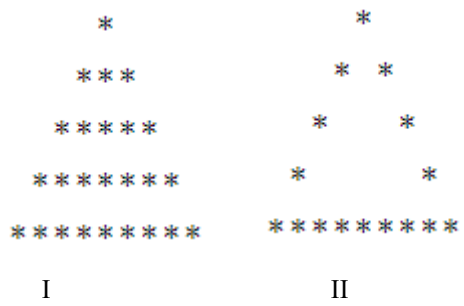
Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe fundamentals in C, enumerators, datatypes, vakeywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2				2				3	2	
Outcome 2	2	2	3	3	2				2				2	2	
Outcome 3	2	3	3	2	2				2				2	2	
Outcome 4	3	3	3	3	2				3				2	3	
Outcome 5	2	3	3	3	3				3				2	2	
Average	**2**	**3**	**3**	**3**	**2**				**2**				**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	**INTRODUCTION TO COMPUTER SCIENCE**	**4**		
1	**Lab Experiment 1:** GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
2	**Lab Experiment 2:** a) Calculation of the area of the triangle. b) Swap two numbers without using a temporary variable. c) Find the roots of a quadratic equation	2	1	1,2
UNIT II	**C PROGRAMMING BASICS**	**6**		
3	**Lab Experiment 3:** a) Find the sum of individual digits of a positive integer and find the reverse of the given number. b) Generate the first n terms of Fibonacci sequence. c) Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	2	1,2	1,2
4	**Lab Experiment 4:** a) Print the multiplication table of a given number n up to a given value, where n is entered by the user. b) Decimal number to binary conversion. c) Check whether a given number is the Armstrong number or not.	2	1,2	1,2
5	**Lab Experiment 5:** Triangle star patterns  I II	2	1,2	1,2
UNIT III	**FUNCTIONS AND ARRAYS**	**9**		
6	**Lab Experiment 6:** **a)** (nCr) and (nPr) of the given numbers $1+x+x^2\backslash 2+x^3\backslash 3!+x^4\backslash 4!+\ldots\ldots\ldots X^n\backslash n!$	2	2,3	1,2
7	**Lab Experiment 7: a)** Interchange the largest and smallest numbers in the array. b. Searching an element in an array b. Sorting array elements.	2	2,3	1,2
8	**Lab Experiment 8:** . Transpose of a matrix. b.Addition and multiplication of 2 matrices.	2	2,3	1,2
9	**Lab Experiment 9:** . Function to find both the largest and smallest number of an array of integers. . Liner search. . Replace a character of string either from beginning or ending or at a specified location.	2	2,3	1,2
10	**Lab Experiment 10:** Pre-processor directives . If Def . Undef . Pragma	1	2,3	1,2

UNIT IV	**POINTERS**	**6**		
11	**Lab Experiment 10:** . Illustrate call by value and call by reference. . Reverse a string using pointers Compare two arrays using pointers	2	3, 4	1,2,3
12	**Lab Experiment 11:** . Array of Int and Char Pointers. Array with Malloc(), calloc() and realloc().	2	3, 4	1,2,3
13	**Lab Experiment 12:** . To find the factorial of a given integer. . To find the GCD (greatest common divisor) of two given integers. . Towers of Hanoi	2	3, 4	1,2,3
UNIT V	**ENUMERATED, STRUCTURE AND UNION TYPES**	**4**		
14	**Lab Experiment 13:** . Reading a complex number . Writing a complex number. . Addition of two complex numbers Multiplication of two complex numbers	2	5	2, 3, 4
15	**Lab Experiment 14:** . File copy . Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		**29**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**		**End Semester Exam (50%)**	
		Lab Record (20%)	**Projects Presentations (30%)**	**Lab Record (20%)**	**Projects Presentations (30%)**
		Practical	Practical	Practical	Practical
Level 1	Remember	70%	60%	30%	40%
	Understand				
Level 2	Apply	30%	40%	70%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Kernighan, B. W., & Ritchie, D. M. (2002). The C programming language.
2. Dey, P., & Ghosh, M. (2011). Programming in C.
3. Hanly, J. R., & Koffman, E. B. (2007). Problem solving and program design in C. Pearson Education India.
4. Bichkar, R. S., (2012) Programming with C.

Other Resources

1. Gottfried, B. S., (2016) Programming with C, McGraw Hill Education, Fourteenth reprint.

Course Designers

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

Industry Standard Employability Skills – I

Course Code	ISES 101	**Course Category**	Ability Enhancement Course (AEC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CDC	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Gain the ability to work in a team and learn leadership skills.
2. Gain the ability to be a leader who can cope up with the challenges, risks, and change management.
3. Gain the ability to understand and be professionals with idealistic practical and moral values.
4. Gain ability to acquire decision making skills in different situations.

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	Recognise the leadership skills for teamwork.	1	70%	60%
Outcome 2	Demonstrate the ability to cope up with changes and challenges.	3	80%	70%
Outcome 3	Manage stress and control emotions.	3	70%	60%
Outcome 4	Apply decision making and problem-solving skills to given scenarios.	3	90%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1								1			2				
Outcome 2	2					1							2		
Outcome 3					2		2								
Outcome 4	2		1					2		1			2		1
Average	2.0		1.0		2.0	1.0	2.0	1.5		1.0	2.0		2.0		1.0

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Interpersonal skills**	**9**		
	Understanding the relationship between Leadership Networking and Teamwork, Realizing Ones Skills in Leadership	3	1,2	1,2
	Networking & Teamwork and Assessing Interpersonal Skills Situation description of Interpersonal Skill.	3	1,4	1,3
	Teamwork Necessity of Team Work Personally, Socially and Educationally.	3	1,4	1,3
Unit No. 2	**Leadership**	**9**		
	Skills for a good Leader, Assessment of Leadership Skills	3	1,2	1,2
	Change Management, Exploring Challenges	3	1,3	1,2
	Risking Comfort Zone, Managing Change	3	1,3	1,3
Unit No. 3	**Stress management**	**9**		
	Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters.	3	2,3	3,4
	Emotional Intelligence What is Emotional Intelligence, emotional quotient	3	2,3	3,4
	why Emotional Intelligence matters, Emotion Scales. Managing Emotions.	3	2,3	3,4
Unit No. 4	**Conflict resolution**	**9**		
	Conflicts in Human Relations	3	1,4	2,3
	Reasons Case Studies	3	4	2,3
	Approaches to conflict resolution	3	1,4	2,3
Unit No. 5	**Decision making**	**9**		
	Importance and necessity of Decision Making	3	1,4	1,4
	process of Decision Making	3	1,4	1,4
	Practical way of Decision Making, Weighing Positives & Negatives.	3	2,4	1,4
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998.
2. Carnegie Dale, How to Win Friends and Influence People, New York: Simon& Schuster, 1998.
3. Thomas A Harris, I am ok, you are ok, New York-Harper and Row, 1972
4. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006.

Other Resources

Course Designers

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

Introduction to Mathematics

Course Code	MAT 104	**Course Category**		**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)	Knowledge of mathematics up to grade 10	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To firm up the language of mathematics, primarily the notion of sets, functions, sequences.
2. To understand polynomials, solving simultaneous linear equations, exponential and logarithmic functions.
3. To learn to count the outcomes of permutations and combinations, appreciate the importance of mathematical modelling and data analysis.
4. To understand spatial representation, the connection between geometry and algebra, notions such as symmetry.
5. To learn the basics of calculus.

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	Write mathematical arguments logically and use the symbol system that is in use universally	3	90%	75%
Outcome 2	Solve problems involving a system of simultaneous linear equations, quadratic polynomials, and other simple algebraic equations algebraically and graphically	3	75%	65%
Outcome 3	Compute the permutations and combinations, sort and arrange data and do elementary data analysis	3	75%	65%
Outcome 4	Differentiate and integrate simple functions and apply their knowledge	3	75%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	2.8	3.0	3.0	2.8	1.0	2.0							2.8	2.8	2.8

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Numbers Sets and Number Systems**	**14**		
	A brief history of numbers and numeration systems, number base, place value notation, zero as a number	2	1	1,2
	Base 10 and algorithmizablility of the four basic operations, counting and counting numbers, measurement, ratio-proportions and fractions, commensurability, and irrationality	2	1	1,2
	The language of sets- notation, subsets, union, intersection, complementation, powerset of a set, finite and infinite sets	2	1	1,2
	Functions- one-one, onto, one-to-one correspondence, inverse of a function, operations on functions	2	1	1,2
	Natural numbers, integers, rational, real, and complex number systems, representation on the number line, complex plane	2	1	1,2
	Number patterns, Arithmetic, and geometric progressions	2	1	1,2
	Sequences including Fibonacci and series, summability	2	1	1,2
Unit No. 2	**Algebraic Thinking**	**12**		
	Representing unknowns and variables, arithmetic on symbols, turning sentences into algebraic expressions	2	2	1,2
	Polynomial expressions, degree of a polynomial, polynomial equations, factorizing polynomials,	2	2	1,2,
	Algebraic equations, identities, inequalities, graphical representation of polynomials, roots of a polynomial, solving quadratic equations in one variable	3	2	1,2
	solving linear equations in 2 or 3 variables,	2	2	1,2,
	Factor and remainder theorem, Some fascinating examples from history. Polynomial, exponential, logarithmic, and rational functions.	3	2	1,2
Unit No. 3	**Spatial Understanding**	**12**		
	A brief look at Euclidean and other geometries, Descartes and the Cartesian coordinate system,	2	2	1,2
	coordinate geometry and algebraic representation of some familiar geometrical objects;	2	2	1,2
	solving polynomial equations- a geometric perspective,	3	2	1,2
	Trigonometry, and trigonometric functions	3	2	1,2
	Symmetries of polygons	2	2	1,2
Unit No. 4	**Mathematical Modelling and Data Analysis**	**14**		
	Permutations and Combinations	4	3	1,2
	Elementary graph theory and some famous problems,	2	3	1,2
	Data, Sorting and representing data as tables and pictograms,	2	3	1,2
	Measures of central tendency: Mean, median, mode, Variations and standard deviation,	4	3	1,2
	Mathematical Models and Constructing mathematical models	2	3	1,2
Unit No. 5	**Calculus: An Introduction**	**8**		
	Derivative of polynomial, exponential and trigonometric functions	2	4	1,2
	Applications of derivative, ,	2	4	1,2
	Integration of a function	2	4	1,2
	Applications of integration	2	4	1,2
Total Contact Hours		**60**		

Learning Assessment

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

Recommended Resources

1. An Introduction to Mathematics by A. N. Whitehead, Williams and Norgate Henry Holtand Co., New York.
2. Introduction to The Foundations of Mathematics, By Raymond L. Wilder, Dover
3. Publications, Inc. Mineola, New York.

Other Resources

Course Designers

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

Introduction to Physics

Course Code	PHY 103	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Physics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Knowledge on great scientific discoveries in modern physics.
2. To understand fundamental concepts of classical mechanics with practical pplications.
3. To understand fundamental concepts of electricity and magnetism with practical applications.
4. To understand fundamental concepts crystal physics with X-ray/electron diffraction methods.
5. To understand types of solids based on energy band diagram

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	Great discoveries in Physics 19 Century	2	70%	65%
Outcome 2	Explain and apply conservation of linear momentum and conservation of mechanical energy	2	70%	65%
Outcome 3	Understand and explain concepts magnetic ekectric field and electromagnetic field	3	70%	65%
Outcome 4	Explain concept of wave particle duality, Quantum Mechanics	3	70%	65%
Outcome 5	Explain basic concept of lattice and X-ray diffraction of crystalline materials	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 5	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	2.8	3.0	3.0	2.8	1.0	2.0							2.8	2.8	2.8

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact hours	CLOs Addressed	Reference Used
Unit No. 1	**Great Discoveries in Physics**	**9**		
	Bremsstrahlung: Braking radiation	1	1	1,2
	Radioactivity	1	1	1,2
	Various models of atoms	1	1	1,2
	Light: Particle or Wave?	1	1	
	Radio waves and long-distance communication	1	1	1,2
	Raman effect and applications	1	1	1,2
	Concept of Ether: Michelson-Morley experiment	1	1	1,2
	Gravitational Waves	1	1	1,2
	Zero resistance and superconductivity	1	1	1,2
Unit No. 2	**Mechanics**	**9**		
	Scalars and vectors, their various products	1	1,2	1,2
	Newton's Laws of motion and kinematics	1	1,2	1,2
	Free body force diagrams and applications on Inclined plane motion	1	1,2	1,2
	Simple Pulley	1	1,2	1,2
	Problem solving, quiz and Group activities on kinematics	1	1,2	1,2
	Impulse and Average force	1	1,2	1,2
	Conservation of linear momentum	1	1,2	1,2
	Work Energy conservation, and application in bullet's motion	1	1,2	1,2
	Conservation of mechanical energy: Pendulum systems	1	1,2	1,2
Unit No. 3	**Electricity and magnetism**	**9**		
	Atoms, types of charge carriers and quantization	1	1,2,3	1,2
	Force between charges, electric field and electric lines of force	1	1,2,3	1,2
	Concept of electric potential and potential difference	1	1,2,3	1,2
	Current through a conductor and Ohm's law	1	1,2,3	1,2
	Force between two current carrying conductors	1	1,2,3	1,2
	Magnetic field and magnetic lines of forces and types of magnets	1	1,2,3	1,2
	Force on a charge due to electric and magnetic field	1	1,2,3	1,2
	Cyclotron motion	1	1,2,3	1,2
	Accelerated charged particles and electromagnetic wave	1	1,2,3	1,2

	(concept)			
Unit No. 4	**Modern Physics**	**9**		
	Longitudinal and transverse waves, travelling wave	1	4	1, 2
	Electromagnetic waves and EM spectrum	1	4	1, 2
	Blackbody radiation, classical interpretation and Planck's hypothesis	1	4	1, 2
	Photoelectric effect and particle nature of wave	1	4	1, 2
	Wave properties of particles and de-Broglie hypothesis	1	4	1, 2
	Concept of Wave function	1	2,4	1, 2
	Probability, physical significance of wavefunction	1	1,2,4	1, 2
	Wavefunction, probability and energy of particle in a box with infinite potential (concept only)	1	1,2,4	1, 2
	Heisenberg's uncertainty principle	1	1,2,4	1, 2
Unit No. 5	**Crystal Physics**	**9**		
	Crystalline, amorphous and glassy phases	1	3,5	2, 3
	Concept of lattice and basis	1	3,5	2, 3
	Primitive unit cell, Bravais lattice, Symmetry elements and operations: rotation, reflection, inversion	1	3,5	2, 3
	in simple, face centered and body centered cubic lattices	1	3,5	2, 3
	Lattice planes and Miller indices	1	3,5	2, 3
	Bragg's law of X-Ray diffraction in crystal	1	3,5	2, 3
	Group activities on X-Ray diffraction methods	1	3,5	2, 3
	Energy band diagrams in metals, insulators and semiconductors	1	3,5	2, 3
	X-ray and Electron diffraction, their applications in solid state physics.	1	3,5	2, 3
Total Contact hours		**45**		

Learning Assessment

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

Recommended Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill

Other Resources

1. Introduction to Solid State Physics, 8th Edition Charles Kittel 8th edition Wiley India Pvt Ltd
2. K.G. Mazumdar and B. Ghosh, "Advanced Practical Physics" Sreedhar Publishers, Revised edition Jan 2004
3. R.K. Shukla and Anchal Srivastava, "Practical Physics" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]

Course Designers

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

Introduction to Physics Lab

Course Code	PHY 103L	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	PHY 103	**Progressive Course(s)**			
Course Offering Department	Physics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Operate physics equipment and measurement tools.
2. Determine physical constants and fundamental materials properties in mechanics, electromagnetism, and optics.
3. To collect experimental data, analyse and graph plot.

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 basic equipment operation and analysis	2	70%	65%
Outcome 2	Compute time period, acceleration due to gravity, viscosity and spring constant	2	70%	65%
Outcome 3	Explain working principle of compound pendulum, spring and thermodynamic laws	3	70%	65%
Outcome 4	Verify basic laws of electromagnetism and optics using experimental results	3	70%	65%
Outcome 5	Plot graphs and analyse the experimental results	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	2	1	2	-	-	-	-	-	-	2	2	2
Outcome 2	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 4	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Outcome 5	3	3	3	3	1	2	-	-	-	-	-	-	3	3	3
Average	**3**	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Course Unitization Plan

Exp. No.	Description of Experiment	Required Contact Hours	CLOs Addressed	References Used
1	Compound Pendulum: Acceleration due to gravity and radius of gyration of the given pendulum	4	2	4, 5
2	Hooke's law and determination of spring constant for a given spring	2	2	4, 5
3	Biot-savart law: Dependence of magnetic field on the current and magnetic field variation along the axis of a current carrying circular loop	4	2	4, 5
4	Faraday law & Induced E.M.F: Measurement of the induced voltage and calculation of the magnetic flux induced by a falling magnet	2		
5	Verification of Stefan's Law of blackbody radiation	2	3	4, 5
6	Measurement of dielectric constant of air and a given object using parallel plate capacitor	4	3	4, 5
7	Photoelectric effect and Planck's Constant determination	4	4	4, 5
8	Spectral lines from Hydrogen discharge lamp: Balmer Series and Rydberg constant	4	4	4, 5
9	Powder X-Ray diffraction patterns of NaCl and KCl	4	5	4, 5
	Total contact hours	**30 Hours**		

Learning Assessment

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

Recommended Resources

1. Laboratory manuals, SRM University – AP
2. R.K. Shukla and Anchal Srivastava, "Practical Physics" New Age international (P) limited Publishers, 2006 [ISBN(13) – 978-81-224-2482-9]

Other Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill

Course Designers

1. Dr Sabyasachi Mukhopadhyay, Assistant Professor, Dept. of Physics, SRM University - AP
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4. Prof. M. S. Ramachandra Rao, Professor, Department of Physics, Indian Institute of Technology, Madras
5. Prof. D. Narayana Rao, Raja Ramanna Fellow, University of Hyderabad

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

Industry Standard Employability Skills -II

Course Code	ISES 102	**Course Category**	Ability Enhancement Course (AEC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CDC	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop interpersonal skills to be a good team player.
2. Develop socialization skills, positive attitude, and behavioural skills
3. Eliminate the barriers of communication and make conscious efforts to improve skill sets.
4. Recognise practice and acquire the skills necessary to deliver effective presentation with clarity and impact.

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	Recognise the intrinsic motivating factors.	1	70%	60%
Outcome 2	Demonstrate the ability to conceptualize an original idea.	3	80%	70%
Outcome 3	Solve the given problems using lateral thinking techniques	3	70%	60%
Outcome 4	Apply interpersonal skills to be a team player	3	90%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1			2		2		1			
Outcome 2		2			3			3	3						
Outcome 3		3							2			2			
Outcome 4								2	3			2			
Average		2.5			2			2.3	2.7	2		1.7			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Motivation**	**9**		
	Soldiers' walk (Activity on factors of motivation)	3	1,4	1,4
	The Japanese fan (An activity on factors 1of motivation)	3	1,4	1,4
	Steps to ward off demotivation.	3	1,4	1,4
Unit No. 2	**Creativity and innovation**	**9**		
	Short film: (Students are encouraged to make a ten-minute documentary on various topics to enhance the power of aesthetics and precision)	3	1,2	1,4
	Creative short film (This activity is aimed at creating an interest on research and think out of the box)	3	1,2	1,4
Unit No. 3	**Critical and lateral thinking**	3		
	Fill me up, stimulating lateral thinking	**9**	1,2	2,4
	The curious case of Mary and Kevin (Activity triggering the different types of thinking)	3	2,3	2,4
	The creative college	3	2	2,4
Unit No. 4	**Team dynamics**	3		
	Story boarding, Frenzy, come to my island.	**9**	1,2,3	2,3
	Striking cars	3	1,2	2,3
	Defend the egg, tallest tower (Activities on the different stages of team building, team communication, coordination, and collaboration.	3	1,2,3	2,3
Unit No. 5	**Mini project**	3		
	Concept 1: Mini project presentation	**9**	1,2,3,4	1,4
	Concept 2: Mini project presentation	3	1,2,3,4	1,4
	Concept 3: Mini project presentation	3	1,2,3,4	1,4
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	40%		50%		40%		50%		50%	
	Understand										
Level 2	Apply	60%		50%		60%		50%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Personality development and soft skills – Braun K. Mitra
2. Key to success in workplace and life – Meenakshi Roman, Shalini Upadhyay.
3. Mastering soft skills – Julian Vyner
4. The Accidental Creative – How to be brilliant at a moment's notice – Todd

Other Resources

Course Designers

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

Industry Standard Coding Practice-I

Course Code	CSC 130	**Course Category**		**L**	**T**	**P**	**C**
				0	0	2	2
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 foundational programming skills.
2. Enhance problem-solving abilities with a focus on efficiency.
3. Master advanced programming concepts related to memory.
4. Explore advanced problem-solving techniques and programming constructs.
5. Introduce Python programming for problem-solving.

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 have a strong foundation in basic coding practices and be able to apply them to solve programming problems.	3	75%	70%
Outcome 2	Students will develop efficient problem-solving skills, especially in dealing with linear list data, arrays, and matrix-related challenges.	4	70%	60%
Outcome 3	Proficiency in advanced programming concepts like pointers, memory handling, and string manipulation will be achieved.	4	75%	70%
Outcome 4	Students will gain expertise in advanced problem-solving techniques, including parameter passing, recursion, and working with structures and unions.	5	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	1	1	3							1	3	2	
Outcome 2	2	3	1	1	3							1	3	2	
Outcome 3	2	3	1	1	3							1	3	2	
Outcome 4	2	3	1	1	3							1	3	2	
Average	2	3	1	1	3							1	3	2	

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

Other Resources

Course Designers

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

Introduction to Communicative English

Course Code	EGL 100	**Course Category**	Foundation Course	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	English	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To Introduce the Principles and Practices of Effective Communication Skills in various contexts.
2. To understand the purpose and differentiate various types of audience.
3. To encourage self-evaluation while collaborating with peers during learning.
4. To prepare the students to produce Language in various contexts be it Oral or Written form.

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	Employ all four skills (listening/speaking/ reading/writing) to express themselves using production skills (Speak and Write)	3	90%	90%
Outcome 2	Illustrate views using Power Point and Word.	3	70%	80%
Outcome 3	Express with proper grammar.	2	60%	50%
Outcome 4	Apply listening skills to practice.	3	80%	80%
Outcome 5	Employ reading skills to read the given text.	4	60%	50%
Outcome 6	Demonstrate the forms of writings	3	70%	70%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1			2	2	3			3	3	3		3			
Outcome 2					3	3		3	3	3		3			
Outcome 3								3	2	3		3			
Outcome 4										3		3			
Outcome 5								2	3	3		3			
Outcome 6								3	3	3		3			
Average			**2**	**2**	**3**	**3**		**2.8**	**2.8**	**3**		**3**			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1		**7**		
	Course Introduction and Overview	1	**1,2,3**	
	Parts of Speech	1		**1,2**
	Tenses	1		**1,2**
	Vocabulary (Etymology, Prefixes, Suffix)	2		**1,2**
	Capitalization & Punctuations	1		**1,2**
	Principles of Sentence Structure & Paragraph Writing (*S+V+O*)	1		**1,2,3**
Unit No. 2		**6**		
	The Fundamentals of Speech (*Ethos, Pathos & Logos*)	1	**1,2**	**1,2**
	How to give a good Speech? (*Rhetoric & Speech Delivery*)	1		**1,2**
	Verbal Communication (Turn taking strategies, Questioning, Types of Qs)	2		**1,2**
	Nonverbal Communication (Cultural Contexts, Importance and Types)	1		**1,2**
	Fundamentals of Personal, Informative, and Scientific Speech	1		**1,2**
Unit No. 3		**10**		
	Listening Skills: Definition, Barriers, Steps to Overcome	2	**4**	**2**
	Listening Comprehension	3		**2**
	Listening to Influence, Negotiate	2		**2**
	Listening to Specific Information	1		**2**
	Note taking & Making while Listening	2		**2**
Unit No. 4		**10**		
	Read to Skim, and Scan	2	**5**	**1,2**
	Read to Comprehend (Predict, Answer Questions & Summarize)	2		**1,2**
	Read to Appreciate, Compose and Present	3		**1,2**
	Read to Understand Referencing Skills for Academic Report Writing and Plagiarism (APA 6th Ed)	3		**1,2**
Unit No. 5		**12**		
	Write to Interpret Data (Flow charts, Bar Diagrams)	2	**6**	**4**
	Write to Inform (News, Emails, Notice, Agenda & Minutes)	2		**4**
	Write to Define (Definitions & Essays)	2		**4**
	Resume and Cover Letter	2		**4**
	Write an Effective Abstract and a Comprehensive Summary	2		**4**
	Write Project Proposal	2		**4**
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. Shoba, Lourdes. (2017). Communicative English: A Workbook. U.K: Cambridge University Press.
2. Steven, Susan, Diana. (2015). Communication: Principles for a Life Time. U.S.A: Pearson 6th Ed.
3. Publication Manual of the American Psychological Association, (2010). 6th Ed.
4. Kosslyn, S.M. "Understanding Charts and Graphs", Applied Cognitive Psychology, vol. 3, pp. 185-226, 1989.

Other Resources

Course Designers

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

Introduction to Environmental Science

Course Code	ENV 100	**Course Category**	**AECC / FC**	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Environmental Science	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To study the scope of Environmental Science and the idea of sustainability.
2. To acquire basic knowledge of environmental ethics, critical environmental laws, and policies.
3. To explore various sources and challenges in the renewable energy sector in replacing conventional energy.

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	Recognise the scope and purview of Environmental Science, the Idea of sustainability, environmental ethics, and global efforts to overcome the hindrance for sustainability.	2	80%	70%
Outcome 2	Interpret the environmental laws and policies.	3	80%	70%
Outcome 3	Investigate climate change, the way it affects life at different scales (global, regional, and local scales), and various mitigation strategies.	2	70%	60%
Outcome 4	Analyse the extent of environmental pollution and pollution reduction strategies through and resource optimization, renewable energy, and waste management.	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	-	-	1	-	3	1	1	-	1	1	-	-	-
Outcome 2	1	-	1	-	1	-	3	-	1	-	1	1	-	-	-
Outcome 3	1	-	-	-	1	-	3	-	1	-	1	1	-	-	-
Outcome 4	1	-	-	-	1	-	3	-	1	-	1	1	-	-	-
Average	**1**	**-**	**1**	**-**	**1**	**-**	**3**	**1**	**1**	**-**	**1**	**1**	-	-	-

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Fundamental Concepts in Environmental Science**	**12**	1	1, 2, 3, 4, 5, 6, 7, 8, 10
	Human population and environment	1		
	Environmental education and awareness Environmental ethics Evolution of Environmental ethics – Leopold's land ethics, Silent Spring	2		
	Population growth, Ecological overshoot, and Ecological Footprint	2		
	Defining global sustainability, Garret Hardin's "Tragedy of the Commons', Brundtland commission report, Principles of sustainable development, Sustainable Development Goals (SDGs), Triple bottom line of sustainable development	2		
	Technology and Society: Information Technology - Human health & Environmental health, Environmental misconception	2		
	Sustainable ethics: Overcoming the obstacles of sustainability Individualizing Responsibility for a sustainable future - Consumption and its impact on sustainable development	3		
Unit No. 2	**Social issues and Environment**	**10**	4	1, 3, 9
	Fronterism, Biological Imperialism, and Natural rights, Significance of Human rights; Human rights and environment	3		
	Wastewater reclamation, Water conservation, Rainwater harvesting, Watershed management, Urban problems related to energy, Nuclear accidents	3		
	Global Environmental Policy, Environmental acts and laws, Water Act 1974, Environmental Protection Act 1986	4		
Unit No. 3	**Global Climate Change**	**14**	3	10, 3
	Differentiating Climate and Weather, Interconnection of Earth systems (Hydrosphere, Geosphere, Cryosphere, Atmosphere, and Biosphere)	2		
	Climate change through data (global temperature, and CO_2 – Mauna Lao Earth observatory)	3		
	Climate change: Impacts - Extreme weather events, Sea-level rise, Food and water security, and Human health & well-being, Biodiversity loss	4		
	Climate change: Adaptation – local to global scales, Synthesis	2		
	Disaster management – landslides, Tsunamis floods, earthquakes, anthropogenic disasters, Bhopal tragedy	2		
	Communicating climate change	1		
Unit No. 4	**Energy and Environment**	**8**	4	3, 4
	Renewable Energy: Global Status and trends	2		
	Global Renewable Energy Applications	2		
	Technical Issues, Challenges & Opportunities Solar, tidal, hydropower, Bioenergy, nuclear	2		
	Renewable Energy Markets	2		
Unit No. 5	**Environmental Pollution and Management**	**16**	2, 4	3, 11
	Pollution: Air pollution, Noise pollution, Water pollution, Soil pollution	4		
	Solid waste management: Collection, Handling, and solid waste management rules	4		
	E-waste and hazardous waste management, biomedical waste management	4		
	Wastewater treatment systems: Industrial and sewage treatment	4		

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%		70%		30%		30%		70%	
	Understand										
Level 2	Apply	30%		30%		70%		70%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Daniel D. Chiras (2012), Environmental Science 9th Edition. Jones & Barlet Publishers
2. Carson, R. (2002). Silent spring. Houghton Mifflin Harcourt.
3. Rajagopalan, R (2015). Environmental Science – from crisis to cure, 3rd Edition. Oxford Higher Education.
4. Walter K Dodds (2018). Humanity's Footprint: Momentum, Impact, and Our Global Environment. Columbia University Press
5. Hayley Stevenson (2018). Global Environmental Politics Problems, Policy and Practice. Cambridge University Press
6. Garette Hardin (1968). The Tragedy of the Commons. Science 162 (3859), 1243-1248. DOI: 10.1126/science.162.3859.1243
7. Brutland Commission Report, 1987. Oxford University Press
8. TRANSFORMING OUR WORLD: The 2030 Agenda for Sustainable Development
9. Shastri, S.C. (2015) Environmental Law by 5th edition, EBC Publications.
10. Intergovernmental Panel on Climate Change (IPCC) Synthesis Report, 2014.
11. C.S. Rao (2018) Environmental Pollution Control Engineering, New Age International Publishers.

Other Resources

1. W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill
2. Divan Shyam (2002). Environmental Law and Policy in India, OUP India
3. Jonathan Cowie, (2002). Climate change: Biological and Human Aspects, 2nd Edition. Cambridge University Press
4. Hanjalic, Kemo, Roel Van de Krol, and Alija Lekic, eds. (2017). Sustainable energy technologies: options and prospects. Springer Science & Business Media

Course Designers

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

Data Structures

Course Code	CSC 107	**Course Category**	Core Course (C)	**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 understand the basic concepts such as abstract data types, linear and non-linear data structures.
2. To understand the behaviour of data structures such as arrays, linked lists, stacks, queues, trees, hash tables, search trees, graphs, and their representations.
3. To provide an independent view of data structures, including its representation and operations performed on them, which are then linked to sorting, searching and indexing methods to increase the knowledge of usage of data structures in an algorithmic perspective.
4. To choose an appropriate data structure for a specified application.

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	Compare and contrast the algorithms for linked list, stack and queue operations.	4	77%	70%
Outcome 2	Illustrate algorithms for Binary Search Trees and AVL Trees.	4	75%	70%
Outcome 3	Analyze Graph traversal and minimum cost spanning tree algorithms.	4	72%	70%
Outcome 4	Distinguish searching and sorting techniques.	3	78%	80%

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

CLOs	Program Learning Outcomes (PLO)													
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2				2				3	2	
Outcome 2	2	2	3	3	2				2				2	2	
Outcome 3	2	3	3	2	2				2				2	2	
Outcome 4	3	3	3	3	2				3				2	3	
Outcome 5	2	3	3	3	3				3				2	2	
Average	**2**	**3**	**3**	**3**	**2**				**2**				**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Data Structures**	9		
	Abstract Data Type (ADT), Time and space requirements of algorithms	2	1	1
	Array ADT, Representing polynomials	1	1	1,2
	Sparse matrix using arrays and its operations	1	1	1
	Stacks: representation and application, implementation of stack operations using C.	1	1	1
	Example applications on Stacks	1	1	
	Queues: representation and application, implementation of queue operations using C.	1	1	1,2
	Example applications on Queues	2	1	1,2
Unit 2	**Linked lists**	8		
	Linked lists: Single linked lists representation	1	1	1,2
	Implementation of linked list various operation using C	3	1	1
	Doubly linked list representation and Implementation of doubly linked list various operation using C	2	1	5
	Implementation of Circular linked list various operation using C	2	1	4,5
Unit 3	**Trees**	**10**		
	Tree terminology	1	2	1
	Binary tree, Representation of Binary Trees using Arrays and Linked lists	1	2	1
	Binary search tree	1	2	1
	Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion	2	2	1
	Tree Traversals, Construction of tree using traversals	2	2	
	Applications, Expression tree	1	2	1
	General tree	1	2	1
	Heap Sort, Balanced Binary Trees, AVL Trees, Insertion, Deletion and Rotations.	1	2	1
Unit 4	**Graphs**	**9**		
	Graph terminology, Representation of graphs, path matrix	1	3	3
	BFS (breadth first search)	1	3	3
	DFS (depth first search)	2	3	3
	Topological sorting	1	3	3
	Priority Queues: Heap structures	1	3	5
	Binomial heaps, leftist heaps	1	3	2
	Shortest path algorithms.	1	3	2
	Implementation of shortest path algorithm using C	1	3	2
Unit 5	**Sorting and Searching techniques**	9		
	Bubble sort, selection sort and their algorithm analysis	1	4	2
	Insertion sort and its algorithm analysis	1	4	2
	Quick sort and its algorithm analysis	1	4	2,3
	Merge sort and its algorithm analysis	1	4	3
	Heap sort and its algorithm analysis	1	4	3
	Radix sort and its algorithm analysis	1	4	5
	Linear and binary search methods and its algorithm analysis.	2	4	5
	Hashing techniques and hash functions	1	4	5

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)	
		Theory (30%)						
		CLA-1 (5%)	Mid-1 (20%)	CLA-2 (5%)	Mid-2 (20%)		Th	
Level 1	Remember	40%	40%	40%	40%		40%	
	Understand							
Level 2	Apply	40%	40%	40%	40%		40%	
	Analyse							
Level 3	Evaluate	20%	20%	20%	20%		20%	
	Create							
Total		100%	100%	100%	100%		100%	

Recommended Resources

1. Langsam, Y., Augenstein, M. J., & Tenenbaum, A. M. (1996). Data Structures using C and C++. Prentice Hall Press.
2. Mark, A. W. (1992). Data structures and algorithm analysis in C.
3. Horowitz, E., Sahni, S., & Anderson-Freed, S. (1992). Fundamentals of data structures in C. WH Freeman & Co..
4. Hubbard, J. R. (2000). Schaum's Outline of Data Structures with C. McGraw-Hill Professional.
5. Pai, G. V. (2008). Data Structures and Algorithms. Tata McGraw-Hill.
6. Kruse, R., & Tondo, C. L. (2007). Data structures and program design in C. Pearson Education India.

Other Resources

1. Mark, A. W. (1992). Data structures and algorithm analysis in C.
2. Dey, P., & Ghosh, M. (2011). Programming in C.

Course Designers

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

Data Structures Lab

Course Code	CSC 107L	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	CSC 107	**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the basic concepts such as abstract data types, linear and non-linear data structures.
2. To understand the behaviour of data structures such as arrays, linked lists, stacks, queues, trees, hash tables, search trees, graphs, and their representations.
3. To provide an independent view of data structures, including its representation and operations performed on them, which are then linked to sorting, searching and indexing methods to increase the knowledge of usage of data structures in an algorithmic perspective.
4. To choose an appropriate data structure for a specified application.

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	Compare and contrast the algorithms for linked list, stack and queue operations.	4	77%	70%
Outcome 2	Illustrate algorithms for Binary Search Trees and AVL Trees.	4	75%	70%
Outcome 3	Analyze Graph traversal and minimum cost spanning tree algorithms.	4	72%	70%
Outcome 4	Distinguish searching and sorting techniques.	3	78%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2		1	2				2				1		3
Outcome 2	2	2	3	3	3				2				3	2	3
Outcome 3	2	2	3	3	3				2				3	2	3
Outcome 4	2	2	2	3	3				3			2	3	2	3
Outcome 5	2	2	3	3	3				2			2	3	2	3
Average	1	2		1	2				2				1		3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Week 1 and 2	Simulate the following operations: a. Conversion of infix expression to postfix expression a. Evaluation of expressions a. Assignment-1: Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules: Only one disk can be moved at a time. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack. No disk may be placed on top of a smaller disk You can choose to use the function *move (4, 1, 3, 2), w*here 4 represents the number of disks. 1 represents disks on source shaft, 3 represents the destination shaft which holds the disks after the move and finally 2 represents the intermediate support shaft – temporary storage. Write a C program to simulate the given problem and: Perform the algorithmic complexity analysis for the solution you propose. Resources: https://www.youtube.com/watch?v=YstLjLCGmgg	4	1	1,6
Week 3 & 4:	Simulate the following tasks: a. Implementation the following operations: enqueue, dequeue and finding an element: Linear Queue using arrays Circular queue arrays Priority queue singly linked list. b. Assignment-2: The "*4-Queens Problem*" consists of placing four queens on a 4 x 4 chessboard so that no two queens can capture each other. That is, no two queens are allowed to be placed on the same row, the same column or the same diagonal (both primary and secondary diagonals). Write a C program to simulate the given problem and perform the algorithmic complexity analysis for the solution you propose.	4	1	1,6
Week 5 &6:	Demonstrate the following though simulation: a. Create a singly linked list and perform the following operations: Add an element at the end of the list Delete an element from the beginning of the list Find the middle element of the list Search the given key form the list i.Polynomial addition using linked list i.Sparse matrix operations using linked list b. Assignment-3: Let us consider a small but busy airport with only one run-way (shown in figure). In each time unit, one plane can land or one plane can take off, but not both. Planes arrive ready to land or to take off at random times, so at any given unit of time, the runway may be idle or a plan may be landing or taking off, and there may be several planes waiting either to land or take off. We therefore need two queues, called *landing* and *takeoff*, to hold these planes. It is better to keep a plane waiting on the ground than in the air, so a small airport allows a plane to take off only if there are no planes waiting to land. Hence, after receiving requests from new planes to land or take off, our simulation will first service the head of the queue of planes waiting to land, and only if the landing queue is empty will it allow a plane to take off. We shall wish to run the simulation through many units of time, and therefore, we embed the main action of the program in a loop that runs for cur-time (denoting current time) from 1 to a variable end-time. ulate the given scenario using and write the output for different inputs.	4	1	1,6

Week 7 & 8:	Write code to perform the following operations: a. Develop a code to test whether the given tree is binary tree or not. a. Implementation of Binary tree traversals techniques – pre-order, in-order, and post-order. a. Implementation of AVL tree and its operations a. Assignment-4: Given a mathematical expression, evaluate it using appropriate tree structure.	4	2	5
Week 9:	Write a C program for implementation of Graph traversals techniques (BFS and DFS).	2	3	1,6
Week 10:	The Dijkstra's algorithm is an algorithm that gives the shortest path between two given vertices of a graph. In this problem we are given a directed graph with each edge having a non-negative weight. Thus, a solution requires a path of many other that costs least. We can think of the problem as like this: think graph G as a map of the airline routes, each node of the graph as the cities and the weights on each edge as the cost of flying from one city to another city. The solution we have to find a routing from a city v to city w such that the total cost is minimum. Write a C program to simulate the given problem. That is find the shortest path between node A and node F in the given graph.	1	3	1,6
Week 11:	Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?	2	4	2
Week 12:	Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?	2	4	2
Week 13:	Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?	1	4	2
Week 14:	Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?	1	4	3
Week 15:	Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?	1	4	3

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**				**End Semester Exam (50%)**	
		Internal Assessment (50%)					
		Lab Record (30%)	**Model Exam (20%)**			Project (20%)	Final Exam ((30%)
Level 1	Remember	40%	40%			40%	40%
	Understand						
Level 2	Apply	40%	40%			40%	40%
	Analyse						
Level 3	Evaluate	20%	20%			20%	20%
	Create						
Total		100%	100%			100%	100%

Recommended Resources

1. Langsam, Y., Augenstein, M. J., & Tenenbaum, A. M. (1996). Data Structures using C and C++. Prentice Hall Press.
2. Mark, A. W. (1992). Data structures and algorithm analysis in C.
3. Horowitz, E., Sahni, S., & Anderson-Freed, S. (1992). Fundamentals of data structures in C. WH Freeman & Co..
4. Hubbard, J. R. (2000). Schaum's Outline of Data Structures with C. McGraw-Hill Professional.
5. Pai, G. V. (2008). Data Structures and Algorithms. Tata McGraw-Hill.
6. Kruse, R., & Tondo, C. L. (2007). Data structures and program design in C. Pearson Education India.

Other Resources

1. Mark, A. W. (1992). Data structures and algorithm analysis in C.
2. Dey, P., & Ghosh, M. (2011). Programming in C.

Course Designers

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

Probability and Statistics for Engineers

Course Code	MAT 221	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)	NA	**Co-Requisite Course(s)**	NA	**Progressive Course(s)**	NA		
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. After this course, students should be able to understand the compute basic probabilities, formulate a problem using random variables, analyze sample data for possible conclusions about population.
2. After taking this course, students will be able to use calculators and tables to perform simple statistical analyses for small samples and use popular statistics packages, such as SAS, SPSS, S-Plus, R or MATLAB, to perform simple and sophisticated analyses for large samples.
3. Students who are interested in becoming statisticians themselves can build a solid foundation in probability and statistics through this course but should plan on additional coursework for thorough and comprehensive preparation

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 basic knowledge on fundamental probability concepts, including random variable, probability of an event, additive rules and conditional probability Bayes' theorem S understand the basic statistical concepts and measures	2	70%	75%
Outcome 2	Demonstrate the concept of the central limit theorem understand several well-known distributions, including, Geometrical, Negative Binomial, Pascal, Normal and Exponential Distribution	4	70%	73%
Outcome 3	Apply the central limit theorem to sampling distribution use estimation technique to determine point estimates confidence interval and sample size.	3	75%	80%
Outcome 4	Interpret and Analyses in SAS, S-PLUS, R or MATLAB	4	70%	70%
Outcome 5	Apply central limit theorem and hypothesis testing	3	70%	72%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	-	-	-	-	-	-	-	-	1			
Outcome 2	3	3	2	1	2	-	-	-	-	-	-	1			
Outcome 3	2	3	2	1	1	-	-	-	-	-	-	-			
Outcome 4	2	3	3	-	1	2	-	-	-	-	-	-			
Outcome 5	2	3	2	-	-	-	-	-	-	-	-	-			
Average	**3**	**3**	**3**	**1**	**1**							**1**			

Course Unitization Plan

Session	Description of Topic	Contact hours	CLOs Addressed	Reference
	Unit I – Introduction to Probability	10		
1.	Basic principle of counting, multinomial coefficients	2	1	1
2.	Axioms of probability, computing probabilities - unions, intersections, and Inclusion-exclusion principle	2	1	1
3.	Conditional probability, Independent events	3	1	1
4.	Bayes' theorem, law of total probability	3	1	1
	Unit II- Random variables and distributions	**16**		
5.	Random variables, cumulative distribution function	1	1	1
6.	Discrete random variables	1	1	1
7.	Cumulative distribution function and its properties	2	1	1
8.	Expectation, variance and standard deviation of discrete random variables, conditional expectation	2	1	1
9.	Bernoulli and binomial distributions, their expectations and variances	1	1	1
10.	Poisson, geometric and negative binomial distributions, their expectati variances	2	1	1
11.	Continuous random variables	1	1	1
12.	Expectation and variance, Conditional expectation	2	1	1
13.	Uniform and exponential distributions	2	1	1
14.	Normal distribution , Student's t-distribution	2	1	1
	Unit III – Joint probability distributions and CLT	10		
15.	Joint distribution of two random variables - discrete and continuous	3	2	1
16.	Change of variables under integration (Determinant of Jacobian), Independent random variables and their sum,	3	2	1
17.	Central limit theorem	2	2	1
18.	Covariance and correlation between random variables	2	2	1
	Unit IV – Descriptive statistics and linear regression	**11**		
19.	Graphical representation of data -Histograms, scatter plots & time plots	3	3,4	1
20.	Descriptive statistics	2	1	2,3
21.	Correlation – Pearson's correlation coefficient	3	3	2,3
22.	Linear regression, Goodness of fit, Normal equations for least-squares regression,	3	3,5	2,3
	Unit V – Introduction to statistical inference	**13**		
23.	Population, sample and statistics	3	3	2,3
24.	Point estimation of population parameters	2	3	2,3
25.	Confidence intervals for population mean, and population proportion	2	3	2,3
26.	P-values, Significance level, Tests of significance for population mean, population proportion.	3	3,4	2,3
27.	Types of errors, contingency table, sensitivity, specificity, power of a test.	3	3	2,3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Assessments (40%)
		CLA-1 (15%)	Mid-1 (25%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	60%	40%	40%	30%	50%
	Understand					
Level 2	Apply	40%	60%	60%	70%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Ross S., (2018). A First course in probability, Pearson Education; Ninth edition
2. Baron, M. (2006). Probability and Statistics for computer scientists, Chapman and Hall/CRC; First edition
3. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & sons.

Other Resources

Course Designers

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

Discrete Mathematics

Course Code	MAT 252	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	MATHEMATICS	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. The objective is to equip the students with the mathematical definitions, proofs, and applicable methods.
2. To enable the students to use mathematically correct terminology and notation.
3. Use foundational concepts in number theory and algorithms and developing problem-solving skills through the application of mathematical reasoning and induction principles.
4. Familiar about graphs and graph models, terminology, and special types is to understand the fundamental concepts and applications of graphs in various domains.

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	Express an argument using predicates, quantifiers and logic connectives and determine if the argument is valid.	2	80%	80%
Outcome 2	Apply the rules of inferences and methods of proofs including direct and indirect proofs, proof by contradiction and mathematical induction.	3	70%	60%
Outcome 3	Describe set properties, set operations, set identities, and representing relationship between the sets.	2	80%	70%
Outcome 4	Discover whether a given function is one-one, onto and invertible.	4	70%	60%
Outcome 5	Define the concept of divisibility, congruence, greatest common divisor, prime numbers, and prime factorization of numbers.	1	80%	80%
Outcome 6	Apply counting principles to determine probabilities and solving problems using recurrence relations.	3	70%	60%
Outcome 7	Explain graphs, their representations and determine the Euler circuits, Hamilton circuits, Euler paths and Hamilton paths in a graph.	3	80%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	-	-	-	-	-	-	-	-	1			
Outcome 2	3	3	2	1	2	-	-	-	-	-	-	1			
Outcome 3	2	3	2	1	1	-	-	-	-	-	-	-			
Outcome 4	3	3	3	-	1	-	-	-	-	-	-	-			
Outcome 5	2	3	2	-	-	-	-	-	-	-	-	-			
Outcome 6	3	3	3	-	-	-	-	-	-	-	-	-			
Outcome 7	3	3	3		-	-	-	-	-	-	-	-			
Average	**3**	**3**	**3**	**1**	**1**							**1**			

Course Unitization Plan

Session	Description of Topic	Contact hours Required	CLOs Addressed	References Used
	Unit I - The Foundations: Logic and Proofs	**14**		
1.	Propositional Logic, Applications of Propositional Logic,	4	1	1
2.	Propositional Equivalences	1	1,2	1
3.	Predicates and Quantifiers	2	1,2	1
4.	Nested Quantifiers, Rules of Inference	2	1,2	1
5.	Introduction to Proofs	2	2	1
6.	Proof Methods and Strategy.	3	2	1
	Unit II- Set Theory	**8**		
7.	Laws of set theory	1	3	1
8.	Set Operations	1	3	1
9.	Functions	3	3,4	1
10.	Sequences and Summations	2	3,4	1
11.	Matrices	1	3,4	1
	Unit III – Elementary number theory, Induction and Recursion	**11**		
12.	Divisibility and Modular Arithmetic	2	5	1
13.	Integer Representations and Algorithms	2	5	1
14.	Primes and Greatest Common Divisors, Solving Congruence	2	5	1
15.	Mathematical Induction, Strong Induction and Well-Ordering	3	2,5	1
16.	Recursive Definitions and Structural Induction.	2	6	1
	Unit IV – Counting principles	**12**		
17.	The Basics of Counting, The Pigeonhole Principle, Permutations Combinations	4	6	1
18.	Binomial Coefficients and Identities	2	6	1
19.	Applications of Recurrence Relations, Solving Linear Recurrence Relations	2	6	1
20.	Divide Divide-and-Conquer Algorithms	2	6	1
21.	Recurrence Relations	2	6	1
	Unit V – Introduction to Graph Theory	**15**		
22.	Graphs and Graph Models, Graph Terminology and Special Types of Graphs	4	7	1
23.	Trees, Spanning trees, Minimal spanning trees	3	7	1
24.	Representing Graphs and Graph Isomorphism	3	7	1
25.	Connectivity, Euler and Hamilton Paths	3	7	1
26.	Shortest-Path Problems	2	7	1
Total Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Assessments (40%)
		CLA-1 (15%)	Mid-1 (25%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	60%	50%	40%	50%	60%
	Understand					
Level 2	Apply	40%	50%	60%	50%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Rosen, K. H. (1999). Discrete mathematics & applications. McGraw-Hill.

Other Resources

Course Designers

1. Dr. Fouzul Atik Assistant Professor Mathematics Department, SRM University, AP.

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

Analytical Skills For Sciences

Course Code	AEC 106	**Course Category**	Ability Enhancement Courses (AEC)	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To categorize, apply and use thought process to distinguish between concepts of quantitative methods.
2. To prepare and explain the fundamentals related to various possibilities.
3. To critically evaluate numerous possibilities related to puzzles.
4. Explore and apply key concepts in logical thinking to business 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	Use logical thinking and analytical abilities to solve quantitative aptitude questions from company specific and other competitive tests.	1	70%	60%
Outcome 2	Solve questions related to Aptitude from company specific and other competitive tests.	3	80%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	70%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	90%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1			2		2		1			
Outcome 2		2			3			3	3						
Outcome 3		3							2			2			
Outcome 4								2	3			2			
Average		2.5			2			2.3	2.3	2		1.6			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Quantitative Aptitude**			
	Data interpretation – Introduction and basics to solve data interpretation	4	1,4	1,4
	Data interpretation line graphs, Data interpretation bar graph.	6	1,4	1,4
Unit No. 2	**Quants**			
	Data interpretation – Pie charts,	2	1,4	1,4
	Data interpretation – Tabular, Data interpretation – case lets.	2	1,4	1,4
Unit No. 3	Statistics	6	1,2	2,3
Unit No. 4	Functions and graphs	3	1,2	1,2
	graph theory with respect to coding	2	1,2	1,2
	math graph theory and coding problems	2	2,3	2,3
	discrete planar theory and coding problems.	3	1,2	2,4
Total Contact 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%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		40%		50%		50%	
	Understand										
Level 2	Apply	60%		50%		60%		50%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S. Agarwal – Reasoning. Reasoning for competitive exams – Agarwal.
3. Objective Quantitative Aptitude – Oswaal books.
4. Test of reasoning and numerical ability, quantitative aptitude book – Sahitya bhavan.
5. Radian's Quantitative Aptitude.
6. Quantitative Aptitude and Reasoning – Shyam Saraf / Abhilasha Swarup.
7. Fast track objective Arithmetic – Rajesh Verma.

Other Resources

Course Designers

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

Digital Literacy

Course Code	SEC 102	**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	ITKM	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce basic digital skills that are needed in today's 21st century work environment.
2. develop the skills that they need to effectively integrate technology into their respective professional practices.
3. Learn practical-oriented and will have a lot of hands-on exercises.
4. Understand basic and practical digital skills.
5. learn and use software and hardware systems, including the basic troubleshooting.
6. Learn issues pertaining to emerging technologies and creating digital identity in various platforms.

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	Discuss the importance of Digital Literacy	2	75%	80%
Outcome 2	Compare and Contrast collaborative features in digital platforms	3	70%	70%
Outcome 3	Create digital identity profile on LinkedIn	3	75%	75%
Outcome 4	Demonstrate best practices of digitally managed workspace on MS office 365 and G Suite	3	70%	75%
Outcome 5	Identify relevant information from authentic data sources	3	70%	75%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					3	3		1	2	3		3			
Outcome 2					3	3		1	2	3		3			
Outcome 3					3	3		1	2	3		3			
Outcome 4					3	3		1	2	3		3			
Outcome 5					3	3		1	2	3		3			
Average					3	3		1	2	3		3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Introduction - Digital Literacy**	**2**	**1**	1,2,3
	About Digital Literacy	0.5	1	1,2,3
	Importance of digital literacy	0.5	1	1,2,3
	Overview of Computing Systems and Platforms	0.5	1	1,2,3
	Digital Proficiency for Career prospects and Everyday living	0.5	1	1,2,3
Unit No. 2	**Know your computer**	**3**	**1**	1,2,3
	Types of computing	0.5	1	1,2,3
	Accessories & peripherals	0.5	1	1,2,3
	System upkeep & maintenance	0.5	1	1,2,3
	Basic Troubleshooting	0.5	1	1,2,3
	Operating Systems	1	1	1,2,3
Unit No. 3	**Microsoft Office Automation software**	**5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Excel - Data Analysis	1	4	1,2,3
	PowerPoint Presentations	1	4	1,2,3
	Digital software tools	1	4	1,2,3
	Best practices	1	4	1,2,3
Unit No. 4	**Google Automation Software**	**3.5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Spreadsheet	1	4	1,2,3
	Presentations	1	4	1,2,3
	Best practices	0.5	4	1,2,3
Unit 5	**Digital Communication tools**	**4**	2	1,2,3
	Emails Systems - Gmail, MS Outlook, Zimbra, etc	0.5	2	1,2,3
	Calendar Functionality	0.5	2	1,2,3
	Drive - Access Permissions - Best practices	1	2	1,2,3
	Chat functionality and Use	1	2	1,2,3
	Zoom, MS Teams, Google meet, Jiomeet,	1	2	1,2,3
Unit No. 6	**Network and Internet**	**3**	1	1,2,3
	Basics of Network	1	1	1,2,3
	Types of browsers, Safety measures, bookmarks	1	1	1,2,3
	Search engines	1	1	1,2,3
Unit No. 7	**Digital Identity for Professional Connect activities**	**5**	3	1,2,3
	Social media	1	3	1,2,3
	Dos and Don’ts handling Social Media Accounts	2	3	1,2,3
	Digital Profile	3	3	1,2,3
Unit No. 8	**Cybersecurity**	**1.5**	1	1,2,3
	Introduction to Cybersecurity	0.5	1	1,2,3
	Strategies to project the personal and professional data	0.5	1	1,2,3
	Awareness on various Cyber Attacks	0.5	1	1,2,3
	Security measures for Email, Personal computing systems		1	1,2,3
Unit No. 9	**Information and Data Literacy**	**4**	5	1,2,3
	Information & Data Mining Strategies	1	5	1,2,3
	Online resources	2	5	1,2,3
	Understanding on Plagiarism	1	5	1,2,3
Total Contact Hours		**30**		

Learning Assessment

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

Recommended Resources

1. Digital Literacy (20210401) Kindle Edition by Mandy Reininger (Author), Darrel Karbginsky (Author) Format: Kindle Edition
2. Digital Literacies: Concepts, Policies and Practices (New Literacies and Digital Epistemologies) New Edition by Colin Lankshear (Editor), Michele Knobel (Editor
3. Read the World: Rethinking Literacy for Empathy and Action in a Digital Age Illustrated Edition by Kristin Ziemke (Author), Katie Muhtaris (Author)

Other Resources

Course Designers

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

Object Oriented Programming with C++

Course Code	CSC 201	Course Category	Core Course(CC)		L	T	P	C
					3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)	NIL	Progressive Course(s)				
Course Offering Department	CSE	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce the concepts of Object Oriented Programming using C++ programming.
2. Apply the Object Oriented Concepts such as Class and Object in solving real-world problems.
3. Demonstrate the principles of inheritance and polymorphism to the design of abstract classes.
4. Apply exception handling and template creation using STL and interfaces.

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	Utilize the Object-Oriented Concepts in solving real word problems through C++.	3	70%	65%
Outcome 2	Use Object Oriented Concepts such as Class and Object in solving real-world problems through C++.	3	70%	65%
Outcome 3	Use the principles of Inheritance and Polymorphism through C++.	3	70%	65%
Outcome 4	Use exception handling and template creation using STL and interfaces.	3, 5	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2								3	2	
Outcome 2	2	2	3	3	2								2	2	
Outcome 3	2	3	3	2	2								2	2	
Outcome 4	3	3	3	3	2								2	3	
Average	**2**	**3**	**3**	**3**	**2**								**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	Ref. Used
Unit 1	**INTRODUCTION**	**11**		
1.	Understanding the Object-Oriented World View, A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes, Objects, and Methods.	1	1	1
2.	OOP principles	1	1	1,2
3.	An overview of C++, basic program construction - data types, variables, constants - type conversion, operators.	1	1	2
4.	Decision making and looping constructs	1		1,2
5.	Arrays, strings and pointers	2		
6.	Functions, passing arguments, Returning values, Reference Arguments	1		
7.	Storage Classes	1		
8.	Dynamic memory management in C++	1		
9.	**Lab Experiment 1:** 1. Takes two integer operands and one operator form the user, performs the operation and then prints the result. 2. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	1	1	1
10.	**Lab Experiment 2:** 1. Write a program to demonstrate the Inline functions. 2. Programs to understand different function call mechanism. a. call by reference b. call by value	1	1	1
Unit 2	**FEATURES OF OBJECT-ORIENTED PROGRAMMING**	**11**		
11.	Concept of classes and objects with real world examples	1	1,2	2
12.	Encapsulation, data hiding using storage classifier	1	1,2	2
13.	Polymorphism, Types of polymorphism, Use-cases	1	1,2	2
14.	Method overloading, Method overriding	1	1,2	2
15.	Virtual functions	1	1,2	2
16.	Interfaces	1	1,2	2
17.	Constructors and destructors	1	1,2	2
18.	Methods, Method calling, Method with object parameters	1	1,2	2
19.	Summary, Putting it all together with hands-on	1	1,2	2
20.	**Lab Experiment 3:** 1. Write a Program to design a class having static member function Named showcount() which has the property of displaying the number of objects created of the class. 2. Write a Program using class to process Shopping List for a Departmental Store. The list includes details such as the Code No and Price of each item and perform the operations like Adding, Deleting Items to the list and Printing the Total value of a Order.	1	2	2
21.	**Lab Experiment 4:** 1. Write a Program which creates & uses array of object of a class. (for eg. implementing the list of Managers of a Company having details such as Name, Age, etc..).	1	2	2

	2. Write a Program to find Maximum out of Two Numbers using friend function. Note: Here one number is a member of one class and the other number is member of some other class.			
Unit 3	**POLYMORPHISM**	**13**		
22.	Concept of Polymorphism	2	1,2	1,2
23.	Function overloading and its advantages	1	1,2	2
24.	Pitfalls of function overloading	1	1,2	2
25.	Operator overloading	1	1,2	2
26.	Overloading unary operations	1	1,2	2
27.	Overloading binary operators	1	1,2	2
28.	Data Conversion	1	1,2	2
29.	Pitfalls of operators overloading and conversions	1	1,2	2
30.	**Lab Experiment 5:** 1. Write a Program to swap private data members of classes Named as class_1, class_2 using friend function. 2. Write a Program to design a class complex to represent complex numbers. The complex class should use an external function (use it as a friend function) to add two complex numbers. The function should return an object of type complex representing the sum of two complex numbers.	1	2	2
31.	**Lab Experiment 6:** 1. Write a Program using copy constructor to copy data of an object to another object. 2. Write a Program to allocate memory dynamically for an object of a given class using class's constructor.	1	2	2
32.	**Lab Experiment 7:** 1.Write a program to design a class representing complex numbers and having the functionality of performing addition & multiplication of two complex numbers using operator overloading. 2. Write a Program to overload operators like *, <<, >> using friend function. The following overloaded operators should work for a class vector.	1	2	2
33.	**Lab Experiment 8:** 1.Write a Program to design a class to represent a matrix. The class should have the functionality to insert and retrieve the elements of the matrix. 2.Write a program to overload new/delete operators in a class.	1	2	2
Unit 4	**INHERITANCE**	**13**		
34.	Inheritance in real world, definition and applications	1	1,2	2
35.	Derived and Base Classes	1	1,2	2
36.	Derived class constructor, Overriding member functions	1	1,2	2
37.	Inheritance in the English distance class	1	1,2	2
38.	Class hierarchies	1	1,2	2
39.	Inheritance and graphics shapes	1	1,2	2
40.	Public and private inheritance, Levels of Inheritance	1	1,2	2

41.	Multiple Inheritance, Ambiguity in Multiple Inheritance with Example	1	1,2	2
42.	Aggregation: Classes within classes	1	1,2	2
43.	**Lab Experiment 9:** 1.Write a Program to design a class to represent a matrix. The class should have the functionality to insert and retrieve the elements of the matrix. 2.Write a program for developing a matrix class which can handle integer matrices of different dimensions. Also overload the operator for addition, multiplication & comparison of matrices.	1	2	2
44.	**Lab Experiment 10:** 1. Write a Program illustrating how the constructors are implemented and the order in which they are called when the classes are inherited. Use three classes Named alpha, beta, gamma such that alpha, beta are base class and gamma is derived class inheriting alpha & beta. 2. Write a Program to design a student class representing student roll no. and a test class (derived class of student) representing the scores of the student in various subjects and sports class representing the score in sports. The sports and test class should be inherited by a result class having the functionality to add the scores and display the final result for a student.	1	2	2
45.	**Lab Experiment 11:** 1. Write a program to maintain the records of person with details (Name and Age) and find the eldest among them. The program must use this pointer to return the result. 2. Write a Program to illustrate the use of pointers to objects which are related by inheritance.	1	2	2
46.	**Lab Experiment 12:** 1. Write a program illustrating the use of virtual functions in class. 2. Write a program to design a class representing the information regarding digital library (books, tape: book & tape should be separate classes having the base class as media). The class should have the functionality for adding new item, issuing, deposit etc. the program should use the runtime polymorphism.	1	2	2
Unit 5	**TEMPLATES AND EXCEPTIONS**	**12**		
47.	Templates: Function templates	1	1,2	2
48.	Class templates	1	1,2	2
49.	Exceptions: Need of Exceptions, keywords,	1	1,2	2
50.	Simple and Multiple Exceptions	1	1,2	2
51.	Re-throwing Exception and Exception Specifications, Custom Exception.	1	1,2	2
52.	Standard Template Library: Containers, Algorithms, iterators - potential problems with STL	1	1,2	2
53.	Algorithms: find (), count (), sort (), search (), merge ()	1	1,2	2
54.	Function Objects: for each (), transform ()	1	1,2	2
55.	Sequence Containers: vectors, Lists, Dequeues - Iterators and specialized.	1	1,2	2
56.	**Lab Experiment 13:** 1. Write a program to show conversion from string to int and vice-versa. 2. Write a program showing data conversion between objects of different classes.	1	2	2

57.	**Lab Experiment 14:** 1. Write a program showing data conversion between objects of different classes and conversion routine should reside in destination class. 2. Write a program to copy the contents of one file to another.	1	2	2
58.	**Lab Experiment 15:** 1. Write a program to implement the exception handling. 2. Write a program to maintain the elementary database of employee using file concepts.	1	2	2

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%	50%	60%	40%	50%	30%	40%	30%	30%	30%
	Understand										
Level 2	Apply	30%	50%	40%	60%	50%	70%	60%	70%	70%	70%
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Lippman, S. B., Lajoie, J., & Moo, B. E. (n.d.). C++ Primer (5th ed.). Addison-Wesley Professional.
2. Schildt, H., & Schildt, H. (1997). C/C++ programmer's reference. Osborne McGraw-Hill.

Other Resources

Course Designers

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

Digital Electronics

Course Code	CSC 202	Course Category	Professional Core (C)	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)	Basic Mathematics and Science, Basics of Electrical	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	EEE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To acquire the basic knowledge of digital logic levels and its application to understand the digital electronic circuits.
2. To impart how to design Digital Circuits both theoretically and practically.

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 various number system and its application in digital electronics and compare different types of logic families.	2	75%	65%
Outcome 2	Apply mapping, mathematical methods and logical tools to design digital circuits.	3	75%	65%
Outcome 3	Designing of various combinational, synchronous, and asynchronous sequential circuits.	4	75%	65%
Outcome 4	Explain the functioning of various memory devices.	3	75%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	2	-	-	-	-	-	3	3	2	1	2
Outcome 2	3	3	3	3	2	3	1	-	3	2	3	3	3	3	3
Outcome 3	3	2	1	1	1	-	-	-	1	-	2	3	1	1	1
Outcome 4	3	2	1	2	2	-	-	-	1	-	2	3	1	1	3
Average	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**-**	**3**	**2**	**3**	**3**	**2**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Digital Fundamentals**	**15**		
	4 and 5 variable K-maps	2	1,2	1,2
	1's and 2's complements	2	1	1
	Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes (*Active Learning*)	2	1,2	1
	Sum of products and product of sums, Minterms and Maxterms	1	1	1
	Quine-McCluskey method of minimization	2	1,2	1,3
	Lab Experiment 1: Realization of Basic Logic Gates.	3	2	1,2
	Lab Experiment 2: Design of Code Converters (Binary to Gray) & (Gray to Binary).	3	2	1
Unit 2	**Combinational Circuit Design**	**18**		
	4 bit Adder and Subtractor	1	1	1,2,3
	Binary Parallel Adder – Carry look ahead adder, BCD Adder	2	1,2	2,3
	Multiplexer, Demultiplexer	2	1,2	1
	Magnitude Comparator	2	1,2	1,3
	Decoder, Encoder, Priority Encoder (*Active Learning*)	2	1,2	2,3
	Lab Experiment 3: Design of Half-Adder/Subtractor, Full-Adder/Subtractor, Multiplexers/De Multiplexers.	3	3	1,2
	Lab Experiment 4: Design of Decoder and Encoder/ BCD 7SSD.	3	3	2,3
	Lab Experiment 5: Design of Magnitude Comparator (2-bit).	3	3	1,3
Unit 3	**Synchronous Sequential Circuits**	**21**		
	Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF	2	1,2	3,4
	Analysis and design of clocked sequential circuits – Design – Moore/Mealy models	2	1	4
	State minimization, State assignment	1	1	4
	Circuit implementation – Design of Counters – Ripple Counters, Ring Counters	2	1,2	4
	Shift Registers, Universal Shift Register	2	1,2	3,4
	Lab Experiment 6: Design and Verification of Flip-Flops using IC.	3	3	3,4
	Lab Experiment 7: Design of Asynchronous Counter (Any Mod, Up and Down, Jhonson and Ring).	3	3	4
	Lab Experiment 8: Design of Synchronous Counter (Any Mod, Decade counter 74ls90).	3	3	4
	Lab Experiment 9: Design of Universal Shift Register (Serial to Parallel, Parallel to Serial, Serial to Serial and Parallel to Parallel Converters).	3	3	3,4
Unit 4	**Asynchronous Sequential Circuits**	**9**		
	Stable and unstable states, output specifications	3	1,2,3	2,3
	Cycles and races, state reduction, race free assignments	2	3	1,3
	Hazards, Essential Hazards	2	2,3	1,3
	Pulse mode sequential circuits, Design of Hazard free circuits	2	1,2,3	1,3
Unit 5	**Memory Devices**	**12**		
	Classification of memories – ROM – ROM organization – PROM – EPROM – EEPROM –EAPROM	2	4	1,5
	RAM – RAM organization – Write operation – Read operation	1	4	2,5
	Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL)	2	4	5
	Field Programmable Gate Arrays (FPGA)	1	4	5
	Implementation of combinational logic circuits using ROM, PLA, PAL.	3	4	3,5
	Lab Experiment 10: Design & Verification of Memory (SRAM)	3	4	2,5
Total Contact Hours (Theory + Lab)		**75**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (40%)				End Semester Exam (30%)
		CLA-1 (10%)	CLA-2 (10%)	CLA-3 (10%)	Mid Sem (10%)	
Level 1	Remember	55%	40%	40%	40%	46%
	Understand					
Level 2	Apply	45%	60%	60%	60%	46%
	Analyse					
Level 3	Evaluate					8%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Mano, M. M. (2014). Digital design (5th ed.). Pearson Education (Singapore) Pvt. Ltd.
2. Wakerly, J. F. (2008). Digital design (4th ed.). Pearson/PHI.
3. Yarbrough, J. M. (2006). Digital logic applications and design. Thomson Learning.
4. Roth, C. H. (2013). Fundamentals of logic design (6th ed.). Thomson Learning.
5. Maini, A. K. (2014). Digital electronics. Wiley.

Other Resources

1. Floyd, T. L. (2011). Digital fundamentals (10th ed.). Pearson Education Inc.
2. Givone, D. D. (2003). Digital principles and design. TMH.

Course Designers

1. Dr. Sibendu Samanta, Assistant Professor. Dept. Of Electronics and Communication Engineering. SRM University - AP
2. Dr. Arijit Datta, Assistant Professor. Dept. Of Electronics and Communication Engineering. SRM University - AP
3. Dr. Manas Ranjan Tripathy, Assistant Professor. Dept. Of Electronics and Communication Engineering. SRM University – AP.

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Design and Analysis of Algorithms

Course Code	CSC 203	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CSC 107	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To impart basic skills to analyse the performance of algorithms.
2. To train the students to choose appropriate algorithm design techniques for solving problems.
3. To make aware how the choice of data structures and algorithm design methods impact the performance of programs.
4. To impart basic proficiency to deal with NP problems and to develop approximate algorithms wherever required
5. To create an understanding of the basic issues of complex and efficient algorithms.
6. To introduce advanced topics of Backtracking and Branch and bound algorithms required in state space search.

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	Choose appropriate algorithm design techniques for solving problems.	4	70%	65%
Outcome 2	Describe how the choice of data structures and algorithm design methods impact the performance of programs.	2	70%	65%
Outcome 3	Analyse the performance of algorithms**.**	4	70%	65%
Outcome 4	Develop approximate algorithms with NP problems.	4	70%	65%
Outcome 5	Explain the complexity and efficiency of algorithms.	3	70%	65%
Outcome 6	Demonstrate Backtracking, Branch and bound algorithms required in state space search.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	3	1			2		2	2	2	2	2
Outcome 2	2	2	3	2	2	1			2		2	3	2	2	2
Outcome 3	2	3	3	3	2	1			2		2	2	2	2	2
Outcome 4	3	3	3	2	3	1			2		3	3	3	2	3
Outcome 5	3	3	3	3	2	1			2		2	3	2	2	2
Outcome 6	3	3	3	3	2	1			2		2	2	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**1**			**2**		**2**	**3**	**2**	**2**	**2**

Course Unitization Plan

Unit Number	Unit Name	Required Contact hours	CLOs Addressed	References Used
UNIT I	Introduction			
	Algorithmic thinking & motivation with examples	2	1,3	1
	Reinforcing the concepts of Data Structures with examples	3	1,4	1,2
	Complexity analysis of algorithms: big O, omega, and theta notation	3	2	1
	Analysis of Sorting and Searching	2	2	2
	Hash table	3	4	1
	Recursive and non-recursive algorithms.	2	4	1
Unit II	General Problem Solving (GPS) techniques			
	Divide and conquer: Merge sort	2	1,3	1
	Quicksort	2	1,3	1,2
	BST	2	1,3	1,2
	Master method for Complexity analysis	2	2	1,2
	Greedy method: Fractional Knapsack	1	3,4	1
	Minimum spanning trees (Prim's & Kruskal's)	2	4	1,2
	Shortest paths: Dijkstra's algorithm	1	4	1,2
	Huffman coding	1	4	1,2
	Dynamic Programming: 0/1 Knapsack	1	1,4	1,2
	All-to-all shortest paths	1	4	1,2
	Lab: Shortest paths: Dijkstra's program	1	4	1,2
	Lab: Huffman coding program	1	4	1,2
	Lab: Dynamic Programming: 0/1 Knapsack program	1	1,4	1,2
	Lab: All-to-all shortest paths program	2	4	1,2
UNIT III	Search techniques and Randomised algorithms			
	BFS & DFS, Backtracking	3	2,4	1
	8-Queen's problem	2	4	
	Knight's tour	2	4	1
	Travelling Salesman Problem (TSP)	2	3,4	1
	Branch-and-bound: 16-puzzle problem	2	4	1
	TSSP	2	4	1
	Randomized algorithms: Playing Cards	2	4	2,3
UNIT IV	Pattern matching and Amortized analysis			
	Pattern matching algorithms: Brute-force,	1	4	4
	Boyer Moore	2	4	4
	KMP algorithms	1	3,4	4
	Algorithm analysis: Probabilistic Analysis	1	2	4
	Amortized analysis,	1	2	4
	Competitive analysis	1	2	4
UNIT V	NP problems			
	Non-polynomial complexity: examples and analysis	2	4	2,4
	Vertex cover	1	3,4	2
	Set cover	1	4	2,4
	TSP	1	4	2,4
	3-SAT	1	4	2,4
	Approximation Algorithms: Vertex cover	1	4	2,4
	TSP	1	4	2,4

	Set cover	1	4	2,4
	Total contact hours	65		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)	
		Theory (30%)				Pract (20%)	Th (30%	Pract (20%)
		CLA-1 (6%)	Mid- 1 (12%)	CLA- 2 (6%)	CLA-3 (6%)			
Level 1	Remember	60%	30%	30%	30%	30%	30%	30%
	Understand							
Level 2	Apply	40%	70%	70%	70%	70%	70%	70%
	Analyse							
Level 3	Evaluate							
	Create							
Total		100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to algorithms (3rd ed.). MIT Press.
2. Dave, P., & Dave, H. (2008). Design and analysis of algorithms. Pearson Education.
3. Goodrich, M., & Tamassia, R. (2006). Algorithm design: Foundations, analysis, and internet examples. Wiley.
4. Aho, A. V., Hopcroft, J. E., & Ullman, J. D. (n.d.). Design and analysis of algorithms. Addison-Wesley Publishing.

Other Resources

1. Kleinberg, J., & Tardos, É. (2005). Algorithm design. Addison-Wesley.
2. Dasgupta, S., Papadimitriou, C., & Vazirani, U. (2006). Algorithms. McGraw-Hill

Course Designers

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

Linear Algebra and Differential Equations

Course Code	CSC 204	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)	Calculus	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop a comprehensive set of skills and knowledge to solve complex systems of linear equations and utilizing matrix operations by introducing determinants, vector spaces, and their applications in real-world scenarios.
2. To gain proficiency in understanding and manipulating linear transformations, eigenvalues, and eigenvectors, enabling them to analyse and interpret diverse mathematical models.
3. To develop practical techniques for solving first and higher-order differential equations, employing methods like reduction of order and variation of parameters to tackle real-world problems involving dynamic systems.

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	Solve linear equations and perform matrix operations. Understand special matrix types, determinants, and vector spaces.	3	75%	80%
Outcome 2	Define and analyze linear transformations. Apply eigenvalue concepts and understand diagonalization.	1, 3	70%	65%
Outcome 3	Identify the existence, uniqueness, and classification of solutions. Solve various types of first-order differential equations, including separable and linear.	2	75%	70%
Outcome 4	Demonstrate homogeneous equations with constant coefficients and Euler-Cauchy equations with solution methods like undetermined coefficients and variation of parameters.	4	70%	65%
Outcome 5	Transform higher-order equations into systems, emphasizing critical points and stability. Address nonhomogeneous linear systems using methods like undetermined coefficients and variation of parameters.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	-	-	-	-	-	-	-	-				
Outcome 2	3	3	2	1		-	-	-	-	-	-				
Outcome 3	2	3	2	1		-	-	-	-	-	-				
Outcome 4	3	3	3	-			-	-	-	-	-				
Outcome 5	3	3	2	-		-	-	-	-	-	-				
Average	**3**	**3**	**3**	**1**											

Course Unitization Plan

Session	Description of Topic	Contact Hours Required	CLOs Addressed	References Used
	Unit I: Linear Equations, Matrices, Determinants and Vector Spaces	**12 Hours**		
1.	Systems of Linear Equations, Algebraic Properties of Matrix Operations	1	**CO 1**	1
2.	Special Types of Matrices, Echelon Form of a Matrix, Rank of a matrix	2	**CO 1**	1
3.	Tutorial	1	**CO 1**	1,3
4.	Solving Linear Systems, Elementary Matrices, Finding A^{-1}.	1	**CO 1**	1
5.	Determinants, Properties of Determinants	2	**CO 1**	1,3
6.	Tutorial	1	**CO 1**	1,3
7.	Vectors in the Plane and in 3-Space, Vector Spaces	1	**CO 1**	1,3
8.	Subspaces, Span, Linear Independence, Basis and Dimensions	2	**CO 1**	1,3
9.	Tutorial	1	**CO 1**	1,3
	Unit II: Linear Transformations, Eigenvalues and Eigenvectors	**12 Hours**		
10.	Definition and Examples of Linear Transformations,	1	**CO 2**	1,3
11.	Kernel and Range of a Linear Transformation,	2	**CO 2**	1,3
12.	Tutorial	1	**CO 2**	1,3
13.	Matrix of a Linear Transformation,	1	**CO 2**	1,3
14.	Eigenvalues and Eigenvectors, Diagonalization and Similar Matrices,	2	**CO 2**	1,3
15.	Tutorial	1	**CO 2**	1,3
16.	Diagonalization of Symmetric Matrices	1	**CO 2**	1,3
17.	Spectral Decomposition and Singular Value Decomposition.	2	**CO 2**	1,3
18.	Tutorial	1	**CO 2**	1,3
	Unit III: First order differential equations	**12 Hours**		
19.	Geometrical meaning of first order differential equations,	1	**CO 3**	2
20.	Existence and uniqueness of solution,	2	**CO 3**	2
21.	Tutorial	1	**CO 3**	2,4
22.	Classification of ODEs,	1	**CO 3**	2
23.	Separable differential equations, Exact differential equations,	2	**CO 3**	2
24.	Tutorial	1	**CO 3**	2,4
25.	Linear differential equations,	1	**CO 3**	2
26.	Bernoulli differential equations, Initial value problems.	2	**CO 3**	2
27.	Tutorial	1	**CO 3**	2,4
	Unit IV: Second or higher order linear differential equations	**12 Hours**		
28.	Method of reduction of order (when one solution is known)	1	**CO 4**	2
29.	Wronskian	2	**CO 4**	2
30.	Tutorial	1	**CO 4**	2,4
31.	Homogeneous differential equations with constant coefficients	1	**CO 4**	2
32.	Homogeneous Euler-Cauchy differential equations	2	**CO 4**	2
33.	Tutorial	1	**CO 4**	2,4
34.	Method of undetermined coefficients	1	**CO 4**	2
35.	Method of variation of parameters.	2	**CO 4**	2
36.	Tutorial	1	**CO 4**	2,4
	Unit V: System of first order differential equations	**12 Hours**		
37.	Solution of homogeneous constant coefficient system of differential equations	2	**CO 5**	2

38.	Converting higher order differential equations into system of equations	1	**CO 5**	2
39.	Tutorial	1	**CO 5**	2,4
40.	Critical points and stability	1	**CO 5**	2
41.	Nonhomogeneous Linear Systems of ODEs.	1	**CO 5**	2
42.	Method of undetermined coefficients	1	**CO 5**	2,4
43.	Tutorial	1	**CO 5**	2
44.	Method of variation of parameters	2	**CO 5**	2
45.	Linearization of Nonlinear Systems.	1	**CO 5**	2,4
46.	Tutorial	1	**CO 5**	2,4
Total		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (60%)**				**End Semester Assessments (40%)**
		CLA-1 (10%)	**Mid-1 (20%)**	**CLA-2 (10%)**	**CLA-3 (10%)**	
Level 1	Remember	50%	40%	60%	50%	55%
	Understand					
Level 2	Apply	50%	60%	40%	50%	45%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Strang, G. (2007). Linear algebra and its applications (4th ed.). Nelson Engineering.
2. Kreyszig, E. (n.d.). Advanced engineering mathematics (10th ed.). Wiley-India.

Other Resources

1. Hill, D., & Kolman, B. (2019). Elementary linear algebra with applications (9th ed.). Pearson.
2. Boyce, W., & DiPrima, R. (n.d.). Elementary differential equations and boundary value problems (11th ed.). Wiley-India.

Course Designers

1. Dr. Fouzul Atik, Dr. Prakash Kumar

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Mathematical Modelling of Physical Data

Course Code	SEC 107	**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	Physics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

- To gain a foundational understanding of statistics and probability, and error analysis.
- To know different types of mathematical models used to understand a data set.
- To construct appropriate mathematical through formulation of real-life problems, solve those problems and validate the results.
- To develop job-relevant skills with hands-on 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	Summarize concepts of statistics and probability, and different data fitting methods	2	70%	65%
Outcome 2	Employ error analysis on a given data set	3	70%	65%
Outcome 3	Examine mathematical models for fitting a given data and solve those numerically	4	70%	65%
Outcome 4	Prepare report using a computational tools e.g., Latex	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)													
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and CT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2			1	1	1					2				
Outcome 2	2	3	1	3	1	3					2	3			
Outcome 3	2	3	2	3	3	3					2	3			
Outcome 4	2	1		3	3	3		2	2	2	2	1			
Average	2.0	2.3	1.5	2.5	2.0	2.5		2.0	2.0	2.0	2.0	2.3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Probability distributions	1	1, 3	1, 2
	Mean, Variance, and Standard deviations	1	1, 3	1, 2
	Central limit theorem	1	1, 3	1, 2
	Gradient decent Method	1	1, 3	1, 2
	Regression	1	1, 3	1, 2
Unit No. 2	Precision and accuracy	1	2, 3	1, 2
	Significant digits and round-off	1	2, 3	1, 2
	Error propagation	1	2, 3	1, 2
	Weighted average	1	2, 3	1, 2
	Least-square fitting and chi-squared test	1	2, 3	1, 2
Unit No. 3	Different types of Mathematical models	1	3	2, 3
	Linear Modeling	1	3	2, 3
	Exponential Modeling	1	3	2, 3
	Modeling with Differential Equations	1	3	2, 3
	Implementation of some of these models using Python	**1**	3	2, 4
Total Contact Hours		**15**		

Course Unitization Plan: Laboratory

S. No	Description of Experiments	Required Contact hours	CLOs Addressed	References
1.	Implementation of mathematical models using Python on real data e.g., weather, stock market etc	10	3	2, 4
2.	Latex: Basics, interface and operation	2	3	5
3.	Preparing a report using Latex	3	4	5
Total Contact Hours		**15**		

Learning Assessment

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

Recommended Resources

1. Epperson, J. F. (2013). An introduction to Numerical methods and analysis (2nd ed.). Hoboken, NJ: Wiley.
2. Meerschaert, M. M. (2007). Mathematical Modeling. Amsterdam: Elsevier

Other Resources

1. Cutrone, J. W. (2019). Precalculus: Mathematical Modeling. Coursera. Retrieved from https://www.coursera.org/learn/precalculus-mathematical-modelling#modules
2. Keijzer, M. et al. (2017). Modelling with Differential Equations. Delft University of Technology. Retrieved from https://online-learning.tudelft.nl/courses/modelling-with-differential-equations/
3. University of Colorado Boulder. (2020). Latex for Beginners. Retrieved from https://www.colorado.edu/aps/sites/default/files/attached-files/latex_primer.pdf

Course Designers

1. Enter Data

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

Computer Organization and Architecture

Course Code	CSC 205	Course Category	Professional Core (C)	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. Learn basic organization of a typical computing system.
2. Understand working of a basic execution data path and control unit of a processor.
3. Understand pipeline processing and its optimization techniques
4. Gain knowledge of how a memory is organized and how it interacts with a processor.
5. Learn how an Input/Output device can interact/communicate with a processor and memory.

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 basic organization of a typical computing system	2	85%	75%
Outcome 2	Illustrate the working of a basic data path and control unit of a processor	2	75%	70%
Outcome 3	Understand pipeline processing and its optimization techniques	2	75%	70%
Outcome 4	Demonstrate memory organization and its interaction with a processor	2	75%	70%
Outcome 5	Illustrate the interaction/communication of an Input/Output device with a processor and memory	2	75%	70%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	**2**	**2**	**1**	**1**	**1**								**3**	**1**	**1**
Outcome 2	**3**	**3**	**3**	**2**	**3**							**3**	**2**	**3**	**2**
Outcome 3	**3**	**3**	**3**	**3**	**3**							**3**	**1**	**3**	**3**
Outcome 4	**3**	**3**	**3**	**3**	**3**							**3**	**1**	**3**	**3**
Outcome 5	**3**	**3**	**3**	**2**	**3**							**3**	**3**	**3**	**2**
Average	**3**	**3**	**3**	**2**	**3**							**3**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**15**		
	Functional units of the computers	1	1	1,2
	Bus structures	1	1	1.2
	Instruction formats, Addressing modes	1	1	1,2
	Architecture and instruction set of 8086/8088 microprocessor	1	1,2	2,3,6
	Assembly language programming	2	1,2	2,7
	Fixed point and floating-point operations	1	1,2	1,2
	ALU design	2	1,2	2,3
	Practical 1: Write Assembly language program to print the numbers from 0 to 9	2	1	7,8
	Practical 2: Write Assembly language programs to find average of numbers stored in an array.	2	2	7.8
	Practical 3: Write Assembly language programs to find the largest number in an array	2	2	7,8
Unit 2	**Basic Processing Unit**	**16**		
	Execution of a complete instruction	2	2	2,3
	Hardwired control design	3	2	1,2,3
	Micro programmed control design	3	2	2,3
	Nano programming	1	2	2,3
	CISC and RISC principles	1	2	1,2
	Practical 4: Write Assembly language programs to sort the numbers in ascending order.	2	2	7,8
	Practical 5: Write Assembly language programs to find L.C.M of two numbers.	2	2	7,8
	Practical 6: Write Assembly language programs to find G.C.D of two numbers.	2	3	7,8
UNIT 3	**Pipeline Processing**	**14**	2	
	Basic concepts of Pipeline Processing	1	2	1,2
	Instruction pipeline	2	2	1,2
	Arithmetic pipeline	1	2	1,2
	Handling Data, Control and Structural hazards	2	2	1,2
	Compiler techniques for improving performance	2	2	1,2
	Practical 7: Write Assembly language programs to display nth term Fibonacci number.	2	3	7,8
	Practical 8: Write Assembly language programs to find the factorial of a number.	2	2	7,8
	Practical 9: Programs for 16-bit Arithmetic Operations for 8086 (Using Microprocessor trainer kit 8086).	2	3	7,8
UNIT 4	**Memory System**	**18**		
	Semiconductor Memories - Speed, Size and cost, RAM, ROM	2	3	2.3,4
	Cache memories	1	3	2,4
	Improving cache performance	2	3	2
	Virtual memory	1	3	2
	Memory management requirements	1	3	2
	Associative memories	1	3	2
	Secondary storage devices	2	3	2
	Practical 10: Program for String Manipulations for 8086 (Using Microprocessor trainer kit 8086)	2	3	7,8,9
	Practical 11: Design and Implementation of hardwired control units.	2	3	7,8,9
	Practical 12: Design and Implementation of microprogrammed control units.	2	3	7,8,9

	Practical 13: Implement concept of cache memory	2	3	7,8,9
UNIT 5	**I/O Organization**	**12**		
	Different types of I/O devices and I/O transfer schemes	2	4	2
	Programmed Input/output	1	4	2
	Interrupts	1	4	2
	Direct Memory Access	1	4	2
	Interface circuits	1	4	2
	Standard I/O Interfaces	1	4	2,5
	I/ O Processors	1	4	3,5
	Practical 14: Develop an assembler to convert the given assembly language program into machine language program by considering 8086/88 microprocessor.	2	2	7,8,9,10
	Practical 15: Develop a simulator for 8086/88 microprocessor.	2	2	7,8,9,10
	Total Contact Hours	**75**		

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%)**		**Practical Internal (50%)**		
		Th	**P**	**Th**	**P**	**Th**	**P**	**Th**	**Pr**		**Th**	**Prac**
Level 1	Remember	60%		60%		60%		60%		40%	50%	40%
	Understand											
Level 2	Apply	40%		40%		40%		40%		60%	50%	50%
	Analyse											
Level 3	Evaluate											10%
	Create											
Total		100%		100%		100%		100%		100%	100%	100%

Recommended Resources

1. Mano, M. (n.d.). Computer system architecture (3rd ed.). Pearson.
2. Hamacher, C., Vranesic, Z., & Zaky, S. (n.d.). Computer organization (5th ed.). McGraw-Hill

Other Resources

1. Stallings, W. (n.d.). Computer organization and architecture: Designing for performance (9th ed.). Pearson.
2. Tanenbaum, A. S. (n.d.). Structured computer organization (6th ed.). Pearson Education India.
3. Patterson, D. A., & Hennessy, J. L. (n.d.). Computer organization and design: The hardware/software interface. Elsevier.
4. Hayes, J. P. (n.d.). Computer architecture and organization (3rd ed.). Tata McGraw Hill.
5. Skinner, T. P. (n.d.). An introduction to 8086/8088 assembly language programming.
6. Savaliya, M. T. (n.d.). 8086 programming and advanced processor architecture (1st ed.). Wiley India.
7. Chopra, R. (2014). Computer architecture and organization: A practical approach. [Publisher information not provided in the request.
8. Shoaib, R. M. (1989). Meta assembler and emulator for the Intel 8086 microprocessor.

Course Designers

1. Enter Data

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

Mobile Application Development with Java

Course Code	CSC 206	**Course Category**		**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department		**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the concepts of Object Oriented Programming using JAVA programming.
2. To demonstrate the introduction and characteristics of mobile applications.
3. To understand the design of user interfaces in mobile devices.
4. To develop mobile applications and deploy in play store.

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	Utilize the Object-Oriented Concepts in solving real word problems through Java.	3,6	75%	75%
Outcome 2	Install and configure Android application development tools.	3	77%	70%
Outcome 3	Design and develop user Interfaces for the Android platform.	3,6	75%	70%
Outcome 4	Apply Java programming concepts to Android application development	3	72%	70%

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

CLOs	Program Learning Outcomes (PLO)													
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2							2	3	2	
Outcome 2	2	2	3	3	2							2	2	2	
Outcome 3	2	3	3	2	2							2	2	2	
Outcome 4	3	3	3	3	2							2	2	3	
Average	**2**	**3**	**3**	**3**	**2**							2	**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Java for Mobile Development**	**12**		
	Basics of Java Programming - Introduction to Java programming language, Setting up Java development Kit (JDK) and Integrated Development Environment (IDE),	**1**	**1**	**8**
	Data types, Variables and Arrays, operators, expressions, Control statements	**2**	**1**	**8**
	Object Oriented Programming in Java - Concepts of Object-Oriented Programming (OOP)	**1**	**1**	**8**
	Classes and objects: definition, instantiation, and access modifiers	**2**	**1**	**8**
	Inheritance - Concept, Member access, Abstract Class, Interface, Creating Multilevel hierarchy- super uses, Packages-access specifiers, using final with inheritance	**2**	**1**	**8**
	Polymorphism - Compile time Polymorphism, Method overloading, Run time polymorphism, Method overriding, Constructor overloading	**2**	**1**	**8**
	Exception handling - try, catch, finally blocks, File I/O in Java: reading and writing files	**2**	**1**	**8**
Unit 2	**Introduction to Mobile Devices & User Interface Development with Layout**	**11**		
	Introduction to mobile devices, Android and its tools: Introduction to Mobile Computing, Introduction to Android Development Environment	**2**	**2**	**2**
	Mobile devices vs. desktop devices, ARM and Intel architectures, Need of Android, Features of Android, Android architecture	**2**	**2**	**2**
	Android Studio: installation and setup, Basic components of an Android app: Activities, Services, Broadcast Receivers, Content Providers,	**2**	**2**	**2**
	AndroidManifest.xml file and its significance.	**1**	**2**	**2**
	User Interface Development with Layout: Control Flow, Directory Structure, Components of a Screen	**2**	**3**	**2**
	Fundamental UI Design, Linear Layout, Absolute Layout, Frame Layout, Table Layout, Relative Layout.	**2**	**3**	**2**
UNIT-III	**Design User Interface with View**	**09**		
	Text View, Edit Text, Button, Image Button, Toggle Button	**2**	**3**	**2**
	Radio Button and Radio Group, Checkbox	**1**	**3**	**2**
	Progress Bar, List View, Grid View, Image View, Scroll View, Custom Toast Alert, Time and Date Picker	**2**	**3**	**2**
	Event handling: onClick, onTouch, and other listeners	**2**	**3**	**2**
	Fragments and activities: lifecycle and communication, UI design principles and guidelines, Building responsive and interactive user interfaces	**2**	**3**	**2**
UNIT-IV	**Mobile App Logic and Functionality & Location-Based Services and Sensors**	**10**		
	Intents: explicit and implicit, Navigation between activities, Data storage options in Android: SQLite databases	**2**	**3**	**2**
	Shared Preferences, Networking in Android: making HTTP requests, Background processing and threading: AsyncTask, Thread	**2**	**3**	**2**
	Handler, Custom views and animations, Multimedia: audio and video playback	**2**	**3**	**2**
	Working with location-based services and Google Maps API	**2**	**3**	**3**

	Sensor integration: accelerometer, gyroscope, and orientation sensors, Augmented Reality (AR) basics and integration possibilities	**2**	**3**	**3, 4**
UNIT-V	**Testing, Deployment, and Future Trends & Emerging Trends and Future directions**	**07**		
	Creating Small Application, Signing of application, Deploying app on Google Play Store	**2**	**3, 4**	**4**
	Publishing Android Applications, Developer Console, Unit testing in Android: JUnit and Espresso	**2**	**3, 4**	**4**
	Debugging techniques in Android Studio	**1**	**3, 4**	**4**
	Introduction to Kotlin for Android development, Cross-platform development with frameworks like Flutter, Exploring emerging technologies: Virtual Reality (VR), Internet of Things (IoT), and Artificial Intelligence (AI) in mobile apps.	**2**	**3**	**4**
Total Contact Hours		**49**		

Course Unitization Plan – Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Install /configure java development kit (JDK), android studio and android SDK. Configure android development tools (ADT) plug-in and create android virtual device.	2	2	2
2	Declare two classes Student and Teacher. The classes will have the data members and constructors as per your convenience. Write a JAVA program, (i) where the Teacher will enter the marks of the all the students in the database. (ii) Once the marks are entered, the student can view the marks.	2	1	8
3	Define a package named gradepack. The gradepack consists of a class named operations. The operations class consists of the methods to compute the average, minimum, maximum, median and standard deviation. Create a class named GradesStatistics, which reads in n grades (of int between 0 and 100, inclusive) and displays the average, minimum, maximum, median and standard deviation by importing the gradepack package. (Pass the grades information to the methods in the operations class.) Display the floating-point values upto 2 decimal places.	2	1	8
4	Create three classes named Student, Teacher, Parent. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized. Similarly, the other two classes should have run methods with few valid statements under synchronized.	2	1	8
5	a. Develop a program to implement linear layout and absolute layout. b. Develop a program to implement frame layout, table layout and relative layout.	2	3	2
6	Develop a program to implement Text View and Edit Text. b Develop a program to implement Auto Complete Text View. c Develop a program to implement Button, Image Button and Toggle Button.	2	3	2
7	Develop a program to implement login window using above UI controls. b. Develop a program to implement Checkbox, Radio Button and Radio Group, c. Progress Bar. d. Develop a program to implement List View, Grid View, Image View and Scroll View.	2	3	2
8	Develop a program to implement Date and Time Picker.	2	3	2

	b. Develop a program to implement Custom Toast Alert.			
9	Develop a program to create an activity. b: Develop a program to implement new activity using explicit intent and implicit intent. c: Develop a program to implement content provider d: Develop a program to implement service.	2	3	2
10	Develop a program to implement broadcast receiver. b: Develop a program to implement sensors. c: Develop a program to build Camera.	2	3	1
11	Develop a program for providing Bluetooth connectivity b: Develop a program for animation c: Perform Async task using SQLite.	2	3, 4	2
12	Create sample application with login module. (Check username and password) On successful login, Change text view "Login Successful" And on login fail, alert user using Toast "Login fail" b: Create login application where you will have to validate username and password till c: the username and password is not validated, login button should remain disabled.	2	3, 4	2
13	Develop a program to: i) Send SMS ii) Receive SMS. b: Develop a program to send and receive e-mail c: Deploy map based application.	2	3, 4	2
Total Contact Hours		26		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (30%)				End Semester Exam (30%)
		CLA-1 (10%)	Mid-1 (10%)	CLA-2 (5%)	CLA-3 (5%)	
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 (20%)		End Semester Exam (20%)
		Lab Record (5%)	Lab Performance (15%)	
Level 1	Remember	50%	50%	50%
	Understand			
Level 2	Apply	50%	50%	50%
	Analyse			
Level 3	Evaluate			
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, "Android Programming: The Big Nerd"
2. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox),2013
3. Ranch Guide, "Big Nerd Ranch LLC", 2nd edition, 2015.
4. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture,Design and Development", Prentice Hall, 2004.
5. "Professional Android 4 Application Development", Reto Meier, Wiley India, (Wrox) ,2012
6. "Android Application Development for Java Programmers", James C Sheusi, Cengage Learning, 2013
7. Dawn Griffiths, David Griffiths,"Head First: Android Development" ,OReilly2015,ISBN: 9781449362188
8. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.

9. http://developer.android.com/develop/index.html
10. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development",Wrox, 2012

Other Resources

1. Tomasz Nurkiewicz and Ben Christensen, Reactive Programming with RxJava, O'ReillyMedia, 2016.
2. Brian Fling, Mobile Design and Development, O'Reilly Media, Inc., 2009.
3. Maximiliano Firtman, Programming the Mobile Web, O'Reilly Media, Inc., 2nd ed.,2013.
4. Cristian Crumlish and Erin Malone, Designing Social Interfaces, 2nd ed., O'ReillyMedia, Inc., 2014.
5. Suzanne Ginsburg, Designing the iPhone User Experience: A User-Centered Approach toSketching and Prototyping iPhone Apps, Addison-Wesley Professional, 2010

Course Designers

1. Enter Data

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

Database Management Systems

Course Code	CSC 207	Course Category	Professional Core (C)	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. Understand the advantages of DBMS over traditional file system and characteristics of DBMS.
2. Design ER-models to represent data of the organization.
3. Design relational database and execute various queries on the database using SQL.
4. Gain knowledge various anomalies that can occur in database and overcome those with the help of normal forms.
5. comprehend the purpose of transaction processing and concurrency control protocols.
6. Learn indexing schemes used in DBMS for the fast retrieval of data from the database.

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	Identify and design database structure for a system.	4	70%	65%
Outcome 2	Design relational database and execute queries on the database using SQL.	3	70%	65%
Outcome 3	Implement concurrency control protocols for transaction processing system.	3	70%	65%
Outcome 4	Use indexing schemes for fast retrieval of data from the database.	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	1						1		3	3	1
Outcome 2	3	3	3	2	1						1	1	3	3	1
Outcome 3	3	2	3	2	1							1	3	3	1
Outcome 4	3	2	2	2	1						1	1	3	3	1
Average	**3**	**3**	**3**	**2**	**1**						**1**	**1**	**3**	**3**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to DBMS and Relational model**	**8**		
	File Processing System, Advantages of DBMS over File Processing System, Database System Applications.	1	1	1,3
	BMS Architecture: The three-schema architecture Data Independence: Logical and Physical.	2	1	1,3
	Data Models: Hierarchical, network and relation models.	1	1	1,3
	Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values.	2	1	1,3
	Database constraints (Domain, Key constraints, integrity constraints) and their importance.	2	1	1,3
Unit II	**Query processing**	**10**		
	Relational Algebra.	2	2	1,3
	Relational Calculus.	1	2	1,3
	Introduction to SQL: Database Objects- DDL Schema definitions.	1	2	1,3
	DML- Insert, select, update, delete.	1	2	1,3
	Views, exercise on SQL queries.	1	2	1,3
	Transaction support in SQL.	1	2	1,3
	Aggregate Functions, Null Values, Views.	1	2	1,3
	Complex Integrity Constraints in SQL.	1	2	1,3
	Assertions, Triggers	1	2	1,3
Unit III	**Conceptual model and database design**	**9**		
	Entity Relationship model Entity types, Entity Sets, Attributes, and Keys Relationships, Relationship types and constraints, Weak Entity types.	3	2	1,2
	Enhanced ER (EER) Modeling: Super/Sub Classes Specialization and Generalization. Constraints and characteristics of Specialization and Generalization.	2	2	1,2
	Example EER Schema.	1	2	
	Basics of Normalization, Normal Forms: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF)	2	2	1,2
	BCNF, 4NF	1	2	1,2
Unit IV	**Transaction Processing, Concurrency Control and Recovery**	**10**		
	ıtroduction of transaction processing, advantages and disadvantages of transaction processing system.	2	3	1,3
	Serializability and Recoverability of transaction.	2	3	1,3
	Concurrency Control Lock based Protocols.	2	3	1,3
	Timestamp Based Protocols – Validation based Protocols - Multiple Granularity Locking.	2	3	1,3
	Recovery techniques.	2	3	1,3
Unit V	**Overview of Storage and Indexing**	**8**		
	Data on External Storage, File Organization and Indexing - Clustered Indexes, Primary and Secondary Indexes.	2	4	1,3
	Indexed Sequential Access Methods (ISAM) B+ Trees: Tree Structure, Search, Insert, Delete.	3	4	1,3
	Hash Based Indexing: Static Hashing, Extendable hashing, Linear Hashing, Extendible vs. Linear Hashing.	3	4	1,3

Course Unitization Plan - Practicals

Session	Description of Experiment	Required Contact Hours	CLOs Addressed	References Used
1.	Implementation of data storage and indexing methods using files.	4	4	1,2,3
2.	DML queries on single table.	2	2	1,4
3.	Queries on Joining tables and Aggregate Functions.	4	2	1,3
4.	Nested queries, Queries on creation of views, indexes, sequences and access privileges.	4	2	1,3
5.	Triggers, Assertions.	4	2	1,3
6.	SQL Transactions.	4	3	1,3
7.	PL/SQL, Stored Procedures.	4	4	4
8.	Design and Develop Applications.	4	1,2	1,3
Total contact hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)	
		Theory (30%)				Practical (20%)		
		CLA-1 (5%)	Mid-1 (10%)	CLA-2 (5%)	Mid-2 (10%)		Th	Prac
Level 1	Remember	50%	40%	60%	50%	50%	40%	40%
	Understand							
Level 2	Apply	50%	60%	40%	50%	50%	60%	60%
	Analyse							
Level 3	Evaluate							
	Create							
Total		100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Elmasri, R., & Navathe, S. (2016). Fundamentals of database systems (7th ed.). Pearson Education.
2. Ramakrishnan, R., & Gehrke, J. (2004). Database management systems. McGraw Hill.
3. Silberschatz, A., Korth, H., & Sudarshan, S. (2011). Database system concepts (6th ed.). McGraw Hill.
4. Garcia-Molina, H., Ullman, J. D., & Widom, J. (2000). Database system implementation. Prentice Hall.

Other Resources

1. Date, C. J. (2003). An introduction to database systems (8th ed.). Addison-Wesley Longman Publishing Co., Inc.

Course Designers

1. Enter Data

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

Coding Skill - I

Course Code	CSE 201	Course Category	SEC	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. Analyze and evaluate code complexity to understand the efficiency and performance of algorithms.
2. Master the implementation of linear data structures, including arrays and linked lists, for solving diverse computational problems.
3. Learn to work with abstract data structures, including stacks and queues, to solve real-world problems.
4. Apply divide and conquer strategies in problem-solving and become proficient in algorithms like Quick Sort and Merge Sort
5. Develop a strong foundation in non-linear data structures, particularly binary trees, and analyze their properties and 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	Compute code complexity and understand the computational efficiency of algorithms.	2, 3	80%	75%
Outcome 2	Implement linear data structures, including arrays and linked lists, to solve problems involving data manipulation and storage.	2, 3	75%	70%
Outcome 3	Apply abstract data structures, including stacks and queues to solve complex, real-world computational problems.	2, 3	75%	70%
Outcome 4	Apply divide and conquer strategies to solve complex problems, with a focus on algorithms like Quick Sort and Merge Sort.	2, 3	75%	70%
Outcome 5	Solve problems related to non-linear data structures, particularly binary trees, and understand their applications in real-world scenarios.	3	65%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3		2				1	1			3	2	
Outcome 2	2	3	3		2				1	1			3	2	
Outcome 3	2	3	3		2				1	1			3	2	
Outcome 4	2	3	3		2				1	1			3	2	
Outcome 5	2	3	3		2				1	1			3	2	
Average	**2**	**3**	**3**		**2**				**1**	**1**			**3**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Code Complexity Analysis & Linear List data Problem solving through Coding, Compare and contrast coding and competitive coding, Various approaches for problem solving, techniques for competitive coding, Orientation on Competitive coding on coding platforms like Codechef/ Codeforces/ Leetcode/ Hackerrank etc. Precise coding techniques implementing the evaluation of the language supported expressions, code complexity analysis, Linear/ Logarithmic/ Super linear/ Polynomial/ Exponential/ Recursion Algorithm analysis, Problem Solving using Linear list data, Subscripts, 2D Array Subscript, RMO & CMO Representation, Matrix Problems. Company Specific Examples & Competitive Programming Practice Problems. Contextual implementation using Competitive Coding using global coding platforms: Code chef/ Leet code / Codeforces / Hackerrank etc	**9**	**1**	
Unit 2	Memory Manipulation Methods and Problem Solving on String data Pointer Variable, Pointer Arithmetic, Memory Layout, Runtime memory allocation, Problem Solving on String Data, String handling methods, Examples, Practice Problems. Problem Solving using Linked List data: Implementing a Structure member pointer reference, Coding solutions for Linked list manipulation, Solutions for order statistic problems on linked lists: Comparison/ Cycle Detection/ Merge Point Detection/ Merging the lists, Coding solution for the circular linked data and Double linked data, coding problems, Examples, Practice problems. Contextual implementation using Competitive Coding using global coding platforms: Code chef/ Leet code / Codeforces / Hackerrank etc.	**9**	2	
Unit 3	Problem Solving using Abstract data structures: Stacks Problem solving using Stacks, Coding solutions for the implementation of stack using an array, Coding solutions for the implementation of stack using a linked list. Problem solving on expression conversion and evaluation, Examples, Practice problems. Problem Solving through Queues & Search-Sort Algorithms: Problem solving using Queues, Coding solutions for the implementation of queue using an array/ linked list, Divide & Conquer Strategies: Linear Vs Binary Search Analysis, Bubble sort and Selection Sort Analysis, Examples, Practice problems. Contextual implementation using Competitive Coding using global coding platforms: Code chef/ Leet code / Codeforces / Hackerrank etc.	**9**	3	
Unit 4	Problem Solving through Divide & Conquer Strategies: Divide & Conquer Strategies: Quick sort Analysis, Merge Sort Analysis, Min/Power functions, Examples, Practice problems. Contextual implementation using Competitive Coding using global coding platforms: Code chef/ Leet code / Codeforces / Hackerrank etc.	**9**	4	
Unit 5	Problem Solving through Non-Linear Data structures – Trees	**9**	5	

	Problem solving approaches using Non-linear data structures, Coding problems on the height of a binary tree, Size of a binary tree, Tree order traversals, Problem Solving on Binary Trees, Time comparison and analysis on Binary Search Trees & Coding problems, Search/probe sequence validation, Significance of height balancing the tree, Examples, Practice problems. Contextual implementation using Competitive Coding using global coding platforms: Code chef/ Leet code / Codeforces / Hackerrank etc.			
	Total contact hours	**45**		

Learning Assessment

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

Recommended Resources

Other Resources

Course Designers

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

Computer Networks

Course Code	CSC 301	Course Category	Professional Core (C)	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. Understand the computer networking fundamentals with data communication system, TCP/IP and OSI reference mode.
2. Analyse the requirements for a given organizational structure and selection of appropriate network architecture and topology.
3. Specify and identify working limitation in existing protocols of networking layers and try to formulate new and better protocols.
4. Gain knowledge of services and design issues of Transport layer. Also compare and contrast TCP and UDP protocol.

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 computer networking fundamentals based on data communication system, TCP/IP and OSI reference model	2	70 %	65%
Outcome 2	Demonstrate error control and flow control techniques at data link layer	3	70 %	65%
Outcome 3	Select the routing protocols for wired and wireless networks	3	70 %	65%
Outcome 4	Implement ECN congestion and flow control transport layer protocols	3	70 %	65%
Outcome 5	Compare and Contrast application layer protocols - FTP, HTTP, SMTP	4	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2								3	2	
Outcome 2	2	2	3	3	2								2	2	
Outcome 3	2	3	3	2	2								2	2	
Outcome 4	3	3	3	3	2								2	3	
Outcome 5	2	3	3	3	2								2	2	
Average	**2**	**3**	**3**	**3**	**2**								**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**15**		
	Basic Computer Network concepts, Protocol, Layering Scenario.	1	1	1,2
	Layer Architecture: OSI Model, TCP/IP model.	1	1	1
	Internet history standards and administration; Comparison of the OSI and TCP/IP reference model.	1	1	1,2
	Guided transmission media, wireless transmission media.	1	1	1
	Different LAN topologies: BUS, RING and STAR topology.	1	1	1
	Data Link layer design issues: Error detection techniques.	1	1	1
	Error Correction Techniques, Flow control.	1	1	1,2
	Sliding Window protocols. Go back N and selective Repeat protocols.	1	1	1,2
	Difference between single bit sliding window and n-bit sliding window protocols.	1	1	1,2
	Lab Experiment 1: Using Wireshark, for sniffing network traffic in real-time and analyse the packet contents--traffic analysis.	2	3	2
	Lab Experiment 2: Simulate error detection technique using CRC Algorithm.	2	3	2
	Lab Experiment 3: Write a program to implement error correction technique using Hamming code.	2	3	2
Unit 2	**Medium Access Control**	**13**		
	Static and Dynamic channel Allocations.	1	2	1,2
	Shared channel Access: Pure ALOHA and slotted ALOHA.	1	2	1,2
	Persistent CSMA protocols: 1,P and Non-persistent CSMA protocols.	1	2	1,2
	CSMA with collision detection. Comparison of different CSMA protocols.	1	2	1,2
	Collision free protocols: Bit-map protocol, Token Ring and Binary Count down protocols.	1	2	1,2
	Limited Contention protocols: Adaptive tree walk protocol.	1	2	1,2
	Shared medium for wireless networks: CSMA/CA or MACA.	1	2	1,2
	Interconnecting LANs: HUBS, Repeaters and Switches and bridges.	1	2	1,2
	Spanning tree algorithm for bridges.	1	2	1,2
	Lab Experiment 4: Write a program to implement 1-bit Stop and Wait Protocol at data link layer.	2	3	2
	Lab Experiment 5: Simulate N-bit Sliding Window protocol, at data link layer.	2	3	2
Unit 3	**Network Layer**	**13**		
	Overview: Connection oriented and connection less services.	1	3	1,2
	Comparison of packet switched, and circuit switched networks.	1	3	1,2
	Routing: proactive routing and reactive routing protocols, static and dynamic routing protocols.	1	3	1,2
	Dijkstra Algorithm, Distance vector routing and Link state routing protocols.	1	3	1,2
	Routing in wireless networks: AODV and DSR routing protocols.	1	3	1,2
	Overview of IP header and IP addressing.	1	3	1,2
	Classful IP addressing: Class A, B,C,D and E.	1	3	1,2
	Limitations of classful Addressing, Introduction to Subnet.	1	3	1,2
	Overview of Congestion: Warning Bit, Choke packets, Load Shedding, RED (Random Early Detection)	1	3	1,2
	Lab Experiment 6: Write a program to implement Dijkstra Shortest path routing protocol	2	3	2

	Lab Experiment 7: Write a program to implement Distance Vector Routing.	2	3	2
Unit 4	**Internetworking and Transport layer**	**11**		
	IP Encapsulation and Tunnelling.	1	4	1
	IP packet fragmentation, ICMP, ARP.	1	4	1
	ICMP, DHCP, Introduction to Transport layer.	1	4	1
	Different end-to-end transport layer protocols: TCP and UDP.	1	4	1
	Brief explanation of TCP protocol.	1	4	1
	Brief explanation of UDP protocol.	1	4	1
	Packet formats for TCP and UDP protocol.	1	4	1
	Lab Experiment 8: Demonstrate TCP Client Server paradigm through simulation	2	3	2
	Lab Experiment 9: Demonstrate UDP Client Server paradigm through simulation.	2	3	2
Unit 5	**Transport and Application protocols**	**23**		
	TCP Connection Management Modelling.	1	5	1
	TCP Sliding Window.	1	5	1
	TCP congestion control.	1	5	1
	Introduction to application layer paradigms.	1	5	1
	Client Server model.	1	5	1
	Introduction and overview of HTTP protocol.	1	5	1
	Overview of FTP protocol.	1	5	1
	Operation of Electronic Mail.	1	5	1
	Introduction to peer-to-peer communication models.	1	5	1
	Introduction and overview of TELNET.	1	5	1
	Importance of Security in computer Networks.	1	5	1
	Lab Experiment 10: Write a program to implement echo command in client server socket programming.	2	3	2
	Lab Experiment 11: Write a program to simulate Trace-route command.	2	3	2
	Lab Experiment 12: Demonstrate the implementation of Ping command	2	3	2
	Lab Experiment 13: Write a code to display the class of IP address, network mask and generate the subnet IP address based on the subnet bits entered from the keyboard	2	3	2
	Lab Experiment 14: Write a code to implement sliding window protocol at the transport layer	2	3	2
	Lab Experiment 15: Simulate transfer file operation using TCP	2	3	2

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**					**End Semester Exam (50%)**	
		Theory (30%)				**Practical (20%)**		
		CLA-1 (5%)	**Mid-1 (10%)**	**CLA-2 (5%)**	**Mid-2 (10%)**		**Th**	**Prac**
Level 1	Remember	70%	60%	30%	30%	50%	60%	50%
	Understand							
Level 2	Apply	30%	40%	70%	70%	50%	40%	50%
	Analyse							
Level 3	Evaluate							
	Create							
Total		100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Tanenbaum, A. S. (n.d.). Computer networks (4th ed.). Pearson Education.
2. Forouzan, B. A. (2013). Data communications and networking (5th ed.). TMH.

Other Resources

1. Kurose, J. F., & Ross, K. W. (n.d.). Computer networking: A top-down approach featuring the Internet (3rd ed.). Pearson Education.
2. Shay, W. A. (n.d.). Understanding communications and networks (3rd ed.). Cengage Learning

Course Designers

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

Operating Systems

Course Code	CSC 302	**Course Category**	Core Course (C)	**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. To understand the main components of an OS & their functions
2. To study the process management and scheduling
3. To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
4. To understand the concepts and implementation Memory management policies and virtual memory.
5. To understand the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS.

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	Discuss the structure and functions of operating systems	2	70%	70%
Outcome 2	Implement shell script for basic programming skills	3	70%	70%
Outcome 3	Analyse process states and implement process scheduling algorithms.	3	70%	70%
Outcome 4	Apply process synchronization techniques.	3	70%	65%
Outcome 5	Implement memory management techniques.	3	70%	65%
Outcome 6	Demonstrate input, output and file management functions of operating system.	3	70%	65%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoningand Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multiculturaland Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	2	1	1	2							2	2	2	2
Outcome 2	3	2	1	1	2							2	2	2	2
Outcome 3	2	3	3	3	2							1	3	3	3
Outcome 4	2	3	3	3	2							1	3	3	3
Outcome 5	2	3	3	3	2							1	3	3	3
Outcome 6	2	3	3	3	2							1	3	3	3
Average	**2**	**3**	**3**	**3**	**2**							**1**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**14**		
	Operating system overview-objectives and functions	1	1	1,2
	Evolution of Operating System	1	1	1,2
	Computer System Organization	1	1	1,2
	Operating System Structure and Operations	1	1	1,2
	System Programs	1	1	1,2
	Generation and System Boot	1	1	1,2
	Lab Experiment: Shell Programming exercises	4	2	5
	Lab Experiment: Implementing Linux system commands using system calls.	4	2	6
Unit 2	**Process Management**	**13**		
	Process Concepts	1	3	1,2
	Various types of scheduling	1	3	1,2
	Operations on Processes	1	3	1,2
	Inter process Communication	2	3	1,2
	CPU Scheduling Algorithms	3	3	1,2
	OS – examples	1	3	1,2
	Lab Experiment: CPU Scheduling Algorithms.	4	3	1
Unit 3	**Process Synchronization and Deadlocks**	**17**		
	Threads- Overview.	1	4	1,3
	Multithreading Models.	1	4	1,3
	Process Synchronization: Critical section problem and mutual exclusion.	1	4	1,3
	Mutex Locks.	1	4	1,3
	Semaphores.	1	4	1,3
	Monitors	1	4	1,3
	Deadlocks	2	4	1,3
	OS examples.	1	4	1,3
	Lab Experiment: Implement producer, consumer problem using semaphores. Computing page faults for various page replacement algorithms.	4	4	1
	Lab Experiment: Implement deadlock avoidance and detections algorithms.	4	4	1
Unit 4	**Storage Management**	**18**		
	Main Memory Management.	1	5	1,2
	Contiguous Memory Allocation.	1	5	1,2
	Segmentation	1	5	1,2
	Virtual Memory	1	5	1,2
	Paging	1	5	1,2
	Demand Paging.	1	5	1,2
	Page Replacement Algorithms.	1	5	1,2
	Frame Allocation Techniques	1	5	1,2
	Thrashing	1	5	1,2
	OS examples.	1	5	1,3
	Lab Experiment: Computing page faults for various page replacement algorithms.	4	5	1
	Lab Experiment: Simulation of Demand Paging System.	4	5	1
Unit 5	**I/O Systems and File Management**	**13**		
	Mass Storage Structure- Overview.	1	6	1,3
	Disk Scheduling and Management.	1	6	1,3
	File System Storage.	1	6	1,3
	File Concepts.	1	6	1,3
	Directory and Disk Structure.	1	6	1,3

	Sharing and Protection.	1	6	1,3
	File System Implementation.	1	6	1,3
	File System Structure, Directory Structure.	1	6	1,3
	Allocation Methods.	1	6	1,3
	Free Space Management.	1	6	1,3
	OS examples.	1	6	1,3
	Lab Experiment: Project Development.	2	6	Internet resources
Total Contact Hours- Theory		**45**		
Total Contact Hours- Lab		**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%)**		**Mid-2 (15%)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	50%	40%	40%	40%	50%	30%	40%	40%	40%	40%
	Understand										
Level 2	Apply	50%	60%	60%	60%	50%	70%	60%	60%	60%	60%
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Silberschatz, A., Galvin, P. B., & Gagne, G. (n.d.). Operating system concepts (9th ed.). John Wiley and Sons Inc.
2. Deitel, H. M., Deitel, P. J., & Choffnes, D. R. (n.d.). Operating system (3rd ed.). Pearson Publications.
3. Stallings, W. (n.d.). Operating systems: Internals and design principles (9th ed.). Pearson Publications.

Other Resources

1. Tanenbaum, A. S. (n.d.). Modern operating systems (4th ed.). Pearson Publications.
2. Michael, R. K. (n.d.). Mastering Unix shell scripting (2nd ed.). Wiley Publications.
3. Love, R. (2007). Linux system programming. O'Reilly Publications.

Course Designers

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

Web Technology

Course Code	CSC 303	**Course Category**	Open Elective (OE)	**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. Gain knowledge on the basics of the internet and the world wide web
2. Familiarize various web development tools such as HTML, CSS and JavaScript
3. Gain knowledge on DHTML
4. Acquire knowledge on XML and its importance in data sharing
5. Comprehend on server-side programming using PHP and the basics web services

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 internet and world wide web	2	70%	65%
Outcome 2	Implement websites using HTML, CSS and JavaScript	3	70%	65%
Outcome 3	Describe the features of DHTML	2	70%	65%
Outcome 4	Use XML for data transmission	3	70%	65%
Outcome 5	Demonstrate Webservices, server-side programming using PHP and the methods to access DBMS.	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2														
Outcome 2	3	3	3	2	3							1			
Outcome 3	3	3	3	3	3							1			
Outcome 4	3	2	2	2	3							1			
Outcome 5	3	2	2	3	3							1			
Average	**3**	**3**	**3**	**3**	**3**							**1**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to WWW and Web development using HTML**	**8**		
	Introduction to world wide web	1	1	1, 2
	Introduction of major tools for web developments	1	1	1
	Introduction to HTML	1	1	1
	Linking images	1	1	1
	Special characters and line breaks in XHTML	1	1	1
	Various lists (Ordered and Unordered lists)	1	1	1
	Tables in HTML	1	1	1
	Forms in HTML	1	1	1
	Lab 1: Practice basic Basic HTML Tags	2	1	1
	Lab 2: Create a static personal web page using hyperlinks, tables, images, etc.	2	1	1
	Lab 3: Create a registration webpage using html	2	1	1
Unit II	**CSS and JavaScript**	**10**		
	Introduction to CSS	1	2	1, 2
	CSS for background	1	2	1
	Manipulation of texts, fonts, borders etc. using CSS	1	2	1, 2
	Padding lists, positioning elements using CSS	1	2	1, 2
	Introduction to JavaScript	1	2	1
	Functions in JS, modules in JS	1	2	1
	Recursion in JS	2	2	1
	Arrays and Objects in JS	2	2	1, 2
	Lab 4: Webpage creation using CSS	2	2	1,2
	Lab 5: Webpage creation with client-side verification using Javascript	2	2	1,2
Unit III	**Dynamic HTML**	**10**		1
	Dynamic HTML: Object Model and Collections	1	3	1
	Object Referencing	1	3	1, 2
	Dynamic positioning	1	3	1, 2
	Basics of event handling	2	3	1, 2
	Various mouse events	1	3	1, 2
	Form processing	2	3	1
	Dynamic HTML Filters and transitions	1	3	1
	Data binding with tabular data control	1	3	1
	Lab 6 &Lab 7: Dynamic webpage development using HTML, CSS, Javascript with event handling	4	3	1,2
Unit IV	**XML and Document Object Model**	**8**		
	Introduction to XML	1	4	1
	Structuring data in XML, Document Type Definitions (DTDs) and Schemas	1	4	1
	W3C XML Schema Documents, XML Vocabularies	1	4	1
	Document Object Model (DOM) and DOM Methods	1	4	1
	Simple API for XML (SAX)	1	4	1
	Extensible Style sheet Language (XSL)	1	4	1
	Simple Object Access Protocol (SOAP)	1	4	1, 2
	Internet and World Wide Web Resources	1	4	1
	Lab 8 & Lab 9: Practive XML concepts: XML attributes, Namespace, XML HttpRequest, etc.	2	4	1,2
Unit V	**Server-side Programming**	**9**		
	Introduction to Webservers	1	5	1, 2
	HTTP request types	1	5	1
	Basics of server-side scripting	1	5	1
	Accessing Web servers	1	5	1

	Introduction to PHP	1	5	1
	String processing, regular expressions, form processing	2	5	1
	Database connectivity using PHP	1	5	1
	Introduction to web services, REST and SOAP	1	5	1, 2
	Lab 10: Practice server-side scripting using PhP	2	5	1,2
	Lab 11 & Lab 12: Work on a web-application development which uses client-side scripting, server-side scripting with database access.	4	5	1,2
Total Hours		**Theory: 45** **Practical: 24**		

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%)**			
		Theory	**Prac.**	**Theory**	**Prac.**	**Theory**	**Prac.**	**Theory**	**Prac**	**Theory**	**Prac.**
Level 1	Remember	40%		50%		40%		30%		40%	
	Understand										
Level 2	Apply	60%		50%		60%		70%		60%	
	Analyze										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Deitel, H. M., Deitel, P. J., & Nieto, T. R. (2011). Internet and World Wide Web: How to program (5th ed.). PHI.
2. Jackson, J. C. (n.d.). Web technologies: A computer science perspective. Pearson Education.

Other Resources

Course Designers

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

Machine Learning

Course Code	CSC 304	**Course Category**	Speciality Stream Courses (C)	**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. Introduce Machine Learning and various task involved in the pipeline of machine learning application development.
2. Understand a wide variety of regression, classification and clustering algorithms.
3. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
4. Learn the rapid advances in Machine Learning and able to understand the research articles.

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 phases of machine learning application development.	2	75%	75%
Outcome 2	Describe the learning algorithms.	2	75%	70%
Outcome 3	Explain the techniques to deal with data and its dimension.	2	70%	65%
Outcome 4	Develop speech recognition, object recognition and classification models using machine learning algorithms	5	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	-	-	-	-	-	-	-	-	-	3	2	
Outcome 2	3	3	3		2	-	-	-	-	-	-	-	3	3	
Outcome 3	3	3	2	-	-	-	-	-	-	-	-	-	3	2	
Outcome 4	3	3	2	-	-	-	-	-	-	-	-	-	3	3	
Average	**3**	**3**	**3**		**2**								**3**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	UNIT I:	**18**		
1.	**Introduction:** Introduction to Machine Learning	1	1	1
2.	Different types of learning	1	1	1
3.	Different models and Learning algorithm	1	1	1
4.	Hypothesis space and inductive bias	1	1	1
5.	Lab: Introduction to Python basics	2	4	4
6.	Training, Testing, validation of models	1	3	2
7.	Evaluation of the model: Train data, Test data	1	3	2
8.	Evaluation of the model: Cross Validation, Overfitting and Underfitting	1	3	2
9.	Lab: Machine Learning packages in Python	2	4	4
10.	**Regression:** Introduction	1	2	3
11.	Linear Regression: Simple	1	2,4	3
12.	Linear Regression: Multiple	1	2,4	3
13.	Polynomial regression	1	2,4	3
14.	Evaluating regression fit	1	2,4	3
15.	Lab: Implement different types of regression using python	2	4	4
	UNIT II:	**23**		
16.	**Decision tree learning:** Introduction, Decision tree representation	1	2,4	1
17.	appropriate problems for decision tree learning, the basic decision tree algorithm	1	2,4	1
18.	hypothesis space search in decision tree learning, inductive bias in decision tree learning,	1	2,4	1
19.	issues in decision tree learning	1	2,4	1
20.	Decision tree learning (ID3) Algorithm and numerical	1	2,4	1
21.	Lab: Implement ID3 algorithm to construct a decision tree. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	2	4	4
22.	Lab: Write a program that provides option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points	2	4	4
23.	**Instance based Learning:** K nearest neighbour, numerical problem	1	2,4	1
24.	Lab: Implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.	2	4	4
25.	the Curse of Dimensionality, Feature selection	1	2,4	1
26.	Univariate and Multivariate feature selection approaches	1	2,4	1
27.	Lab: Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix	2	4	4
28.	Feature selection techniques	1	2,4	1
29.	Feature reduction: Principal Component Analysis	1	2,4	1
30.	Feature reduction: Principal Component Analysis	1	2,4	1
31.	Lab: Write a program to implement feature reduction using Principle Component Analysis	2	4	4
32.	Feature reduction: Linear Discriminant Analysis	1	2,4	1
33.	**Recommender System:** Content based system, Collaborative filtering based	1	2,4	4
	UNIT III:	**8**		
34.	**Probability and Bayes Learning:** Probability and classification, Bayesian Learning,	1	2	1
35.	Bayes optimal decisions, Naïve Bayes	1	2,4	1

36.	Lab: Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.	2	4	4
37.	**Support Vector Machine:** Introduction, the Dual formulation,	1	2,4	1
38.	Lab: Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate it test performance.	2	4	4
39.	Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem, python exercise on SVM	1	2,4	1
	UNIT IV:	**17**		
40.	**Artificial Neural Networks:** Introduction, , Biological motivation, ANN representation	1	2,4	2
41.	appropriate problem for ANN learning, McCulloh Pitt neuron	1	2,4	2
42.	Peceptron, Perceptron learning, implementation of logic gates using perceptron	1	2,4	2
43.	Problem with perceptron, Gradient descent algorithm	1	2,4	2
44.	Lab: Write a program to implement perceptron for different learning task.	2	4	2
45.	ADALINE and delta rule, implementation of logic gates using ADALINE	1	2,4	2
46.	Problem with ADALINE, Nonlinear classification using ADALINE: Polynomial discriminate function, MADALINE	1	2,4	2
47.	Lab: Write programs to implement ADALINE and MADALINE for given learning task.	2	4	2
48.	multilayer networks and the back propagation algorithm	1	2,4	2
49.	Lab: Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	2	4	2
50.	Radial Basis Function Neural Network	1	2,4	2
51.	Radial Basis Function Neural Network	1	2,4	2
52.	**Introduction to Computational Learning Theory:** Introduction	1	2	1
53.	sample complexity, finite hypothesis space, VC dimension	1	2	1
	UNIT V:	**9**		
54.	**Ensembles:** Introduction, Bagging and boosting, Random Forest	1	2,4	3
55.	Fixed rule fusion techniques, Trained rule fusion techniques	1	2,4	3
56.	Trained rule fusion techniques	1	2,4	3
57.	**Clustering:** Introduction, K-mean clustering	1	2,4	3
58.	Lab: Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K	2	4	4
59.	Hierarchical clustering	1	2,4	3
	Lab: Implementation of hierarchical clustering using python	2	4	5
	Total contact hours	**75**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**					**End Semester Exam (50%)**	
		CLA-1 (5%)	**Mid-1 (10%)**	**CLA-2 (5%)**	**Mid-2 (10%)**	**Practical (20%)**	**Th (30%)**	**Prac (20%)**
Level 1	Remember	70%	50%	40%	40%	20%	40%	30%
	Understand							
Level 2	Apply	30%	50%	60%	40%	30%	40%	30%
	Analyse							
Level 3	Evaluate				20%	50%	20%	40%
	Create							
Total		100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Mitchell, T. (1997). Machine learning (1st ed.). McGraw-Hill.
2. Sivanandam, S. N., & Deepa, S. N. (2011). Principles of soft computing (2nd ed.). Wiley India.
3. Alpaydin, E. (n.d.). Introduction to machine learning (2nd ed.). [Publisher not provided].
4. Swamynathan, M. (2019). Mastering machine learning with Python in six steps: A practical implementation guide to predictive data analytics using Python. Apress

Other Resources

1. Bishop, C. M. (2007). Pattern recognition and machine learning. Springer.

Course Designers

CO-CURRICULAR ACTIVITIES

Course Code	VAC 103	**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	SA	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop essential skills, including leadership, communication, and teamwork, among students.
2. Offer opportunities for students to apply academic concepts in practical, real-world scenarios.
3. Promote self-exploration, confidence-building, and social responsibility.

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 confidence in leading group activities, communicate clearly, and collaborate effectively with diverse teams.	2	80%	75%
Outcome 2	Apply theories to practical tasks by solving problems and adapting concepts to real-life situations through cocurricular activities	2	80%	70%
Outcome 3	Develop new experiences with an open approach through guided reflection to assess personal growth, skills, and learning for holistic development.	3	80%	70%

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments 100%**			
		CLA-1 25%	**CLA-2 25%**	**CLA-3 25%**	**CLA-4 25%**
Level 1	Remember				
	Understand				
Level 2	Apply	15%	15%	15%	15%
	Analyse				
Level 3	Evaluate	10%	10%	10%	10%
	Create				
Total		**25%**	**25%**	**25%**	**25%**

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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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Major Project

Course Code	CSC 402	Course Category	Other Courses (P)	L	T	P	C
				0	0	12	12
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	2	75%	70%
Outcome 2	Devise a plan to do the literature survey on the idea	4	75%	70%
Outcome 3	Formulate the mathematical model for the problem.	3	75%	70%
Outcome 4	Assess the relevance and societal impact of the work	5	70%	65%
Outcome 5	Write a technical paper and report the findings.	6	75%	70%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoningand Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multiculturaland Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3				2		1	2	3	2	1	3	2	2	3
Outcome 2	3	2	2	3	3	1	1	3	3	3	2	3	2	1	3
Outcome 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Outcome 4		2				3	3	3			3	3	2	1	3
Outcome 5	3	1	1	3	3			3	3	3		3	3	3	3
Average	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact hours	CLOs Addressed	References Used
Unit 1	**Conception of Idea**	**60 hours**		
	Based on interest conceive an idea	50 hours	1,4	1
	Do a feasibility check of the project	10 hours	1,4	1
Unit 2	**Submission of Abstract of the idea**	**110 hours**		
	Literature survey of the related works	90 hours	2	1,2,3,4,5
	Write an abstract of the proposed idea	20 hours	2	1
Unit 3	**Formulate the Mathematical model**	**60 hours**		
	Formulate the mathematical model for the considered problem	50 hours	3	1
	Creating timeline for execution of various module of the project.	10 hours	3	1,6
Unit 4	**Conducting Simulations and Publish results**	**220 hours**		
	Execution of the various modules of the project and intermediate report submission.	150 hours	3	1
	Initiation of the process for a possible publication.	70 hours	5	2,3,4,5
Total		**450 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

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Artificial Intelligence

Course Code	CSC 455	Course Category	Specialization Electives (SE)	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. To enhance comprehension of both the theory that underpins and the accomplishments of artificial intelligence.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems.
3. To review the different stages of development of the AI field from human like behaviour to Rational Agents.
4. To impart basic proficiency in representing difficult real-life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
5. To develop an awareness of the fundamental problems with knowledge representation, logic, blind and heuristic search, and other subjects like minimum, resolution, etc. that are crucial to AI systems.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

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	Identify the Intelligent systems and Approaches.	1	75%	65%
Outcome 2	Discuss the building blocks of AI as presented in terms of intelligent agents.	2	75%	65%
Outcome 3	Formalize the problem as a state space, graph, design heuristics and select amongst search or game-based techniques to solve them.	4	75%	65%
Outcome 4	Develop intelligent algorithms for constraint satisfaction problems and intelligent systems for Game Playing.	5	75%	65%
Outcome 5	Implement application-specific intelligent systems	3	75%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	3	3	1			2		2	2	2	2	2
Outcome 2	3	2	3	2	2	1			2		2	3	2	2	2
Outcome 3	3	3	3	3	2	1			2		2	2	2	2	2
Outcome 4	3	3	3	2	3	1			2		3	3	3	2	3
Outcome 5	3	3	3	3	2	1			2		2	3	2	2	2
Outcome 6	3	3	3	3	2	1			2		2	2	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**1**			**2**		**2**	**3**	**2**	**2**	**3**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**9**		
	What is Intelligence.	1	1	1, 2
	Foundations and History of Artificial Intelligence.	1	1	1, 2
	Applications of Artificial Intelligence.	1	2	1, 2
	Types of Different Intelligent system.	1	2	1, 2
	Intelligent Agents, Structure of Intelligent Agents.	1	1, 2	1, 2
	Introduction to Machine Learning and categorization.	1	1, 2	1, 2
	Introduction to Reinforcement Learning.	1	1, 2	1, 2
	Introduction to Deep Learning.	1	1, 2	1, 2
	Introduction to Agents	1	1	1, 2
Unit 2	**Search Mechanisms & Constraint Satisfaction problems.**	**9**		
	Introduction to Search (Single Agent).	1	1	1, 2
	Introduction to Search (Two Agents).	1	1	1, 2
	Introduction to State space.	1	1	1, 2
	Searching for solutions.	1	2, 3	1, 2
	Uniformed search strategies.	1	3, 4	1, 2
	Informed search strategies.	1	3, 4	1, 2
	Local search algorithms and optimistic problems Adversarial Search.	1	3, 4	1, 2
	Least commitment search.	1	3	1, 2
	Constraint satisfaction problems.	1	2	1, 2
Unit 3	**Knowledge Representation and Reasoning**	**9**		
	Propositional Logic and Inference rules.	1	2	1, 2, 3, 4
	Predicate Logic (first order logic).	1	2, 3	1, 2, 3, 4
	Inference in FOL.	1	2, 3	1, 2, 3, 4
	Rule-based system, Logical Reasoning.	1	2, 3	1, 2, 3, 4
	Forward &Backward Chaining.	1	2, 3	1, 2, 3, 4
	Knowledge Resolution.	1	3, 4	1, 2, 3, 4
	AI languages and tools – Lisp.	1	5	1, 2, 3, 4
	AI languages and tools –Prolog.	1	5	1, 2, 3, 4
	AI languages and tools –CLIPS.	1	5	1, 2, 3, 4
Unit 4	**Problem Solving and planning**	**9**		
	Formulating problems.	1	1, 2	1, 2, 3, 4
	Problem types	1	2	1, 2, 3, 4
	Solving Problems by Searching.	1	3, 4	1, 2, 3, 4
	Heuristic search techniques.	2	2, 3	1, 2, 3, 4
	Constraint satisfaction problems.	1	3, 4	1, 2, 3, 4
	Plan space, partial order planning, planning algorithms	1	3, 4	1, 2, 3, 4
	Stochastic search methods.	1	4	1, 2, 3, 4
	Tabu search, best first search.	1	4	1, 2, 3, 4
Unit 5	**Learning**	**9**		
	Overview of different forms of learning, Inductive tree	1	1	1, 2
	Decision trees, rule- Game playing	1	2, 3	1, 2
	Perfect decision game-based learning.	1	2, 3	1, 2
	Neural networks.	1	3, 4, 5	1, 2
	Reinforcement learning.	1	2, 4, 5	1, 2
	Game playing: Perfect decision game.	1	3, 4	1, 2
	Imperfect decision game.	1	3, 4	1, 2
	Evaluation function.	1	3, 4	1, 2
	Minimax, Alpha-beta pruning.	1	4, 6	1, 2
Total Theory Contact Hours		**45**		

Course Unitization Plan – Lab

S.No.	Lab Experiment	Required Contact Hours	CLOs Addressed	References Used
1	Artificial Intelligence Problem identification, PEAS description, and Introduction to PROLOG	2	1	1, 2, 3
2	Study of facts, objects, predicates, variables, arithmetic operators, simple input/output, and compound goals in PROLOG	4	2	1, 2
3	Study of string operations in PROLOG. Implement string operations like substring, string position, palindrome, and implement all set operations (Union, intersection, complement).	4	1, 2	1, 2, 4
4	Write a program for Usage of rules in Prolog. Create a family tree program to include following rules 1. M is the mother of P if she is a parent of P and is female 2. F is the father of P if he is a parent of P and is male 3. X is a sibling of Y if they both have the same parent. 4. Then add rules for grand-parents, uncle-aunt, sister and brother.	4	2, 3	1, 2
5	Write programs for studying Usage of arithmetic operators in Prolog. a) Accept name of the student, roll no, his/her subject name, maximum marks and obtained marks in the subject. (Take marks of atleast 6 subjects). Compute the percentage of a student. Display his result with other information. b) Accept department, designation, name, age, basic salary, house rent allowance (HRA) of an employee. Compute dearness allowance (DA) which is 15% of basic salary. Determine the gross salary (basic salary + HRA + DA) of the employee. Display all information of the employee (Generate Payslip).	4	4	1, 2, 3
6	Implement a program for recursion and list in PROLOG	4	4, 5	1, 2, 4, 5
7	Write a program for studying usage of compound object and list in Prolog. a) Write a program to maintain inventory items using a compound object: i. Accept from user the details of at least 10 objects. ii. Display from user the details of objects entered by user b) Find and display odd and even numbers from a given input list.	4	5	3, 4, 5
8	Write a program to solve the following problems. 1. Write a prolog program to solve “Water Jug Problem”. 2. Write a program to implement a monkey banana problem. 3. Write a program to implement 8 Queens Problem. 4. Write a program to solve traveling salesman problem. 5. Write a program to solve water jug problem using LISP.	4	5, 6	4, 5
Total Lab Contact Hours		**30**		

Learning Assessment (Theory)

Bloom’s Level of Cognitive Task		**Continuous Learning Assessments (30%)**				**End Semester Exam (30%)**
		CLA-1 (10%)	**Mid-1 (10%)**	**CLA-2 (5%)**	**CLA-3 (5%)**	
Level 1	Remember	40%	50%	40%	50%	30%
	Understand					
Level 2	Apply	40%	40%	40%	30%	50%
	Analyse					
Level 3	Evaluate	20%	10%	20%	20%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment (Lab)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (20%)		End Semester Exam (20%)
		Lab Record (5%)	Lab Performance (15%)	
Level 1	Remember	10%	50%	30%
	Understand			
Level 2	Apply	50%	30%	50%
	Analyse			
Level 3	Evaluate	40%	20%	20%
	Create			
Total		**100%**	**100%**	**100%**

Recommended Resources

1. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Prentice Hall.
2. Charniak, E., & McDermott, D. (2002). Introduction to Artificial Intelligence. Pearson Education.
3. Nilsson, N. J. (2002). Artificial Intelligence: A New Synthesis. Morgan Kaufmann.
4. Pearl, J. (2009). Causality: Models, Reasoning and Inference (2nd ed.). Cambridge University Press.
5. Rich, E., Knight, K., & Nair, S. B. (2017). Artificial Intelligence (3rd ed.). McGraw Hill Education.

Other Resources

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Digital Image Processing

Course Code	CSC 456	Course Category	Core Elective (CE)	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	MathWorks License for MATLAB software				

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the overview of the field of image processing.
2. Gain knowledge of the fundamental algorithms and how to implement them.
3. Prepare to read the current image processing research literature.
4. Gain experience in applying image processing algorithms to real 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	Describe the process of image processing and techniques involved in image processing pipeline.	2	75%	75%
Outcome 2	Identify image enhancement techniques.	2	75%	70%
Outcome 3	Illustrate the causes for image degradation and overview of image restoration techniques.	3	70%	65%
Outcome 4	Apply spatial and frequency domain techniques for image compression.	3	70%	65%
Outcome 5	Demonstrate extraction techniques for image analysis and recognition.	3	75%	70%
Outcome 6	Develop an image processing application using feature extraction and representation	5	65%	60%
Outcome 7	Recognize the rapid advances in Machine vision.	2	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	-	-	-	-	-	-	-	-	-	3	2	
Outcome 2	3	3	3		2	-	-	-	-	-	-	-	3	3	
Outcome 3	3	3	2	-	-	-	-	-	-	-	-	-	3	2	
Outcome 4	3	3	2	-	-	-	-	-	-	-	-	-	3	3	
Outcome 5	3	3	2	-	2	-	-	-	-	-	-	-	3	3	
Outcome 6	2	2	3	3	3	-	-	-	-	-	-	-	2	3	
Outcome 7	3	3	1	-	-	-	-	-	-	-	-	-	3	3	
Average	**3**	**3**	**2**	**3**	**2**								**3**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**9**		
	Introduction: What is digital image and DIP? History, Applications of DIP	1	1,7	1
	Key stages of Digital Image processing, Advances in machine vision application domain		1,7	1, 4
	Image sampling and quantization, spatial resolution, intensity resolution	1	1	1
	Relationship between pixels: neighbourhood, adjacency and connectivity, Path, region boundary		1	1
	Connected component labelling, Distance measure: Euclidian, chess board, city block.	1	1	1
	Image acquisition and Pre-processing, Intensity transformations, spatial filtering		2	1
	Image enhancement: Introduction, Point Processing- image negative, log transform, dynamic range compression.	1	2, 6	1
	Power law or gamma Transformation, gamma correction	1	2, 6	1
	Piecewise linear transformation: contrast stretching, threshold, bit-plane slicing		2, 6	1
	Histogram processing: image histogram, histogram equalization	1	2, 6	1
	Numerical on histogram equalization, histogram specification, numerical on histogram specification		2	1
	Spatial filters for smoothing operations: linear filters (average and weighted average), order statistics (nonlinear) filters: median, min, max filters.	1	2, 6, 7	1
	Spatial filters for sharpening operations: Convolution vs. correlation, objective (integration, differentiation, application of sharpening),	1	2, 6	1
	First order and second order derivative operators and their response, Laplacian operator, unsharp masking,	1	2	1
Unit 2	**Filtering in the Frequency Domain, Image Restoration**	**9**		
	Frequency domain approach: low pass filtering, high pass filtering, Laplacian, high boost filtering.	1	2	1, 2, 3
	Image transform and its importance, Fourier transform, 1D FT, 1D Discrete Fourier Transform (DFT)	1	2	1, 2, 3
	2D DFT and its property, Holomorphic filtering	1	2	1, 2, 3
	Image restoration: Fundamentals,	1	3	1, 2, 3
	Noise models, example images affected with noise	1	3	1, 2, 3
	Estimation of noise parameters models	1	3	1, 2
	Restoration in presence of noise (Spatial domain techniques): mean filters, order statistics filters	1	3	1, 2
	Adaptive local noise filter, adaptive median filter	1	3	1, 2
	Estimation of degradation function: (i) by observation, (ii) by experimentation (iii) mathematical modelling	1	3	1, 2
Unit 3	**Image Segmentation**	**9**		
	Image segmentation: Fundamentals, point, line detection,	1	5, 6	1
	Basic edge detection techniques, Hough transform	1	5, 6	1
	Thresholding: Bi-modal and Multi-model Histogram,	1	5	1
	Noise effect on thresholding, Illumination effect on image thresholding	1	5	1

	Basic global thresholding, Optimal thresholding using Otsu's method	1	5	1, 2
	Multi-spectral thresholding, Region based segmentation.	2	5	1, 2
	Region growing, Region splitting and Merging.	2	5	1, 2
Unit 4	**Color Image Processing, Image Compression**	**9**		
	Colour image processing: Fundamentals, motivation, full and pseudo colour image processing	2	5	1
	Components of colour, primary and secondary colours, tristimulus, chromaticity diagram,	1	5	1
	Colour models: RGB, CMY, CMYK, HSI	1	5	1, 3
	Colour conversion, numerical on colour conversion	1	5	1, 3
	Image compression: Motivation, Applications, Compression ratio	1	4	1, 2
	Data redundancy- Coding, Inter-pixel and Psycho-visual redundancy,	1	4	1, 2
	JPEG Coding, Huffman Coding	1	4	1, 2
	LPZ coding, arithmetic coding, lossless and lossy predictive coding	1	4	1, 2
Unit 5	**Image representation and Object Recognition**	**9**		
	Image presentation and description- Introduction, Motivations	2	5	3
	Shape features (Region-based shape representation and descriptors) Area, Euler's number, eccentricity, Elongatedness, rectangularity, direction, compactness. moments, covex hull.	2	5	3
	Texture features, Color features	1	5	3
	Object and Pattern Recognition: Pattern and pattern classes.	1	5	3
	Matching, classifier role minimum distance or nearest neighbor classifier.	1	5	1, 4
	Matching by correlation, Optimum statistical classifier	1	5	1, 4
	Neural network classifier	1	5	1, 4
	Total Contact Hours	45		

Course Unitization Plan - Lab

S. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
		30		
1.	**Lab Experiment 1:** Perform the following operations using library functions a. Read, Display and write any color image in other formats. b. Find RED, GREEN and BLUE plane of the color image. c. Convert color image to grayscale image and binary image d. Resize the image by one half and one quarter. i.e. Image rotates by 45, 90 and 180 degrees.	2	1	1
2.	**Lab Experiment 2:** Create black and white images (A) of size 1024x1024. Which consists of alternative horizontal lines of black and white? Each line is of size 128. Create black and white images (B) of size 1024x1024. Which consists of alternative vertical lines of black and white? Each line is of size128. Perform the following operations on Image A and Image B. a. Image addition of A and B b. Subtraction of A and B c. Multiplying Images of A and B d. Create a grayscale image of size 256 x 1024. Intensity of image should vary sinusoidally. e. Create a white image of size 256x256, with black box of size 58x58 at centre.	2	1	1
3.	**Lab Experiment 3:**	3	2,3	1

	Develop programs for following intensity transformation operation on a grayscale image. Collect any gray scale image from any source. Process that image using these operations. a. Image negative b. Log transformation and inverse log transform: s = c log (1+r), c is a const, r ≥ 0. s is pixel intensity of output image, r is the pixel intensity of input image. Study the effect of constant c on the quality of output image. c. Power law transformation: Study the effect of different values of Gamma used in this transformation. d. Contrast stretching e. Gray level slicing			
4.	**Lab Experiment 4:** Develop programs for following spatial filtering operations on a grayscale image. a. Averaging: Implement averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality. b. Weighted averaging: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality. c. Median filtering: Implement weighted averaging filtering operations for different window sizes and study their effect on the quality of output image. Write your observations on output image quality. d. Max filtering e. Min filtering	3	4,5	4
5.	**Lab Experiment 5:** Take a grayscale image and add salt and pepper noise. Write programs for following operations and observe their outputs a. Linear smoothing or Image averaging b. Weighted averaging c. Median filtering. Compare the output quality among Image averaging and median filtering. d. Max filtering e. Min filtering	4	2,6	1
6.	**Lab Experiment 6:** Write programs to perform following sharpening operations on a grayscale image a. Laplacian filter b. Filtering using composite mask c. Unsharp masking d. High boost filtering e. Filtering using first order derivative operators such as sobel and prewitt mask.	4	2,6	1
7.	**Lab Experiment 7:** Write a program to improve contrast of an image using histogram equalization. The prototype of the function is as below: histogram_equalisation(input_Image, no_of_bins); The function should return the enhanced image. Consider two low contrast input images. Study the nature of the output image quality in each case by varying the number of bins.	3	2	1
8.	**Lab Experiment 8:** Take a low contrast grayscale image (A) and a high contrast gray scale image (B). Write a program to improve the contrast of A with the help of image B using histogram specification or matching. The prototype of the function is as below: Histogram_sp(input_Image,	3	2	1

	specified_Iage, no_of_bins); The function should return the enhanced image.			
9.	**Lab Experiment 9:** Develop programs to implement frequency domain smoothing filters (Ideal, Butterworth and Gaussian) and apply these filters on a grayscale image. a. Compare/comment on the output of Ideal, Butterworth and Gaussian Low pass Filters having the same radii (cutoff frequency) value. b. Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal low pass frequency domain filter. c. Compare the output of Butterworth low pass filters (order n=2) for different cutoff frequencies (5, 15, 30, 90, 120). d. Compare the output of Gaussian low pass filters for different cut-off frequencies (5, 15, 30, 90, and 120).	3	2	1,2,3
10.	**Lab Experiment 10:** Develop programs to implement frequency domain sharpening/High pass filters (Ideal, Butterworth and Gaussian) and apply these filters on a grayscale image. a. Compare/comment on the output of Ideal, Butterworth and Gaussian High pass Filters having the same radii (cutoff frequency) value. b. Consider a suitable gray scale image and demonstrate the ringing effect on the output of Ideal high pass frequency domain filter. c. Compare the output of Butterworth high pass filters (order n=2) for different cut-off frequencies (5, 15, 30, 90, 120). d. Compare the output of Gaussian high pass filters for different cut-off frequencies (5, 15, 30, 90, and 120).	3	2	1,2,3
Total Contact Hours		30		

Learning Assessment (Theory)

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

Learning Assessment Lab

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

Recommended Resources

1. Gonzalez, R. C. (2009). Digital image processing. Pearson education India.
2. Sridhar, S. (2016) Digital Image Processing, Oxford University Press.
3. Sonka, M., Hlavac, V., & Boyle, R. (2013). Image processing, analysis and machine vision. Springer.
4. Forsyth, D. A., & Ponce, J. (2002). Computer vision: a modern approach. prentice hall professional technical reference.

Other Resources

Course Designers

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

Deep Learning

Course Code	CSC 457	Course Category	Core Elective (CE)	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. Understand the fundamental concepts of ML/DL, tensor flow, and keras.
2. Study of different activation functions and ANN.
3. Study and application of CNN, and RNN models
4. Application of different deep learning concepts.

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	Illustrate the concepts of ML/DL	1	70%	68%
Outcome 2	Design and implement CNN model	2	70%	65%
Outcome 3	Design and implement RNN model	2	70%	65%
Outcome 4	Apply deep learning models to given problems.	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	1	1	1	2								2	2	2
Outcome 2	2	2	3	2	3								3	2	2
Outcome 3	2	2	3	2	3								2	3	2
Outcome 4	2	2	3	3	3								2	3	2
Average	**2**	**2**	**3**	**2**	**3**								**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction:**	**18**		
	Overview of machine learning	2	1	1
	Linear classifiers, loss functions	1	1	1
	Lab 1: To implement a Multilayer Perceptron (MLP) using Keras with TensorFlow, and fine-tune neural network hyperparameters for regression problem (house price prediction	2	1	1
	Introduction to TensorFlow:	1	1	1
	Computational Graph, Key highlights, Creating a Graph	2	1	1
	Regression example	1	1	1
	Gradient Descent	1	1	1
	TensorBoard	2	1	1
	Lab 2: To implement a MLP using Keras with TensorFlow for classification problem (heart disease prediction).	2	1	1
	Modularity, Sharing Variables	1	1	1
	Keras	1	4	3
	Lab 3: To implement a Convolution Neural Network (CNN) for dog/cat classification problem using TensorFlow/Keras.	2	1	1
Unit 2	**ACTIVATION FUNCTIONS , PERCEPTRON, ANN**	**11**		
	Activation Functions: Sigmoid, ReLU, Hyperbolic Fns, Softmax	2	1	1,2
	Lab 4: To implement a CNN for handwritten digit recognition.	2	1	1
	Perceptrons: What is a Perceptron, XOR Gate	1	1	1
	Artificial Neural Networks: Introduction	1	1	2
	Perceptron Training Rule	2	1	2
	Gradient Descent Rule	1	1	2
	Vanishing gradient problem and solution	1	1	2
Unit 3	**Convolutional Neural Networks**	**14**		
	Introduction to CNNs	2	1,2	3
	Kernel filter	1	1,2	3
	Lab 5: To Implement a CNN for object detection in the given image.	2	1	1
	Principles behind CNNs	1	1,2	3
	Long Short-Term Memory (LSTM)	2	1,2	3
	Lab 6: To implement a Long Short-Term Memory (LSTM) for predicting time series data.	2		
	Problem and solution of under fitting and overfitting	2	1,2	3
	Lab 7: To implement a Seq2Seq Model for Neural Machine Translation.	2	1	1
Unit 4	**Recurrent Neural Networks**	**14**		
	Introduction to RNNs	2	1,3	2
	Lab 8: To implement a Recurrent Neural Network (RNN) for predicting time series data.	2	1	1
	Unfolded RNNs	1	1,3	2
	Seq2Seq RNNs	1	1,3	2
	LSTM	2	1,3	2
	GRU	2	1,3	2
	Encoder Decoder architectures	2	1,3	2

	Lab 9: To implement an Encoder-Decoder Recurrent neural network model for Neural Machine Translation.	2	1	1
Unit 5	**Deep Learning applications**	**13**		
	Image segmentation	1	4	3
	Self-Driving Cars	1	4	3
	Case Study 1: Object detection for Self-Driving Cars	2	1	1
	News Aggregation and Fraud News Detection	1	4	3
	Natural Language Processing	1	4	3
	Case Study 2: Object detection for Healthcare images	2	1	1
	Virtual Assistants	1	4	3
	Entertainment	1	4	3
	Visual Recognition	1	4	3
	Fraud Detection, Healthcare	2	4	3
	Total Contact Hours	**70**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**	
		CLA-1		**Mid-1 (15%)**		**CLA-2**		**CLA-3**			
		Th (5%)	**Prac**	**Th**	**Prac**	**Th (5%)**	**Prac**	**Th (10%)**	**Prac (15%)**	**Th (35%)**	**Prac (15%)**
Level 1	Remember	40%		40%		20%		10%	10%	10%	10%
	Understand										
Level 2	Apply	30%		30%		40%		50%	40%	40%	40%
	Analyse										
Level 3	Evaluate	30%		30%		40%		40%	50%	50%	50%
	Create										
Total		**100%**		**100%**		**100%**		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Buduma, Nikhil, and Nicholas Locascio (2017). Fundamentals of deep learning: Designing next-generation machine intelligence algorithms. " O'Reilly Media, Inc.".
2. Goodfellow, I., Bengio,Y., and Courville, A., (2016). Deep Learning, MIT Press.
3. Josh Patterson, Adam Gibson, (2017). Deep Learning: A Practitioner's Approach, OReilly.

Other Resources

1. Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017
2. https://www.youtube.com/watch?v=aPfkYu_qiF4&list=PLyqSpQzTE6M9gCgajvQbc68Hk_JKGBAYT
3. https://www.coursera.org/professional-certificates/tensorflow

Course Designers

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Principles of Soft Computing

Course Code	CSC 458	Course Category	Specialization Electives (SE)	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. 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 neural network model	3	90%	75%
Outcome 2	Describe neural network architectures, algorithms, applications and their limitations	2	70%	65%
Outcome 3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems	3	80%	75%
Outcome 4	Apply genetic algorithms to combinatorial optimization problems	3	80%	75%
Outcome 5	Evaluate and compare solutions by genetic algorithms with traditional approaches for a given problem.	5	65%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	2	1	2	1	1	2	3	2	1	3	3	2	1
Outcome 2	3	2	1	2	2	2	2	2	3	3	2	3	3	2	1
Outcome 3	3	3	3	2	2	2	2	2	3	3	2	3	3	2	2
Outcome 4	3	3	3	2	3	2	2	2	3	3	2	3	3	3	2
Outcome 5	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
Average	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to Soft Computing, ANN**	**9**		
	Introduction to Soft Computing, Artificial Neural Network (ANN)	1	1	1
	Fundamentals of ANN, Basic Models of an artificial Neuron, Neural Network Architecture	1	1,2	1
	Learning methods, Terminologies of ANN	1	1	1,3
	Hebb network	1	2	1,3
	Supervised Learning Networks: Perceptron, Adaline, Madaline	1	1	1
	Multi-Layer Perceptron	1	1,2	1
	Feed forward Back propagation Network	1	1,2	1
	Back propagation learning	1	1,2	1
	Learning Effect of Tuning parameters of the Back propagation	1	2,5	1
Unit II	**Advanced Neural Network**	**9**		
	RBF Network, Associative memory:	1	2	1,3
	Auto, hetero and linear associative memory network	1	2	1,3
	Adaptive Resonance Theory: ART1	1	2	1,3
	ART2	1	2	1,3
	Introduction to Computer vision	1	2	1,3
	Introduction to Convolutional Neural Network	1	2	1,3
	Popular architectures: AlexNet	1	2,5	1,3
	GoogleNet	1	2,5	1,3
	VGG Net	1	2,5	1,3
Unit III	**Fuzzy Logic**	**9**		
	FUZZY LOGIC : Fuzzy set theory:	1	3	2
	Crisp sets, fuzzy sets	1	3	2
	Crisp relations, fuzzy relations	1	3	2
	Fuzzy Systems	1	3	2,3
	Crisp logic, predicate logic	1	3	2,3
	Fuzzy logic	1	3	2,3
	fuzzy Rule based system	1	3,5	2,3
	Defuzzification Methods	1	3	2,3
	Fuzzy rule-based reasoning	1	3,5	2,3
Unit IV	**Genetic Algorithms**	**9**		
	Genetic Algorithms: Fundamentals of genetic algorithms:	1	4	3
	Encoding, Fitness functions, Reproduction.	1	4	3
	Genetic Modeling : Cross cover, Inversion and deletion	1	4	3
	Mutation operator, Bit-wise operators, Bitwise operators used in GA.	1	4	3
	Convergence of Genetic algorithm.	1	4	3
	Applications of Genetic Algorithms	1	4,5	3
	Real life Problems of Genetic Algorithms	1	5	3
	Particle Swarm Optimization	1	4,5	3
	Variants of PSO	1	4	3
Unit V	**Advanced Soft Computing**	**9**		
	Hybrid Soft Computing Techniques Hybrid system	1	4	2,3
	Advanced neural Networks	1	2	1,3
	Fuzzy logic and Genetic algorithms hybrids.	1	3,4	2,3
	Genetic Algorithm based Back propagation Networks	1	1,4	2,3
	GA based weight determination applications	1	4,5	2,3
	Fuzzy logic controlled genetic Algorithms	1	3,4	2,3
	Soft computing tools	1	5	3
	Soft computing Applications	2	5	3
	Total contact hours	**45**		

Course Unitization Plan - Lab

Unit No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
	Introduction to Soft Computing and ANN			
Unit I	Write a Python Program to implement a perceptron. The input is your semester marks.	1	1	1,3
	Write a python program to extend the exercise given above to implement Feed Forward Network. The inbuilt function should not be used.	2	1,2	1,3
	Write a python program to implement Hebb Network. The inbuilt function should not be used.	2	1,2	1,3
	Write a python program to implement Multilayer Perceptron. The inbuilt function should not be used.	2	2	1,3
	Write a python program to implement any ANN with back propagation learning Algorithm.	2	1,2	1,3
Unit II	**Advanced Neural Network**			
	Write a Python Program to implement ART1 and ART 2.	2	2	1,3
	Write a python program to implement CNN.	2	2	1,3
	Write a python Programming to realize the working principles of popular architectures such as AlexNet, GoogleNet and VGG Net.	2	2	1,3
Unit III	**Fuzzy Logic**			
	Write python Program to realize Fuzzy Sets arithmetic.	2	2	2,3
	Write a python Program to realize fuzzy relations.	1	2	2,3
	Write a python program to realize a fuzzy rule of any popular problem (s).	2	3	2,3
	Write a python program to realize a defuzzification scheme for the above exercise.	2	3	2,3
	Write a python Program to reason the fuzzy rules in exercises 12 and 13.	2	3	2,3
Unit IV	**Genetic Algorithms**			
	Write a python program to realize various steps of Genetic Algorithms.	2	4	3
	Write a Python Program to realize GA based back propagation Networks.	2	4,5	3
Unit V	**Advanced Soft Computing**			
	Write a Python Program to realize Fuzzy Controlled Genetic Algorithms.	2	4,5	1,3
	Total contact hours	**30**		

Learning Assessment (Theory)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (20%)		Mid-1 (20%)		CLA-2 (5%)		CLA-3 (5%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		40%	
	Understand										
Level 2	Apply	40%		40%		40%		40%		40%	
	Analyse										
Level 3	Evaluate	20%		20%		20%		20%		20%	
	Create										
Total		100%		100%		100%		100%		100%	

Learning Assessment (Lab)

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%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember		50%		40%		20%		20%		10%
	Understand										
Level 2	Apply		50%		60%		60%		60%		60%
	Analyse										
Level 3	Evaluate						20%		20%		30%
	Create										
Total			100%		100%		100%		100%		100%

Recommended Resources

1. Sivanandan, S. N. and Deepa, S. N. (2011). Principles of Soft Computing Willey India, 2nd Edition.
2. Jang, J. S. R. (1997). Neuro-Fuzzy and Soft Computing/J.-SR Jang, C.-T. Sun, E. Mizutani. A Compute. Approach to Learn. Mach. Intell. Saddle River, NJ Prentice Hall, Inc.
3. Rajasekaran, S., & Pai, G. V. (2003). Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). PHI Learning Pvt. Ltd..

Other Resources

Course Designers

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

Data Warehousing and Mining

Course Code	CSC 463	**Course Category**	Stream Elective (SE)	**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. To introduce the basic concepts of Data Warehouse and Data Mining techniques.
2. Examine the types of data to be mined and apply pre-processing methods on raw data.
3. Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
4. Learn various data mining algorithms and its application domain.
5. Understand the latest trends of research in data mining.

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 can be able to **identify** methods to create a data warehouse and pre-process the real world data to make it suitable for various data mining algorithms.	2	75%	70%
Outcome 2	Students can be able to ***implement*** models to measure interesting patterns from different kinds of databases.	5	75%	70%
Outcome 3	Students can be able to ***design***, ***develop*** and ***model*** various techniques such as clustering, classification, and association mining of real world data for public health and safety, and the cultural, societal, and environmental considerations.	3	70%	60%
Outcome 4	Acquire the knowledge of advanced trends in data mining.	4	70%	60%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	1	2		1									1		3
Outcome 2	2	2	3	3									3	2	3
Outcome 3	2	2	3	3									3	2	3
Outcome 4	2	2	2	3									3	2	3
Average	**2**	**2**	**3**	**3**									**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**7**		
	Data Warehousing and online analytical processing.	1	1	1
	Data Warehouse Modelling.	3	1	1, 2
	Data Warehouse Implementation.	3	1	1, 2
	Lab Experiment 1: Implementation of OLAP operations	2	1	1,5
Unit 2	**Association Rules in Knowledge Discovery**	**8**		
	Introduction, Market-Basket Analysis	1	1	1
	Mining Frequent Patterns, Associations, and Correlations, Apriori Algorithm	1	1	1
	Pattern-Growth Approach for Mining Frequent Itemsets	1	1	1
	Mining Frequent Itemsets using Vertical Data Format, Mining Closed and Max Patterns	1	1, 2	1
	Pattern Mining in Multilevel, Multidimensional Space	1	1, 2	1
	Constraint-Based Frequent Pattern Mining	1	1, 2	1
	Mining High-Dimensional Data and Colossal Patterns	1	1, 2	1
	Mining Compressed or Approximate Patterns	1	1, 2	1
	Lab Experiment 2: Data pre-processing techniques. **Lab Experiment 3:** Write a program in any programming language to generate at least 10,000 transactions in a text file with at least three items. **Lab Experiment 4:** Write a program to implement the APRIORI algorithm **Lab Experiment 5:** Write a program for FP-Growth algorithm.	2	1	1,2,3,4
Unit 3	**Classification**	**10**		
	Basic Concepts, Decision Tree Induction	2	1, 3	1
	Bayes Classification Methods: Bayes' Theorem, Na¨ıve Bayesian Classification, Rule-Based Classification	2	1, 3	1
	Model Evaluation and Selection	1	1, 3	1
	Bagging, Boosting and AdaBoost, Random Forests	2	1, 3	1, 3
	Improving Classification Accuracy of Class-Imbalanced Data	1	1, 3	1
	Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches	2	1, 3	1, 2
	Lab Experiment 8: Write a program to implement Decision tree-based classification. **Lab Experiment 9:** Write a program to implement Bayesian classification	2	2,3	1,2,3,4
Unit 4	**Cluster Analysis**	**10**		
	Introduction, k-Means, k-Medoids	2	1, 4	1
	Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods	2	1, 4	1
	Multiphase Hierarchical Clustering Using Clustering, Feature Trees	2	1, 4	1
	Multiphase Hierarchical Clustering Using Dynamic Modelling, Probabilistic Hierarchical Clustering	2	1, 4	1
	Density-Based Methods, Grid-Based Methods	2	1, 4	1
	Lab Experiment 10: Write a program to implement K-means clustering. **Lab Experiment 11**: Write a program to implement Divisive clustering **Lab Experiment 12**: Write a program to implement Agglomerative clustering **Lab Experiment 13:** Write a program to implement DBSCAN clustering	2	2,3	1,2,3,4
Unit 5	**Data Warehouse Trends and Research Frontiers**	**10**		
	Mining complex data type.	3	1, 5	1
	Data Mining Applications	3	1, 5	1
	Data Mining and Society.	2	1, 5	1
	Data Mining Trends	2	1, 5	1, 2, 3
	Case Study	**2**	2,3	1,2,3,4

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%	50%	40%	40%	30%	30%	30%	30%	30%	30%
	Understand										
Level 2	Apply	20%	30%	40%	40%	50%	50%	40%	50%	50%	50%
	Analyse										
Level 3	Evaluate	10%	20%	20%	20%	20%	20%	30%	20%	20%	20%
	Create										
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Data Mining Concepts and Techniques, Third Edition, by Jiawei Han, Micheline Kamber, and Jian Pei.
2. Olson DL, Delen D. Advanced data mining techniques. Springer Science & Business Media.
3. Aggarwal CC. Data mining: the textbook. Springer. William

Other Resources

Course Designers

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

Applied Data Science

Course Code	CSC 464	Course Category	Stream Elective (SE)	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)	CSE 411		
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the skill sets and technologies required for data science.
2. Gain knowledge of data science process and basic tools for Exploratory Data Analysis
3. Learn various data science algorithms and its application domain.
4. Understand the implement recommendation system using fundamental mathematical and algorithmic ingredients.
5. Understand the use of data visualization tool.

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	Apply statistical measures to fit a model to a data.	2	75%	70%
Outcome 2	Apply data science algorithms such as Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes to solve the given real-world problems.	5	75%	70%
Outcome 3	Apply Feature Selection algorithms such as Filters, Wrappers, Decision Trees, Random Forests to solve a given problem	3	70%	60%
Outcome 4	Acquire real world data from different sources to build Recommendation Systems as well as represent knowledge using Visualization tools.	4	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2		1									1		3
Outcome 2	2	2	3	3									3	2	3
Outcome 3	2	2	3	3									3	2	3
Outcome 4	2	2	2	3									3	2	3
Average	**2**	**2**	**3**	**3**									**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1		**13**		
	Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now?	2	1	1,2,3,6,8
	Datafication- Current landscape of perspectives	1	1	1,2,3,5,9,10
	Skill sets needed	1	1	1,2
	Statistical Inference - Populations and samples	1	1	1,2,6,9
	Statistical modelling,	1	1	1,2,6,9
	probability distributions,	1	1	1,2,6,9
	fitting a model	1	1	1,2,6,9
	Introduction to R	1	1	1,2,8
	Lab Experiment 1: Write R program to calculate the central tendency of any popular data set. The inbuilt functions in the python should not be used.	2	3	2
	Lab Experiment 2: Write R – Programming to plot various charts and graphs. You have to consider minimum two popular data sets and draw all the statistical observations.	2	3	2
Unit 2		**17**		
	Exploratory Data Analysis and the Data Science Process	2	1	1,2,3
	Philosophy of EDA - The Data Science Process	2	1	1,2,3
	The Data Science Process	1	1	1,2,6
	Three Basic Machine Learning Algorithms – Introduction	1	1, 2	1-10
	Linear Regression	1	1, 2	5,7
	K-Nearest Neighbours (K-NN)	1	1, 2	5,7
	K-means	1	1, 2	5,7
	Lab Experiment 3: Write a R Program to apply EDA on any two popular data sets and provided your analysis and interpretations. Use matplotlib library of python along with other libraries for the analysis and interpretation.	2	2	3
	Lab Experiment 4: Write R program to implement Linear Regression. Also, write your own program to implement Linear Regression without using the inbuilt function. Compare and contrast the results.	2	2	5
	Lab Experiment 5: Write R program to implement K-Nearest Neighbors. Also, write your own program to implement K-Nearest Neighbors without using the inbuilt function. Compare and contrast the results.	2	2	5
	Lab Experiment 6: Write R program to implement K-Means using inbuilt Library. Also, write your own program to implement K-Means without using the inbuilt function. Compare and contrast the results.	2	3	5
Unit 3		**19**		
	One More Machine Learning Algorithm and Usage in Applications	**1**	2	5,7
	Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam	1	1, 2	5,7,9,10
	Naive Bayes and why it works for Filtering Spam	1	1, 2	5,7
	Data Wrangling: APIs and other tools for scrapping the Web	1	1, 2	4-10
	Feature Generation and Feature Selection (Extracting Meaning From Data)	1	3	4-10
	Motivating application: user (customer) retention	1	3	4-10
	Feature Generation (brainstorming, role of domain expertise, and place for imagination) -	1	3	4-10

	Feature Selection algorithms	1	3	4-10
	Filters; Wrappers; Decision Trees; Random Forests	1	3	4-10
	Lab Experiment 7: Write a R program to implement a Spam Filter using Linear Regression and K-NN. Use a popular dataset.	2	3	5
	Lab Experiment 8: Write a R Program to Scrapping the Web using suitable API. Create a usable dataset for classification and clustering purpose.	2	3	5
	Lab Experiment 9: Write a R program to generate the features from the data set created by you for Lab experiment 8.	2	3	5
	Lab Experiment 10: Write a R Program to implement Filter and Wrappers.	2	3	5
	Lab Experiment 11: Write a R Program to implement Decision Trees, Random Forests – The inbuilt functions should not be used for the implementation.	2	3	5
Unit 4		**15**		
	Recommendation Systems: Building a User-Facing Data Product	2	4	1,2,8
	Algorithmic ingredients of a Recommendation Engine	1	4	1,2,8
	Dimensionality Reduction	2	4	8,9
	Singular Value Decomposition - Principal Component Analysis -	1	4	8,9
	Mining Social-Network Graphs	1	4	8,9
	Clustering of graphs - Direct discovery of communities in graphs	1	4	8,9
	Partitioning of graphs - Neighbourhood properties in graphs	1	4	8,9
	Lab Experiment 12: Write a R Program to implement Singular Value Decomposition and Principal Component Analysis. Use any popular data set.	2	4	8
	Lab Experiment 13: Write a R Program to extract the friendship details of your face book account as Social network Graph and represent in various visual forms.	2	4	8
	Lab Experiment 14: Write a R program to extend the above exercise to discover the communities in the graph, partition the graph and extracting the neighbourhood properties of the graphs.	2	4	8
Unit 5		**11**		
	Data Visualization	1	4	1,2,3,6
	Basic principles, ideas and tools for data visualization	2	4	1,2,3,6
	Examples of inspiring (industry) projects -	2	4	1,2,3,6
	Data Science and Ethical Issues	1	4	1,2,3,6
	Discussions on privacy, security, ethics	1	4	1,2,3,6
	A look back at Data Science	1	4	1,2,3,6
	Next-generation data scientists	1	4	1,2,3,6
	Lab Experiment 15: Write R Program using Bokeh 2.1.1 to realize the all the basic principles of data visualization.	2	4	2

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%	50%	40%	40%	30%	30%	30%	30%	30%	30%
	Understand										
Level 2	Apply	20%	30%	40%	40%	50%	50%	40%	50%	50%	50%
	Analyse										
Level 3	Evaluate	10%	20%	20%	20%	20%	20%	30%	20%	20%	20%
	Create										
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Grus, J. (2019). Data science from scratch: first principles with python. O'Reilly Media.
2. VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. " O'Reilly Media, Inc.".
3. O'Neil, C., & Schutt, R. (2013). Doing data science: Straight talk from the frontline. " O'Reilly Media, Inc.".
4. Rajaraman, A., & Ullman, J. D. (2011). Mining of massive datasets. Autoedicion.
5. Murphy, K. P. (2012). Machine learning: a probabilistic perspective. MIT press.
6. Provost, F., & Fawcett, T. (2013). Data Science for Business: What you need to know about data mining and data-analytic thinking. " O'Reilly Media, Inc.".
7. Hastie, T., Tibshirani, R., Friedman, J. H., & Friedman, J. H. (2009). The elements of statistical learning: data mining, inference, and prediction (Vol. 2, pp. 1-758). New York: springer.
8. Blum, A., Hopcroft, J., & Kannan, R. (2020). Foundations of data science. Cambridge University Press.
9. Zaki, M. J., & Meira, W. (2014). Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press.
10. Han, J., Kamber, M., & Pei, J. (2012). Data Mining: Concepts and. Techniques, Waltham: Morgan Kaufmann Publishers.

Other Resources

Course Designers

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

Principles of Big Data Management

Course Code	CSC 465	**Course Category**	Specialization Electives (SE)	**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. Understand the Big Data Platform and its Use cases.
2. Learn the overview of Apache Hadoop.
3. Gain knowledge of Flume-Sqoop-Pig-Spark-HBase
4. Understanding the querying bigdata with Hive.
5. Learning Data Manipulation using Hive QL Queries
6. Exposure to Big Data Analytics using R. Creating Graphs, data management.

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	Identify Big Data and its Business Implications	2	70%	65%
Outcome 2	List the components of Hadoop and Hadoop Eco-System	1	70%	65%
Outcome 3	Access and Process Data on Distributed File System	2	70%	65%
Outcome 4	Analyse Job Execution in Hadoop Environment	4	70%	65%
Outcome 5	Develop Big Data Solutions using Hadoop Eco System	4	70%	65%
Outcome 6	Apply Machine Learning Techniques using R	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1		1										1	2	2
Outcome 2	2		1	1	3							1	3	2	2
Outcome 3	1	2	2	2	3							1	3	3	3
Outcome 4	1	2	2	2	3							1	3	3	3
Outcome 5	2	2	3	2	3							1	3	3	3
Outcome 6	2	2	2	2	3				2			1	3	3	3
Average	**2**	**2**	**2**	**2**	**3**				**2**			**1**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I		**9**		
1	Big Data introduction – Concepts and Terminology	1	1	1
2	Different types of Big Data	1	1	1
3	Big Data Storage concepts, clusters	1	2	1,2,3
4	Introduction to Distributed computing	1	3	1,2,3
5	Introduction to Hadoop	1	2	1,2,3
6	Hadoop Distributed File System (HDFS) Architecture	1	3	1,2,3
7	HDFS commands for loading/getting data	1	3	1,2,3
8	Accessing HDFS through Java program	2	3	1,2,3
Unit II		**9**		
9	Concepts of Big Data processing	1	4	2,3
10	Parallel Data Processing	1	4	2,3
11	Distributed Data Processing	1	4	2,3
12	Hadoop processing, processing workloads	2	4	2,3
13	Batch processing with map reduce	2	4	2,3
14	Map and reduce tasks	1	4	2,3
15	Examples of map reduce	1	4	2,3
Unit III		**7**		
16	Hadoop ecosystem components: Flume	2	5	4,5
17	Hadoop ecosystem components: Sqoop, Pig	2	5	4,5
18	Hadoop ecosystem components: Spark, Hbase	3	5	4,5
.Unit IV		**7**		
19.	Introduction to Hive-QL	2	5	4,5
20.	Data definition Hive QL	2	5	4,5
21.	Data Manipulation, Hive QL Queries	3	5	4,5
Unit V		**13**		
22.	Data Analytics using R: Introduction to R	3	6	6,7
23.	Creating a dataset	2	6	6,7
24.	Getting started with graphs	2	6	6,7
25.	Basic data management	4	6	6,7
26.	Advanced data management	3	6	6,7
Total Contact Hours		**45**		

Course Unitization Plan - Lab

Session No.	Description of Experiments	Required Contact Hours	CLOs Addressed	References Used
1.	a. Hadoop Installation b. Hadoop Shell Commands	4	2	1,2
2.	a. Writing a file from local file system to Hadoop Distributed file system (HDFS) b. Reading a file from HDFS to local file system.	4	3	2,3
3.	a. Implementation of Word Count program using MapReduce without combiner logic. b. Implementation of Word Count program using MapReduce with combiner logic**.**	3	4	2,3
4.	Implementation of MapReduce algorithm for Matrix Multiplication.	3	4	3

5.	Use HiveQL to analyze the stock exchange dataset and calculate the covariance between the stocks for each month. This will help a stock-broker in recommending the stocks to his customers.	4	5	4
6.	Implement JOINS using HIVE a. Inner Join b. Left outer join c. Right outer Join d. Full outer join	3	5	4,5
7.	Write a R program to create student record using Vector concept.	3	6	6
8.	Write a R program to create medical patients' status using data frame i) Patient age ii) Gender iii) Symptoms iv) Patient Status	3	6	6,7
9.	Write a R program to visualize student marks of various subjects using Bar-chart and Scatter plot.	3	6	7
Total Contact Hours		**30**		

Learning Assessment (Theory)

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

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**				**End Semester Exam (50%)**
		Mid-Term (20%)	**CLA-I (20%)**	**CLA-II (5%)**	**CLA-III (5%)**	
Level 1	Remember	40%	50%	40%	40%	30%
	Understand					
Level 2	Apply	60%	50%	60%	60%	70%
	Analyse					
Leve 3	Evaluate					
	Create					
Total		100%	100%	100 %	100%	100%

Recommended Resources

1. Erl, T., Khattak, W., & Buhler, P. (2016). Big data fundamentals: concepts, drivers & techniques. Prentice Hall Press.
2. White, T. (2012). Hadoop: The definitive guide. " O'Reilly Media, Inc.".
3. Lam, C. (2010). Hadoop in action. Simon and Schuster.
4. Capriolo, E., Wampler, D., & Rutherglen, J. (2012). Programming hive. " O'Reilly Media, Inc.".
5. Bansal, H., Chauhan, S., & Mehrotra, S. (2016). Apache Hive Cookbook. Packt Publishing Ltd.
6. Kabacoff, R. (2022). R in action: data analysis and graphics with R and Tidyverse. Simon and Schuster.
7. Mount, J., & Zumel, N. (2019). Practical data science with R. Simon and Schuster.

Other Resources

Course Designers

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

Information Retrieval

Course Code	CSC 466	Course Category	Stream Elective (SE)	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. To learn the major milestones of historical development of IR systems.
2. To learn an architecture of a generic IR system and how to build one from scratch.
3. To understand how users interact with IR systems and how to maximize their satisfaction.
4. To learn the major theories and algorithms that are powering the modern search engines.
5. To gain hands-on experience in developing a working IR system.

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 understand and implement the basic concepts in indexing and its compressed construction	3	70%	60%
Outcome 2	Students will understand and implement the statistical IR models such as Probabilistic model, vector-space model, and language models.	3	70%	60%
Outcome 3	Students will build a document retrieval system through the practical sessions, including the implementation of a relevance feedback mechanism.	3	70%	60%
Outcome 4	Students will implement the Text/Document classification and clustering algorithms	4	70%	60%
Outcome 5	Students will understand the issues involved IR techniques for the web including crawling, link-based algorithms.	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2												1	3	
Outcome 2	2	2	3	2	3							1	3	3	
Outcome 3	2	2	3	2	3							1	3	3	
Outcome 4	1	2	2	2	3							1	3	3	
Outcome 5	1	2	2	2	3							1	3	3	
Average	**2**	**2**	**3**	**2**	**3**							**1**	**3**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**INTRODUCTION TO IR**	**9L hrs**		
	IR Problem, IR System, The Web	1	1	1
	Search Interface, Visualizing Search Interface	1	1	1
	Inverted Index and Boolean Queries	1	1	1
	Tokenization, Stemming, Stop-words, Phrases, Phrasal Queries	1	1	1
	Index Construction	2	1	2
	Index Compression	2	1	2
	k-gram Indexes	1	1	1
		12P hrs		
	Lab Experiment: Tokenization, Stemming, Stop words removal	2	1	1,2
	Lab Experiment: Inverted index construction - Token sequence, Sort, Dictionary & Postings, Implementation of Boolean queries.	2	1	1,2
	Lab Experiment: Sort-based index construction.	2	1	1,2
	Lab Experiment: Implementation of External memory indexing - BSBI, SPIMI.	2	1	1,2
	Lab Experiment: Implementation of External memory indexing - SPIMI.	2	1	1,2
	Lab Experiment: Implementations of Dynamic indexing - Logarithmic merge.	2	1	1,2
Unit 2	**BOOLEAN MODELS, EVALUATION OF IR SYSTEM**	**8L hrs**		
	Boolean Modes	1	2	1,2
	Vector Space Model	1	2	1,2
	TF-IDF	1	2	1,2
	Cosine Measure, Document Length Normalization	1	2	1,2
	Probabilistic Models, Binary Independence Model	1	2	1,2
	Language Modelling	1	2	1,2
	Precision, Recall, F-Measure, E-Measure, Normalized Recall	1	2	1,2
	Evaluation Problems	1	2	1,2
		6P hrs		
	Lab Experiment: Implementation of TF-IDF, Vector space model, Cosine similarity.	2	2	1,2
	Lab Experiment: Implementation of Binary Independence Model	2	2	1,2
	Lab Experiment: Implementation of Okapi BM25	2	2	1,2
Unit 3	**RELEVANCE FEEDBACK AND QUERY EXPANSION**	**5L hrs**		
	Explicit relevance feedback, Explicit Feedback through clicks and local analysis	1	3	1,2
	Implicit relevance feedback through local & global analysis	1	3	1,2
	Document Format, Markup Language, Text Properties	1	3	1,2
	Document Processing, Organization, Text Compression	1	3	1,2
	Query Language and Properties	1	3	1,2
		2P hrs		
	Lab Experiment: Dictionary compression - Implementation of Blocking, Posting Compression - Implementation of Gamma codes	2	3	1,2
Unit 4	**TEXT/DOCUMENT CLASSIFICATION CLUSTERING AND LSI**	**11L hrs**		
	Introduction to Classification, Naïve Bayes Models	1	4	1,2
	Rocchio Classification, K-Nearest Neighbours, SVM,	2	4	1,2
	Decision Trees, Bagging, Boosting, Choosing Right Classifier	2	4	1,2
	Introduction of Clustering, Evaluation of Clustering	1	4	1,2
	K-means, Hierarchical agglomerative clustering	2	4	1,2
	Divisive clustering, Low-Rank approximations	2	4	1,2
	Latent Semantic Indexing	1	4	1,2
		8P hrs		

	Lab Experiment: Implementation of Text/Document classification algorithms: Naive Bayes models, Rocchio, k-Nearest Neighbours.	2	4	1,2
	Lab Experiment: Implementation of Text/Document classification algorithms: Support vector machine classifiers, Decision trees, Bagging, Boosting.	2	4	1,2
	Lab Experiment: Implementation of Text/Document clustering algorithms: k-means clustering, Hierarchical agglomerative clustering, Divisive clustering.	2	4	1,2
	Lab Experiment: Implementation of Low-rank approximations, Latent semantic indexing	2	4	1,2
Unit 5	**Web IR**	**9L hrs**		
	Hypertext, Web Crawling, Indexes	2	5	1,2
	Search Engines	1	5	1,2
	Ranking	2	5	1,2
	Link Analysis	2	5	1,2
	Page Rank, Hits	2	5	1,2
		2P hrs		
	Lab Experiment: Development of a Web Crawler and a small-scale web search engine - Ranking, PageRank, HITS	2	5	1,2
	Total Contact Hours required	**42L hrs + 30P hrs**		

Learning Assessment

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

Recommended Resources

1. Ribeiro-Neto, B., & Baeza-Yates, R. (2011). Modern information retrieval: the concepts and technology behind search.
2. Manning, C. D. (2008). Introduction to information retrieval. Syngress Publishing,.
3. Chakrabarti, S. (2002). Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann.
4. Tiwary, U. S., & Siddiqui, T. (2008). Natural language processing and information retrieval. Oxford University Press, Inc..

Other Resources

1. https://nlp.stanford.edu/IR-book/
2. https://cs.usm.maine.edu/~behrooz.mansouri/courses/IR2022.html
3. https://cse.iitkgp.ac.in/~pabitra/course/ir06/ir06.html

Course Designers

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

Human Computer Interaction

Course Code	CSC 421	Course Category	Core Elective (CE)	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)	FIC 113	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce the capabilities of both humans and computers through human information processing.
2. Gain knowledge of typical HCI models, styles and various historic HCI paradigms.
3. Understand interactive design process and universal design principles to designing HCI systems.
4. Comprehend HCI design principles, standards and guidelines.
5. Understand user models, user support, socio-organizational issues and stakeholder requirements of HCI systems.
6. Familiarize with tasks and dialogues of relevant HCI systems based on task analysis and dialogue design.

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	Identify the user requirements and challenges of HCI	2	70%	65%
Outcome 2	Apply theories and principles to design and model new HCI interface concepts	3	75%	65%
Outcome 3	Infer design patterns of HCI interfaces for mobile applications	2	70%	65%
Outcome 4	Develop graphical design interfaces for web applications based on design parameters	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2	2	2	2								2	2	
Outcome 2	2	2	3	2	3								3	2	
Outcome 3	2	3	3	2	2								2	3	
Outcome 4	2	2	3	3	3								2	3	
Average	**2**	**2**	**3**	**2**	**3**								**2**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Learning Hours	CLOs Addressed	References Used
UNIT 1	**Foundations Of HCI**	9		
	The Human: I/O channels and Memory	1	1	1
	Reasoning and problem solving	1	1	1
	The computer: Devices and Memory	1	1	1
	Processing and networks	1	1	1
	Interaction: Models	1	1	1
	Interaction: Frameworks	1	1	1
	Ergonomics	1	1	1
	Interaction: Styles and Elements	1	1	1
	Interactivity and Paradigms	1	1	1
UNIT 2	**Design and Software Process**	9		
	Interactive design basics and process	1	1,2	1
	Scenarios and Navigation	1	1,2	1
	Screen design	1	1,2	1
	Iteration and prototyping	1	1,2	1
	HCI in software process and life cycle	1	1,2	1
	Usability engineering	1	1,2	1
	Prototyping in practice, design rationale	1	1,2	1
	Design rules, principles, standards, and guidelines	1	1,2	1
	Evaluation Techniques, Universal Design.	1	1,2	1
UNIT 3	**Models and Theories**	**8**		
	Cognitive models	1	1,2	1
	Socio-Organizational issues and stake holder requirements	2	1,2	1
	Communication and collaboration Models	2	1,2	1
	Hypertext	1	1,2	1
	Multimedia	1	1,2	1
	WWW	1	1,2	1
UNIT 4	**Mobile HCI**	**10**		
	Mobile Ecosystem: Platforms	1	3	1,2
	Mobile Ecosystem: Application frameworks	2	3	1,2
	Types of Mobile Applications	1	3	1,2
	Widgets and Applications	1	3	1,2
	Games	1	3	1,2
	Mobile Information Architecture	1	3	1,2
	Mobile 2.0	1	3	1,2
	Mobile Design: Elements of Mobile Design	1	3	1,2
	Mobile Design: Tools	1	3	1,2
UNIT 5	**WEB Interface Design**	**9**		
	Designing Web Interfaces	2	4	1,3
	Drag and drop	1	4	1,3
	Direct Selection	1	4	1,3
	Contextual Tools	1	4	1,3
	Overlays	1	4	1,3
	Inlays and Virtual Pages	1	4	1,3
	Process Flow	1	4	1,3
	Case Studies.	1	4	1,3
	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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	70%		65%		60%		50%		40%	
	Understand										
Level 2	Apply	30%		35%		40%		50%		60%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Dix, A. (2003). Human-computer interaction. Pearson Education.
2. Brian Fling (2009). Mobile Design and Development. O'Reilly Media Inc.
3. Bill Scott and Theresa Neil (2009). Designing Web Interfaces. O'Reilly Media Inc.

Other Resources

1. Dr. Samit Bhattacharya and Dr. Pradeep G. Yammiyavar, NPTEL Lecture serias. http://nptel.ac.in/courses/106103115/

Course Designers

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

Advanced Computer Architecture

Course Code	CSC 422	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSE 235	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Learn how to measure performance of a computing system.
2. Gain knowledge of several optimization in advanced computer architectures.
3. Understand several advanced memory optimization techniques.
4. Familiarize with the architectural issues of a computing systems (devices).

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 processor performance improvement using instruction level parallelism	2	85%	75%
Outcome 2	Demonstrate the optimization techniques for improving performance of advanced computer architectures	3	70%	70%
Outcome 3	Illustrate advanced memory optimization techniques	2	70%	65%
Outcome 4	Identify the architectural issues in computing systems (devices).	2	65%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	1	1	1								1	1	1
Outcome 2	3	3	3	3	3						2	3	3	3	3
Outcome 3	3	3	3	3	3						2	3	3	3	3
Outcome 4	3	3	3	3	3						2	3	3	3	3
Average	3	3	3	3	3						2	3	3	3	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	**Instruction Level Parallelism**	**7**		
	ILP – Concepts and challenges	2	1	1, 3
	Hardware and software approaches	1	1	1, 3
	Dynamic scheduling	1	1	1, 3
	Speculation	1	1	1
	Compiler techniques for exposing ILP	1	1	1
	Branch prediction.	1	1	1
UNIT 2	**Multiple Issue Processors**	**10**		
	VLIW & EPIC	1	2	1, 3
	Advanced compiler support	1	2	1, 3
	Hardware support for exposing parallelism	1	2	1, 3
	Hardware versus software speculation mechanisms	2	2	1, 3
	IA 64 and Itanium processors	3	2	1, 3
	Limits on ILP	2	2	1, 3
UNIT 3	**Multiprocessors and Thread Level Parallelism**	**9**		
	Symmetric and distributed shared memory architectures	2	2	1, 3, 4
	Performance issues	2	2	1, 3, 4
	Synchronization	2	2	1, 3, 4
	Models of memory consistency	2	2	1, 3, 4
	Introduction to Multithreading	1	2	1, 2
UNIT 4	**Memory and I/O**	**10**		
	Cache performance	1	3	1
	Reducing cache miss penalty and miss rate	1	3	1
	Reducing hit time	1	3	1
	Main memory and performance	1	3	1
	Memory technology	1	3	1
	Types of storage devices	1	3	1
	Buses – RAID – Reliability	1	3	1
	Availability and dependability	1	3	1
	I/O performance measures	1	3	1
	Designing an I/O system	1	3	1
UNIT 5	**Multi-core Architectures**	**9**		
	Software and hardware multithreading	2	4	1, 5
	SMT and CMP architectures	1	4	1, 5
	Design issues	1	4	1, 5
	Case studies	1	4	1, 5
	Intel Multi-core architecture	1	4	1, 5
	SUN CMP architecture	1	4	1, 5
	Heterogeneous multi-core processors	1	4	1, 5
	Case study: IBM Cell Processor	1	4	1, 5
	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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	100%		70%		80%		80%		70%	
	Understand										
Level 2	Apply			30%		20%		20%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Hennessy, John L., and David A. Patterson (2017). Computer architecture: a quantitative approach. 6th edition Morgan Kaufman.

Other Resources

1. Shen, John Paul, and Mikko H. Lipasti (2013). Modern processor design: fundamentals of superscalar processors. Waveland Press
2. Dally, William James, and Brian Patrick Towles (2004). Principles and practices of interconnection networks. Elsevier.
3. Hwang, Kai, and Naresh Jotwani (2016). Advanced computer architecture. McGraw-Hill Education.
4. Dezsosima, Terence Fountain, Peter Kacsuk (1997). Advanced Computer Architectures-A Design Space Approach. Pearson Education India.
5. Brian Tuomanen (2018). Hands-On GPU Programming with Python and CUDA: Explore high-performance parallel computing with CUDA. First edition.
6. David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-on Approach. 3rd edition. Morgan Kaufman.

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
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Natural Language Processing

Course Code	CSC 423	Course Category	Core Elective (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. Learn the basics of natural language processing and understand various steps in it.
2. To introduce the fundamentals of language processing from the algorithmic viewpoint.
3. To discuss various issues that make natural language processing a hard task.
4. To discuss some well-known applications of natural language processing

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 fundamental concepts of natural language processing.	1	70%	68%
Outcome 2	Demonstrate algorithms for word level and syntactic analysis of textual data.	2	70%	65%
Outcome 3	Develop systems for language processing and information related tasks using text processing.	3	70%	60%
Outcome 4	Implement systems using natural language generation algorithms and machine translation techniques based on user queries	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2								3	2	2
Outcome 2	2	2	3	3	2								2	2	2
Outcome 3	2	3	3	2	2								2	2	2
Outcome 4	3	3	3	3	2								2	3	2
Average	**2**	**3**	**3**	**3**	**2**								**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	**Introduction**	**11**		
	Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues – Applications	2	1	1
	The role of machine learning	1	1	1
	Probability Basics	2	1	1
	Information theory	2	1	1
	N-gram Language Models	1	1,2	1
	Estimating parameters and smoothing	1	1,2	1
	Evaluating language models	1	1,2	1
UNIT 2	**Word Level and Syntactic Analysis**	**9**		
	Word Level Analysis: Regular Expressions	1	1	1,2
	Finite-State Automata	1	1	1,2
	Morphological Parsing	1	1	1,2
	Spelling Error Detection and Correction-Words	1	1,2	1,2
	Word Classes-Part-of Speech Tagging	1	1,2	1,2
	Syntactic Analysis: Context-free Grammar	2	1	1,2
	Constituency	1	1,2	1,2
	Parsing-Probabilistic Parsing	1	1,2	1,2
UNIT 3	**Semantic Analysis and Discourse Processing**	**8**		
	Semantic Analysis: Meaning Representation	2	1,2,3	3
	Lexical Semantics	1	1,3	3
	Ambiguity-Word Sense Disambiguation	1	1,3	3
	Discourse Processing: Cohesion	1	1,3	3
	Reference Resolution	1	1,3	3
	Discourse Coherence and Structure	2	1,3	3
UNIT 4	**Natural Language Generation and Machine Translation**	**10**		
	Natural Language Generation: Architecture of NLG Systems	2	4	1,3
	Generation Tasks and Representations	1	4	1,3
	Application of NLG	1	4	1,3
	Machine Translation: Problems in Machine Translation	2	4	1,3
	Characteristics of Indian Languages	1	4	1,3
	Machine Translation Approaches	2	4	1,3
	Translation involving Indian Languages	1	4	1,3
UNIT 5	**Information Retrieval and Lexical Resources**	**7**		
	Information Retrieval: Design features of Information Retrieval Systems	2	3,4	1,2,3
	Classical, Non-classical Retrieval systems	1	3,4	1,2,3
	Alternative Models of Information Retrieval - Valuation	1	3,4	1,2,3
	Lexical Resources: WorldNet	1	3,4	1,2,3
	Frame Net-Stemmers	1	3,4	1,2,3
	POS Tagger- Research Corpora	1	3,4	1,2,3
	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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	70%		65%		60%		50%		40%	
	Understand										
Level 2	Apply	30%		35%		40%		50%		60%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. James Allen (1994), Natural Language Understanding. The Benajmins/Cummings Publishing Company Inc. 2nd Edition.
2. Manning, Christopher, and Hinrich Schutze (1999). Foundations of statistical natural language processing. MIT press.
3. Daniel Jurafsky, James H. Martin (2024) . Speech & language processing. Pearson publications. 3rd Edition.

Other Resources

1. Dr. Pawan Goyal. IIT Kharagpur. NPTEL Lecture series. https://youtu.be/02QWRAhGc7g
2. Dr. Pushpak Bhattacharya. IIT Bombay. NPTEL Lecture series. https://youtu.be/aeOLjFe256E
3. Bird, Steven, Ewan Klein, and Edward Loper (2009). Natural language processing with Python: Analyzing text with the natural language toolkit. O'Reilly Media, In.

Course Designers

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

Computer Graphics

Course Code	CSC 424	Course Category	Core Elective (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. Introduce how graphics are represented in digital media.
2. Gain knowledgeon how digital is presented in viewing devices and computers.
3. Understandthe modification and representation in 2D and 3D media over a wide domain.

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 2d and 3D model graphics media in computer vision.	3	80%	70%
Outcome 2	Examine the inner content of 2D and 3D media.	4	70%	65%
Outcome 3	Use of heterogeneous display devices (like mobile, tv, hologram etc.) in computer vision to display the content of 2D and 3D media.	3	80%	70%
Outcome 4	Implement a system using graphic design skills to fulfil user requirements.	2	90%	70%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	2	1	2							2	3	2	1
Outcome 2	3	2	1	2	2							3	3	2	2
Outcome 3	3	3	3	2	2							3	3	2	2
Outcome 4	3	3	3	3	3							3	3	3	2
Average	**3**	**2**	**2**	**2**	**2**							**3**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	**Introduction**	**9**		
	Application areas of Computer Graphics,	1	1	1, 2
	Overview of graphics systems, video-display devices,	1	1	1, 2
	Raster-scan systems,	1	1	1, 2
	Random scan systems	1	1	1, 2
	Graphics monitors and workstations and input devices	1	1	1, 2
	Points and lines, line drawing algorithms,	1	1	1, 2
	Mid-point circle and ellipse algorithms.	1	1	1, 2
	Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.	2	1	1, 2
UNIT 2	**2-D Geometrical transforms**	**10**		
	Translation, scaling, rotation	2	1,2	1, 2
	Reflection and shear transformations	1	1,2	1, 2
	Matrix representations and homogeneous coordinates,	2	1,2	1, 2
	Composite transforms,	1	1, 2	1, 2
	Transformations between coordinate systems.	1	1, 2	1, 2
	The viewing pipeline, viewing coordinate reference frame,	1	1, 2	1, 2
	Window to view-port coordinate transformation, viewing functions,	1	1, 2	1, 2
	Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.	1	1,2	1,2
UNIT 3	**3-D Object representation**	**11**		
	Polygon surfaces, quadric surfaces,	1	1, 2	1, 2
	Spline representation	1	1, 2	1, 2
	Hermite curve,	1	1, 2	1, 2
	Bezier curve and B-spline curves, Bezier and B-spline surfaces.	2	1, 2	1, 2
	Basic illumination models,	1	1, 2	1, 2
	Polygon rendering methods.	1	1, 2	1, 2
	Translation, rotation, scaling, reflection and shear Transformations, composite transformations.	2	1, 2	1, 2
	3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and Clipping	2	1, 2	1, 2
UNIT 4	**Visible surface detection methods**	**7**		
	Classification,	1	3	1, 2
	Back-face detection,	1	3	1, 2
	Depth-buffer,	1	3	1, 2
	Scan-line,	1	3	1, 2
	Depth sorting	1	3	1, 2
	BSP-tree methods,	1	3	1, 2
	Area sub-division and octree methods	1	3	1, 2
UNIT 5	**Computer animation**	**8**		
	Design of animation sequence,	1	4	1, 2
	General computer animation functions,	1	4	1, 2
	Raster animation,	1	4	1, 2
	Computer animation languages,	2	4	1, 2
	Key frame systems,	1	4	1, 2
	Motion specifications	2	4	1, 2
	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 (20%)		CLA-2 (10%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	50%		50%		50%		50%		30%	
	Understand										
Level 2	Apply	50%		50%		50%		50%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Hearn, D., & Baker, M. P. (2002). Computer Graphics C Version. Pearson Education.
2. Foley, J. D., Van Dam, A., Feiner, S. K., & Hughes, J. F. (2013). Computer Graphics Principles & Practice (2nd ed. in C). Pearson Education.

Other Resources

1. Xiang, Z., & Plastock, R. (2000). Computer Graphics, Second Edition. Schaum's Outlines. Tata McGraw-Hill Education.
2. Rogers, D. F. (2017). Procedural Elements for Computer Graphics (2nd ed.). Tata McGraw-Hill.
3. Neumann, P. G., & Sproull, R. F. (2001). Principles of Interactive Computer Graphics. Tata McGraw-Hill.
4. Govil-Pai, S. (2007). Principles of Computer Graphics. Springer.

Course Designers

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

Advanced Data Structures and Algorithms

Course Code	CSC 425	**Course Category**	Core Elective (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. Gain knowledge on a variety of advanced data structures and their implementations.
2. Learn to analyse the efficiency of algorithms.
3. Understand approximation algorithms and NP-completeness.
4. Comprehend different algorithm design techniques to solve problems.
5. Learn complex problems by implementing learned algorithm design techniques and data structures.

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 advanced data structures and red-black trees, AVL trees, heaps, Hamiltonian graphs, Euler graphs, eternal sorting and randomized algorithms	2	70%	65%
Outcome 2	Analyze the performance of asymptotic, probabilistic, amortized, competitive and approximation algorithms in terms of time and space complexity – the efficiency.	4	70%	65%
Outcome 3	Develop TSP & Knapsack optimal and approximation algorithms based on P or NP-hard or NP-complete.	5	70%	65%
Outcome 4	Solve the given problem based on algorithmic design paradigms and method of analysis - dynamic programming, branch-n-bound & backtracking	5	70%	65%
Outcome 5	Justify the algorithmic approach used to calculate time complexity and class of problems based on P, NP and NP hard	5	70%	65%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	1	1	1	2								3	2	
Outcome 2	3	3	1	1	2								3	2	
Outcome 3	3	3	3	3	2								3	2	
Outcome 4	3	3	3	3	2								3	2	1
Outcome 5	3	2	2	2	2				3	2	1		1	1	1
Average	**3**	**3**	**3**	**2**	**2**				**3**	**2**	**1**		**3**	**2**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1		9		
	Importance and need of good data structures and algorithms Heaps,	1	1, 2	1
	AVL Trees	1	1, 2	1
	Red-Black Trees	1	1, 2	1
	Red-Black Trees	1	1, 2	1
	Splay Trees	1	1, 2	1
	B-trees, B+ Trees	1	1, 2	1
	Fibonacci heaps	1	1, 2	1
	Data Structures for Disjoint Sets	1	1, 2	1
	Augmented Data Structures	1	1, 2	1
UNIT 2		8		
	Basics of graphs and algorithms	1	1, 4	1
	Cut-sets, Connectivity and Separability,	1	1, 4	1
	Planar Graphs, Isomorphism	1	1, 4	1
	Graph Colouring, Covering and Partitioning	1	1, 4	1
	Topological Sort	1	1, 4	1
	Ford-Fulkerson Algorithm, Max-flow and Min-cut.	1	1, 4	1
	Few Algorithms for Dynamic Graphs	1	1	1
	Union Find Algorithms	1	1	1
UNIT 3		10		
	Basics of geometric algorithms	1	1,4	1
	Point location, Convex hulls and Voronoi diagrams	1	1, 4	1
	Arrangement and Graph connectivity	1	1, 4	1
	Network Flow and Matching, Flow algorithms	1	1, 4	1
	Maximum Flow – Cuts	1	1, 4	1
	Maximum Bipartite Matching	1	1, 4	1
	Graph partitioning via multi-commodity flow	1	1, 4	1
	Karger'r Min Cut Algorithm	1	1, 4	1
	String matching	1	1, 4	1
	Document processing algorithms	1	1, 4	1
UNIT 4		9		
	Approximation algorithms for known NP hard problems	1	3,5	1
	Need of approximation algorithms	1	3,5	1
	Introduction to P, NP, NP-Hard	1	3,5	1
	NP-Complete	1	3,5	1
	Deterministic, non-Deterministic Polynomial time algorithms	1	3,5	1
	Use of Linear programming and primal dual	1	3,5	1
	Local search heuristics	1	3,5	1
	Basic techniques for sorting, searching, merging	1	3,5	1
	list ranking in PRAMs and Interconnection	1	3,5	1
UNIT 5		9		
	Randomized algorithms	1	3,4	1
	Type of Randomized Algorithms	1	3,4	1
	Quick Sort	1	3,4	1
	Min-cut	1	3,4	1
	2-SAT	1	3,4	1
	Game Theoretic Techniques	1	3,4	2
	Game Theoretic Techniques	1	3,4	2
	Random Walks	1	3,4	1,3
	Random Walks	1	3,4	1,3
	Total Contact Hours	45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)
		CLA-1 (5%)	Mid-1 (10%)	CLA-2 (5%)	CLA-3 (10%)	Course Project (20%)	
		Th	Th	Th	Th		Th
Level 1	Remember	20%	20%	20%	20%	20%	20%
	Understand						
Level 2	Apply	40%	40%	40%	40%	40%	40%
	Analyse						
Level 3	Evaluate	40%	40%	40%	40%	40%	40%
	Create						
Total		100%	100%	100%	100%	100%	100%

Recommended Resources

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to Algorithms. Prentice Hall India.
2. Goldberg, D. E. (2005). Genetic Algorithms. Pearson Education.
3. Sedgewick, R., & Wayne, K. (2011). Algorithms. Addison-Wesley Professional.

Other Resources

1. Sahni, S. (2005). Data Structures, Algorithms, and Applications in C++. MIT Press.

Course Designers

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

Distributed Operating Systems

Course Code	CSC 426	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSC 302	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the concepts that underlie distributed computing systems along with design and implementation issues.
2. To study the key mechanisms and models for distributed systems.

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 architectural models and design issues in distributed systems.	3	70%	65%
Outcome 2	Illustrate the time services in distributed systems.	3	70%	65%
Outcome 3	Explain concurrent programming languages.	2	70%	65%
Outcome 4	Identify Inter Process Communication techniques.	2	70%	65%
Outcome 5	Compare and contrast distributed scheduling algorithms.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2								3	2	1
Outcome 2	2	2	3	3	2								2	2	2
Outcome 3	2	3	3	2	2								2	2	2
Outcome 4	3	3	3	3	2								2	3	2
Outcome 5	3	3	3	3	2								2	3	2
Average	**2**	**3**	**3**	**3**	**2**								**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Fundamentals	9		
	What is distributed operating system	1	1	1, 2, 1
	Issues in designing distributed operating system	1	1	1, 2, 1
	Computer networks: Lan, WAN technologies	1	1	1, 2
	Communication protocols, internetworking	1	1	1, 2
	Message passing	1	1	1, 2
	Issues in IPC by message passing	1	1	1, 2
	Synchronization	1	1, 2	1, 2
	Buffering group communication	1	1, 2	1, 2
	Case study	1	1, 2	1, 2
UNIT 2	Remote Procedure Calls	9		
	The RPC model	1	1, 3, 4	1, 2
	Implementing RPC	1	3, 4	1, 2
	RPCs in heterogeneous environment	1	3, 4	1, 2
	Lightweight RPC	1	3, 4	1, 2
	Distributed shared memory: general architecture of DSM systems	1	1	1, 2
	Design and implementation issues of DSM	1	1	1, 2
	Consistency models	1	1	1, 2
	Replacement strategies, advantages of DSM	1	1	1, 2
	Case study	1	1, 3, 4	1, 2
UNIT 3	Process Management	9		
	Introduction, Process migration	1	1, 4	1, 2
	Threads. Synchronization: Clock synchronization	1	1, 4	1, 2, 3
	Event ordering	1	1, 4	2, 3
	Mutual exclusion	1	4	2, 3
	Deadlock	1	4	2, 3
	Election algorithms	1	4	1, 2
	Resource management: global scheduling algorithm	1	4, 5	1, 2
	Task assignment	1	5	1, 2
	Load sharing and balancing approaches.	1	5	1, 2
UNIT 4	Distributed File System	9		
	Desirable features of a good DFS	1	1	1, 2, 3
	File models	1	1	1, 3
	File accessing models	1	1	1, 3
	File sharing semantics	1	1	1, 3
	File caching schemes	1	1, 2	1, 3
	File replication		1	1, 3
	Fault tolerance		1, 2	1, 3
	Atomic transactions, design principles	1	1, 2, 4	1, 3
	Case study: Google DFS and Hadoop DFS	1	1, 2, 4	1, 3
UNIT 5	Naming	9		
	Desirable features of a good naming system, system- oriented names	1	1	2, 3, 1
	Object locating mechanisms, human oriented names	1	1	2, 3
	Name caches	1	1	2, 3
	Naming and security	1	1	2, 3
	Security: potential attacks	1	1	2, 3
	Cryptography	1	1	2, 3
	Authentication	1	1, 2	2, 3
	Access control	1	1, 2	2, 3
	Digital signatures, design principles	1	1	2, 3
Total Contact Hours		45		

Learning Assessment

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

Recommended Resources

1. Sinha, P. K. (2007). Distributed Operating Systems: Concepts and Design, Prentice Hall of India.
2. Singhal, M., & Shivratri, N. (2017). Advanced Concepts in Operating System, Mc Graw hill publications.
3. Tanenbaul A. S. & Steen, M. V. Distributed Systems, Principles and Paradigms, Pearson publications, 2nd edition.

Other Resources

1. Tannenbaum, A. S. Distributed Operating Systems, Pearson Education, 5th edition.

Course Designers

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

Data and Web Mining

Course Code	CSC 427	Course Category	Technical Elective (TE)	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 need for data mining.
2. Gain knowledge various stages in data mining process.
3. Learn various data mining algorithms and its application domain.
4. Familiarize web mining in detail and the need for web mining.
5. Understand the use of web mining in social network analysis.

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	Apply data mining algorithms to solve the given problems.	2	75%	70%
Outcome 2	Compare and evaluate data mining techniques	5	75%	70%
Outcome 3	Apply web crawling, web-page pre-processing and page ranking	3	70%	60%
Outcome 4	Acquire data from social networking websites and analyse it for efficient recommendation purpose.	4	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2		1									1		3
Outcome 2	2	2	3	3									3	2	3
Outcome 3	2	2	3	3									3	2	3
Outcome 4	2	2	2	3									3	2	3
Average	**2**	**2**	**3**	**3**									**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	9		
	Introduction to Data Mining: What is data mining? Data Mining Goals.	2	1	1, 2
	Related technologies - Machine Learning, DBMS, OLAP, Statistics.	1	1	1
	Stages of the Data Mining Process.	1	1	1, 2
	Data Mining Techniques.	1	2	1, 2
	Knowledge Representation Methods.	1	2	1, 2
	Data Warehouse and OLAP: Data Warehouse and DBMS.	1	1	1
	Multidimensional data model.	1	1	1
	OLAP operations.	1	1	1
UNIT 2	Data pre-processing	9		
	Data pre-processing: Data cleaning. Data transformation.	2	1	1
	Data reduction. Data mining knowledge representation	2	1	1
	Attribute-oriented analysis.	1	1	1
	Data mining algorithms: Association rules: Motivation and terminology.	1	1, 2	1, 2
	Basic idea: item sets.	1	1, 2	1, 2
	Generating item sets and rules efficiently.	1	1, 2	1, 2
	Correlation analysis.	1	1, 2	1, 2
UNIT 3	Data mining algorithms	9		
	Data mining algorithms: Classification.	1	1, 2	1, 2
	Basic learning/mining tasks, inferring rudimentary rules: 1R algorithm.	2	1, 2	1, 2
	Decision trees, Covering rules.	1	1, 2	1, 2
	Data mining algorithms: Prediction, The prediction task.	2	1, 2	1, 2
	Statistical (Bayesian) classification.	1	1, 2	1, 2
	Bayesian networks.	1	1, 2	1, 2
	Instance-based methods (nearest neighbour), Linear models.	1	1, 2	1, 2
UNIT 4	Web crawling	9		
	Web crawling: Basic crawler algorithm.	2	3	3, 4
	Focused crawlers, Topical crawlers.	2	3	3, 4
	Web search: Web page pre-processing.	2	3	3, 4
	Inverted index, HITS algorithm.	1	3	3, 4
	Page ranking algorithm.	1	3	3, 4
	Leadership algorithm.	1	3	3, 4
UNIT 5	Social network analysis	9		
	Social network analysis: Co-citation and bibliographic coupling	2	4	5
	Community discovery.	2	4	5
	Web usage mining: Recommender systems.	2	4	5
	Mining Twitter.	1	4	5
	Mining Face book.	1	4	5
	Mining Instagram.	1	4	5
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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	20%	-	10%	-	-	-	10%	-	10%	-
	Understand										
Level 2	Apply	70%	-	70%	-	70	-	80%	-	80%	-
	Analyse										
Level 3	Evaluate	10%	-	20%	-	30%	-	10%	-	10%	-
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Han, J., Kamber, M., & Pei, J. (2011). Data mining: Concepts and techniques, 3rd ed. Morgan Kaufmann publications.
2. 2. Michael, V. K., Steinbach, Pang-Ning Tan, (2016). Introduction to Data Mining, Pearson publications.
3. 3. Chakrabarti, S. (2002). Mining the web, Elsevier publications.
4. 4. Liu, B. (2011). Web Data Mining, Second Edition, Springer publications.
5. 5. Russel, M. A., & Klassen, M. (2018). Mining the Social Web, Third edition, Oreily publications.

Other Resources

Course Designers

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

Complexity Theory

Course Code	CSC 428	Course Category	CORE ELECTIVE(TE)	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 complexity of a problem can be solved using algorithms, and how much resources (in form of time and space) it takes to solve a problem algorithmically.
2. Studies problems that cannot be solved and problems for which it is difficult to design efficient algorithms and how we can recognize such hard problems.
3. Gives a precise definition of what an algorithm is via Turing machines.
4. Learn central complexity classes, in particular NP-complete 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	Define an algorithm and identify the given problems that be solved using an algorithm.	1	70%	65%
Outcome 2	Illustrate the ideas of solvability, computational models, and working with Turing Machines.	1	65%	60%
Outcome 3	Classify and apply decision problems into appropriate complexity classes, including P, NP, PSPACE and complexity classes based on randomised machine models	2	65%	60%
Outcome 4	Demonstrate NP-completeness basic hard problems.	2	60%	55%
Outcome 5	Apply interactive proofs in the analysis of optimization problems.	3	60%	55%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary	Analytical Reasoning and	Critical and Reflective	Scientific Reasoning and	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	1	2									3	2	
Outcome 2	1	2	3	3	1								2	2	
Outcome 3	1	3	2	3	1								3	2	
Outcome 4	1	3	2	3	1								3	2	
Outcome 5	1	3	1	3									2	1	
Average	**1**	**3**	**2**	**3**	**1**								**3**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	COMPUTABILITY	9		
	A recap of automata theory and the Church-Turing Thesis	1	1,2	1
	Computational models: Lambda calculus, Turing machine	1	1,2	1
	Decidability	2	1,2	1
	Reducibility	2	1,2	1
	The PCP problem & Mapping reducibility	1	1,2	1
	The Recursion Theorem	1	2,3	1
	Definition of Information	1	2,3	1
UNIT 2	TIME COMPLEXITY	10		
	Measuring Complexity, Big-O and small-o notation, Analysing algorithms.	1	3	1
	Complexity relationships among computational models	1	3	1
	The Class-P, Examples	2	3	1
	The Class-NP, Examples	2	3	1
	The P versus NP question	1	3	1
	NP-completeness	1	3	1
	The Cook-Levin Theorem	1	3	1
	Additional NP-completeness Problems	1	3	1
UNIT 3	SPACE COMPLEXITY	9		
	Space complexity.	1	3	1
	Savitch's Theorem and NL.	2	3	1
	NL-completeness and log-space reductions.	2	3	1
	From P-completeness to PSPACE-completeness.	2	3	1
	The Classes L and NL	1	3	1
	NL completeness, NL equals coNL	1	3	1
UNIT 4	INTERACTABILITY	9		
	Hierarchy Theorems	3	4	1
	Relativization	3	4	1
	Circuit Complexity	3	4	1
UNIT 5	ADVANCED TOPICS IN COMPLEXITY THEORY	8		
	Approximation Algorithms	1	1,5	1
	Probabilistic Algorithms	2	1,5	1
	Alternation	2	1,5	1
	Interactive Proof Systems	3	1,5	1
	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 (20%)		CLA-2 (10%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		80%		65%		65%		60%	
	Understand										
Level 2	Apply	20%		20%		35%		35%		40%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Sipser, M. Introduction to the Theory of Computation,3rd edition.

Other Resources

1. Barak, A. Computational Complexity.

Course Designers

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

Software Project Management

Course Code	CSC 429	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSC 305	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Deliver successful software projects that support organization's strategic goals.
2. Match organizational needs to the most effective software development model.
3. Plan and manage projects at each stage of the software development life cycle (SDLC).
4. Create project plans that address real-world management challenges.
5. Develop the skills for tracking and controlling software deliverables.

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	Apply the process to be followed in the software development life-cycle models.	3	70%	65%
Outcome 2	Implement communication, modelling, construction & deployment practices in software development.	3	70%	65%
Outcome 3	Describe the key phases of project management.	3	70%	65%
Outcome 4	Apply the concepts of project management & planning.	3	70%	65%
Outcome 5	Explain the quality management & different types of metrics used in software development.	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	1				1	1	3	1	3	2	1	
Outcome 2	3	2	2	1						3	1	3	2	1	
Outcome 3	3	2	2	2				1	1	3	1	3	2	1	
Outcome 4	3	3	2	2				1	1	3	1	3	2	1	
Outcome 5	3	3	2	2				1	1	3	2	3	2	1	
Average	**3**	**3**	**2**	**2**				**1**	**1**	**3**	**1**	**3**	**2**	**1**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	SOFTWARE MANAGEMENT & ECONOMICS	12		
	Conventional Software Management	1	1	1, 2
	SDLC -waterfall model	1	1	1, 2
	Conventional software Management performance.	2	1	1, 2
	Software Economics.	1	1	1, 2
	pragmatic software cost estimation.	1	1	1, 2
	Improving Software Economics-Reducing software product size	1	1	1, 2
	Improving Software Processes & Team Effectiveness.	1	1	1, 2
	Improving Automation through Software Environments.	1	1	1, 2
	The principles of conventional software Engineering	1	1	1, 2
	Principles of modern software management	1	1	1, 2
	Transitioning to an iterative process.	1	1	1, 2
UNIT 2	THE OLD AND THE NEW WAY OF PROJECT MANAGEMENT	8		
	The principles of conventional software engineering	1	2	1, 2
	Principles of modern software management	1	2	1, 2
	Transitioning to an iterative process	1	2	1, 2
	Basics of Software estimation – Effort and Cost estimation techniques	1	2	1, 5
	COSMIC Full function points	1	2	1, 5
	COCOMO-I and COCOMO II	2	2	1, 5
	A Parametric Productivity Model - Staffing Pattern.	1	2	1, 5
UNIT 3	SOFTWARE MANAGEMENT PROCESS FRAMEWORK	9		
	Life cycle phases: Engineering and production stages.	1	3	1, 2
	Inception, Elaboration.	1	3	1, 2
	Construction, transition phases.	1	3	1, 2
	Artifacts of the process: The artifact sets, Management artifacts.	1	3	1, 2
	Engineering artifacts, programmatic artifacts.	1	3	1, 2
	Model based software architectures: A Management perspective and technical perspective.	2	3	1, 2
	Work Flows of the process: Software process workflows, Iteration workflows.	1	3	1, 2
	Checkpoints of the process: Major milestones, Minor Milestones, Periodic status assessment.	1	3	1, 2
UNIT 4	PROJECT ORGANIZATION AND PLANNING	8		
	Iterative Process Planning: Work breakdown structures, planning guidelines,	2	4	1, 2
	Cost and schedule estimating.	1	4	1, 2
	Iteration planning process.	1	4	1, 2
	Pragmatic planning.	1	4	1, 2
	Project Organizations and Responsibilities: Line-of-Business Organizations.	1	4	1, 2
	Project Organizations, evolution of Organizations.	1	4	1, 2
	Process Automation: Automation Building blocks, The Project Environment.	1	4	1, 2
UNIT 5	PROJECT CONTROL AND PROCESS INSTRUMENTATION	8		
	The seven core Metrics, Management indicators.	1	5	1, 3
	Quality indicators, life cycle expectations.	1	5	1, 3
	Pragmatic Software Metrics, Metrics automation.	1	5	1, 3
	Tailoring the Process: Process discriminates.	1	5	1, 3
	Future Software Project Management	1	5	1, 3
	Modern Project Profiles	1	5	1, 3, 4

	Next generation Software economics	1	5	1, 3, 4
	Modern process transitions.	1	5	1, 3, 4
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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		50%		40%		30%	
	Understand										
Level 2	Apply	60%		40%		50%		60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Royce, W. (2006). Software Project Management, 1st Edition, Pearson Education.
2. Huges, B., & Cotterell, M., & Mall, R. (2017). Software Project Management, 6th Edition, Tata McGraw Hill.
3. Kelkar, SA. (2013). Software Project Management: A Concise Study, 3rd Edition, PHI.
4. Henry, J. (2009). Software Project Management: A Real-World Guide to Success, Pearson Education.
5. Jalote, P. (2015). Software Project Management in Practice, Pearson Education.

Other Resources

1. Weck, O. de, &b Lyneis, J. Braha, D. System Project Management. Retrieved From https://ocw.mit.edu/courses/engineering-systems-division/esd-36-system-project-management-fall-2012/
2. Project Management. Retrieved From https://uit.stanford.edu/pmo/pm-life-cycle

Course Designers

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

Multimedia

Course Code	CSC 430	Course Category	Core Elective (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. Introduces multimedia elements including image, graphics, sound, and video components.
2. To learn the fundamentals of multimedia processing with relation to the multimedia elements.
3. To gain knowledge over accessing and modification of multimedia content in real-world scenario.

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	Content creation editing and managing of multimedia as image, video, and sound media.	3	80%	70%
Outcome 2	Use and examine the inner content of multimedia signal	3	70%	65%
Outcome 3	Use spatial and temporal analysis in the frequency domain of the signal processing to process multimedia signals and make them easy to handle.	3	80%	70%
Outcome 4	Implement a system using MM techniques to solve user requirements.	6	80%	70%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	2	1	2							3	3	2	1
Outcome 2	3	2	1	2	2							3	3	2	2
Outcome 3	3	3	3	2	2							3	3	2	2
Outcome 4	3	3	3	2	3							3	3	3	2
Average	**3**	**2**	**2**	**2**	**2**							**3**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	INTRODUCTION TO MULTIMEDIA	8		
	What is Multimedia?	1	1	1, 2
	Multimedia and Hypermedia	1	1	1
	Overview of Mu1timedia Software Tools	1	1	1, 2
	Graphics Image Data Types	2	1	1, 2
	File Formats and representation (image, video, and sound)	3	1	1, 2
UNIT 2	COLOUR IN IMAGE AND VIDEO	9		
	Color Science	1	1,2	1
	Color Models in Images	1	1,2	1
	Color Models in Video	1	1,2	1
	Fundamental Concepts in Video	1	1,2	1,2
	Analog Video	1	1,2	1,2
	Digital Video	1	1,2	1,2
	Digitization of Sound, MIDI: Musical Instrument Digital Interface,	1	1,2	1,2
	Quantization and Transmission of Audio.	1	1,2	1,2
	Color Science	1	1,2	1,2
UNIT 3	LOSSLESS COMPRESSION ALGORITHMS	9		
	Basics of Information Theory, Run-Length Coding,	1	2	1,2
	Variable-Length Coding,	2	2	1,2
	Dictionary-Based Coding	1	2	1,2
	Arithmetic Coding	1	2	1,2
	Lossless Image Compression	1	2	1,2
	Distortion Measures, The Rate-Distortion Theory	1	2	1,2
	Quantization, Transform Coding,	1	2	1,2
	Wavelet-Based Coding, Embedded Zero tree of Wavelet Coefficients,	1	2	1,2
UNIT 4	IMAGE COMPRESSION STANDARDS	10		
	The JPEG Standard	1	3	1
	The JPEG2000 Standard,	1	3	1
	The JPEG-LS Standard, Bilevel Image Compression Standards	1	3	1
	Introduction to Video Compression,	1	3	1
	Video Compression Based on Motion Compensation,	1	3	1
	Search for Motion Vectors,	2	3	1
	H.261	1	3	1
	H.263	1	3	1
	ADPCM in Speech Coding, G.726 ADPCM, Vocoders	1	3	1
UNIT 5	MPEG Video Coding I - MPEG-1 and 2	9		
	MPEG-1	1	4	1
	PEG-2	1	4	1
	Overview ofMPEG-4	1	4	1
	Object-Based Visual Coding in MPEG-4	1	4	1
	Synthetic Object Coding in MPEG-4	1	4	1
	MPEG-4 Part10/H.264, H.264/SVC	1	4	1
	MPEG-7, H.265/HEVC, 3D-HEVC	1	4	1
	MPEG Audio, Commercial Audio codes.	1	4	1
	MPEG-1	1	4	1
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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		10%	
	Understand										
Level 2	Apply	40%		40%		40%		40%		50%	
	Analyse										
Level 3	Evaluate	20%		20%		20%		20%		40%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Ze-Nian Li, Mark S. Drew, (2004). Fundamentals of Multimedia (FM), in Prentice Hall, (Springer 2nd Edition, 2014 with additional author of Dr.Jiangchuan Liu)
2. Nigel P./ Chapman, Jenny, (2009). Digital Multimedia by Chapman (DM), in John Wiley & Sons Inc (3rd Edition)

Other Resources

1. Multimedia: Making It Work, (2014). 9 Edition by Vaughan, Tay in McGraw-Hill.
2. Multimedia: Computing, Communications and Applications (2012). by Ralf Steinmetz in Pearson Education.
3. Recent articles about multimedia (recommended at classes)

Course Designers

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

Deep Learning

Course Code	CSC 431	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSC 304	**Co-Requisite Course(s)**	NIL	**Progressive Course(s)**	NIL		
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the fundamental concepts of ML/DL, tensor flow, and keras.
2. Study of different activation functions and ANN.
3. Study and application of CNN, and RNN models
4. Application of different deep learning concepts.

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	Illustrate the concepts of ML/DL	1	70%	68%
Outcome 2	Design and implement CNN model	2	70%	65%
Outcome 3	Design and implement RNN model	2	70%	65%
Outcome 4	Apply deep learning models to given problems.	3	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	1	1	1	2								2	2	2
Outcome 2	2	2	3	2	3								3	2	2
Outcome 3	2	2	3	2	3								2	3	2
Outcome 4	2	2	3	3	3								2	3	2
Average	**2**	**2**	**3**	**2**	**3**								**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction:	15		
1	Overview of machine learning	2	1	1
2	Linear classifiers, loss functions	1	1	1
3	Introduction to TensorFlow	1	1	1
4	Computational Graph, Key highlights, Creating a Graph	2	1	1
5	Regression example	1	1	1
6	Gradient Descent	1	1	1
7	Tensor Board	3	1	1
8	Modularity, Sharing Variables	1	1	1
9	Keras	3	4	3
Unit 2	Activation functions, perceptron, ann	7		
10	Activation Functions: Sigmoid, ReLU, Hyperbolic Fns, Softmax	2	1	1,2
11	Perceptrons: What is a Perceptron, XOR Gate	1	1	1
12	Artificial Neural Networks: Introduction	1	1	2
13	Perceptron Training Rule	1	1	2
14	Gradient Descent Rule	1	1	2
15	Vanishing gradient problem and solution	1	1	2
Unit 3	Convolutional Neural Networks	7		
16	Introduction to CNNs	1	1,2	3
17	Kernel filter	1	1,2	3
18	Principles behind CNNs	1	1,2	3
19	Multiple Filters	2	1,2	3
20	Problem and solution of under fitting and overfitting	2	1,2	3
Unit 4	Recurrent Neural Networks	8		
21	Introduction to RNNs	1	1,3	2
22	Unfolded RNNs	1	1,3	2
23	Seq2Seq RNNs	1	1,3	2
24	LSTM	1	1,3	2
25	GRU	2	1,3	2
26	Encoder Decoder architectures	2	1,3	2
Unit 5	Deep Learning applications	8		
27	Image segmentation	1	4	3
28	Self-Driving Cars	1	4	3
29	News Aggregation and Fraud News Detection	1	4	3
30	Natural Language Processing	1	4	3
31	Virtual Assistants	1	4	3
32	Entertainment	1	4	3
33	Visual Recognition	1	4	3
34	Fraud Detection, Healthcare	1	4	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 (05%)	CLA-3 (15%)	
Level 1	Remember	70%	65%	60%	50%	40%
	Understand					
Level 2	Apply	30%	35%	40%	50%	60%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Buduma, Nikhil, & Nicholas Locascio. (2017). Fundamentals of deep learning: Designing next-generation machine intelligence algorithms. O'Reilly Media, Inc..
2. Goodfellow, I., Bengio,Y., & Courville, A. (2016). Deep Learning, MIT Press.
3. Josh Patterson & Adam Gibson (2017). Deep Learning: A Practitioner's Approach, OReilly.

Other Resources

1. Gulli, Antonio, and Sujit Pal. (2017). Deep learning with Keras. Packt Publishing Ltd.
2. https://www.youtube.com/watch?v=aPfkYu_qiF4&list=PLyqSpQzTE6M9gCgajvQbc68Hk_JKGBAYT
3. https://www.coursera.org/professional-certificates/tensorflow.

Course Designers

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

Advanced Database Management Systems

Course Code	CSC 432	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSC 207	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand how to store data using fixed and variable length records in the file.
2. To implement index structures in the file.
3. To implement query parsing and execution.
4. To understand concurrency control protocols used for transaction processing.
5. To understand recovery techniques for recovering from transaction failures.

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	Outline DBMS components, data storage in files and implement indexing schemes for fast retrieval of data. Explain B-tree, hash tables for complex data storage.	2	75%	80%
Outcome 2	Plan query execution. Construct query compiler, planner and executor.	3	70%	75%
Outcome 3	Analyse data base operations and Compare concurrency control protocols for transaction processing system.	4	75%	80%
Outcome 4	Explain concurrency control and system failure	2	75%	80%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	2	2	-	-	-	-	-	-	-	-	2	2	2	1
Outcome 2	3	3	2	-	-	-	-	-	-	-	-	2	3	3	2
Outcome 3	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
Outcome 4	3	3	2	2	-	-	-	-	-	-	-	2	3	1	2
Average	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction	9		
	Overview of the DBMS, Representing data elements	1	1	1
	Introduction to DBMS implementation using Megatron 2000 database system.	1	1	1
	Data storage using main memory and hard disks, Disk failures	1	1	1
	Recovery from disk crashes	2	1	1,2
	Representing data elements such as record address, block, variable length data and solve various numeric	2	1	1
	Variable length data and records, Record modifications, solve various numeric	1	1	1
	Doubt clearing class.	1	1	1
Unit 2	Index Structure	9		
	Index structures: Indexes on sequential files	1	2	1
	Secondary indexes	1	2	1,2
	B-Trees Concept, B-Tree examples, solving numeric	2	2	1,2
	Hash tables concepts	2	1,2	2
	Multidimensional indexes: Hash and tree like structures for multidimensional data	2	1,2	1,2
	Bitmap indexes, solve numeric and doubt clearing class	1	1,2	1
Unit 3	Query Execution	9		
	Query execution: Algebra for queries	1	2	1
	Introduction to Physical-Query-Plan Operators	1	2	1,3
	One-Pass Algorithms for Database Operations	1	2	1
	Nested-Loop Joins	1	2	1
	Two-Pass Algorithms Based on Sorting. Example discussion.	1	2	2
	Index-Based Algorithms ,Buffer Management. More example	2	2	1
	Algorithms Using More Than Two Passes. Solving numeric	1	2	1
	Parallel Algorithms for Relational Operations.	1	2,3	1
Unit 4	Query compiler	9		
	The query compiler: Parsing	2	2	1,2
	Algebraic Laws for Improving Query Plans	2	2	1
	From Parse Trees to Logical Query Plans	1	2	1
	Estimating the Cost of Operations	1	2	1
	Introduction to Cost-Based Plan Selection	1	2	2,1
	Choosing an Order for Joins	1	2	3
	Completing the Physical-Query-Plan Selection	1	2	1
Unit 5	Concurrency Control	9		
	Concurrency control: Conflict-Serializability	1	3	1
	View serializability	1	3	1
	Locking Systems with Several Lock Modes	1	3	1
	An Architecture for a Locking Scheduler	1	3,4	1
	Concurrency control by timestamps and validation	1	3,4	1
	Transactions that Read Uncommitted Data	1	3,4	1
	Coping with system failures: Undo/Redo logging, Examples on Undo/Redo, view serializability	2	3,4	2
	Protecting media failures, Numeric solved, Doubt clearing.	1	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 (15%)	Mid-1 (20%)	CLA-2 (5%)	CLA-3 (10%)	
		Th	Th	Th	Th	Th
Level 1	Remember	70%	60%	70%	40%	70%
	Understand					
Level 2	Apply	30%	40%	30%	60%	30%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Hector Garcia Molina, Jeffrey D. Ullman & Jennifer Widom. (2002). Database System Implementation. 1st ed. Pearson publications.
2. Hector Garcia Molina, Jeffrey D. Ullman & Jennifer Widom. (2013). Database system the complete book, 2nd ed. Pearson New International Edition.

Other Resources

1. Bhalotia, Gaurav, et al. Keyword searching and browsing in databases using BANKS. (2002). Proceedings 18th international conference on data engineering. IEEE.
2. Srivastava, Divesh, Peter J. Stuckey, & Sundararajarao Sudarshan. (2000). Optimization of queries using relational algebraic theta-semijoin operator. U.S. Patent No. 6,032,144. 29 Feb.
3. Shanbhag, Anil, and S. Sudarshan. (2014). Optimizing join enumeration in transformation-based query optimizers. Proceedings of the VLDB Endowment 7.12 : 1243-1254.

Course Designers

Fog Computing

Course Code	CSC 433	Course Category	Core Elective (CE)	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)	CSE 301	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards	OpenEdge, IEEE 1934, IETF				

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the limitations of today's Cloud computing models which are not designed for the volume, variety, and velocity of data generated by billions of Internet of Things (IoT) devices.
2. To understand the features of Edge Computing architecture and analyse business models that address the challenges of resource management and optimization.
3. To familiarize with Edge applications that monitor real-time data from network-connected things and initiating action involving machine-to-machine (M2M) communication.
4. To understand how developers, write IoT applications for Edge Computing nodes that are closest to the network edge and ingest the data from IoT devices.
5. To understand how Edge Nodes, extend the Cloud to the Network Edge through the Case studies for Response time, Data storage time, coverage area, and kinds of 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	Demonstrate various architectural models and design issues in Edge Computing.	2	65%	60%
Outcome 2	Learn and apply various Edge+IoT communication paradigms and Edge+Edge Middleware.	4	65%	60%
Outcome 3	Identify and mitigate Resource management and optimization challenges of Edge Computing model.	3	65%	60%
Outcome 4	Develop efficient models for deployment and dimensioning of edge networks	2	65%	60%
Outcome 5	Will gain hands on experience with different case studies and simulation frameworks for real-life Edge applications.	6	65%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	1							3	3	1	2
Outcome 2	3	3	3	2	2	1			3			2	3	2	2
Outcome 3	3	3	3	2	2				3			3	3	2	2
Outcome 4	3	3	3	3	2	1			3			2	3	2	2
Outcome 5	3	3	3	2	2	1			2			2	3	2	2
Average	**3**	**3**	**3**	**2**	**2**	**1**			**3**			**2**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	9		
	Cloud Computing Fundamentals	1	1,2	1,2
	Limitation of Cloud computing, the Needs of Edge Computing	1	1,2	1,2
	Edge definition, Characteristic Features of Edge computing – SCALE	1	1,2	1,2
	Architectural differences between Cloud and Edge computing	1	1,2	1,2
	Edge Computing Models (Service models)	2	1,2	1,2,3
	Edge and Edge Illustrative Use Cases	2	1,2	1,2,3
	Opportunities and Challenges	1	1,2	1,2,3
UNIT 2	Disruptive Technology Enablers for Edge Computing	9		
	Edge Computing for IoT: Definition and Requirements	1	1,2	1,2
	OpenEdge	1	1,2	1,2
	Communication technologies for edge computing- 4G, 5G, 6LoPAN, DSRC	2	1,2	1,2
	Protocols and Algorithms for edge communication	2	1,2	1,2
	Software defined networking for edge computing	1	1,2	3
	Caching and Networking in 5G edge networks	2	1,2	3
UNIT 3	Middleware for Edge and Edge Computing	9		
	Need for Edge and Edge Computing Middleware	1	2,3	1,3
	Design goals	1	2,3	1,3
	Quality of Service (QoS) in edge computing	2	2,3	1,2,3
	Authentication. privacy and security of edge nodes	2	2,3	1
	Data management in edge computing	1	2,3	1
	Challenges and research prospects	2	2,3	1,2,3
UNIT 4	Deployment and Dimensioning of Edge Networks	9		
	Introduction to Edge node placement problem	1	3,4	1,2
	Optimization models for edge node placement problem	2	3,4	1,2
	Resource provisioning in edge networks	2	3,4	1,2,3
	Mobility models for edge nodes	2	3,4	2
	Edge orchestration	2	3,4	1
UNIT 5	Modeling and Simulation of Distributed Edge Environment	9		
	Introduction to modeling and simulation	2	2,3,5	1
	EdgeNetSim++: Architecture	1	2,3,5	1
	EdgeNetSim++: Installation and Environment Setup	1	2,3,5	1
	OMNeT++ Installation and sample programs	1	2,3,5	1
	Sample Edge Simulation	2	2,3,5	1
	Advanced topics in edge research	2	2,3,5	1,2,3
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 (20%)	CLA-2 (10%)	CLA-3 (10%)	
		Th	Th	Th	Th	Th
Level 1	Remember	40%	60%	20%		30%
	Understand					
Level 2	Apply	60%	40%	50%	60%	50%
	Analyse					
Level 3	Evaluate			30%	40%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Buyya, Rajkumar, and Satish Narayana Srirama, eds. (2019). Fog and edge computing: principles and paradigms. John Wiley & Sons.
2. Mahmood, Zaigham, ed. (2018). Fog computing: Concepts, frameworks and technologies. Springer.
3. Abbas, Assad, Samee U. Khan, & Albert Y. Zomaya, eds. (2020). Fog Computing: Theory and Practice. John Wiley & Sons.

Other Resources

1. Articles from IEEE, ACM, Springer and Elsevier

Course Designers

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

Parallel Algorithms

Course Code	CSC 434	**Course Category**	Core Elective (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**	IEEE				

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the fundamental concepts of parallel processing, interconnection networks, parallel computation models.
2. To design, analyse, and implement the modern parallel algorithms techniques.
3. To measure the performance of various parallel algorithms and comparison with sequential algorithms
4. To learn various problem-solving strategies to achieve parallelism.

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	Illustrate the requirements of parallel programming systems and its facilitation in concurrent systems	2	65%	60%
Outcome 2	Analyze the strengths and limitations of parallel computing approaches for problem solving	4	65%	60%
Outcome 3	Compute the performance of parallel algorithms	3	65%	60%
Outcome 4	Design the parallel searching and sorting algorithms	2	65%	60%
Outcome 5	Evaluate the differences among parallel algorithms solving the same problem and defend the best approach.	5	65%	60%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	3	3	2	1							3	3	1	2
Outcome 2	3	3	3	2	2	1			3			2	3	2	2
Outcome 3	3	3	3	2	2				3			3	3	2	2
Outcome 4	3	3	3	3	2	1			3			2	3	2	2
Outcome 5	3	3	3	2	2	1			2			2	3	2	2
Average	**3**	**3**	**3**	**2**	**2**	**1**			**3**			**2**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	12		
	Sequential model need of alternative model	1	1,2	3,4
	Parallel computational models: PRAM, LMCC	1	1,2	3,4
	Parallel computational models: Hypercube, Cube Connected Cycle	2	1,2	3,4
	Parallel computational models: Butterfly, Perfect Shuffle Computers	2	1,2	3,4
	Parallel computational models: Tree model, Pyramid model	2	1,2	3,4
	Fully Connected model	1	1,2	3,4
	PRAM-CREW, EREW models	2	1,2	3,4
	Simulation of one model from another one	1	1,2	3,4
UNIT 2	Performance of Parallel Algorithms	8		
	Performance measures of parallel algorithms	2	2,3	1,2
	Speed-up and efficiency of parallel algorithms	2	2,3	1,2
	Cost-optimality	2	2,3	1,2
	Example of cost-optimal algorithms: summation	1	2,3	1,2
	Example of cost-optimal algorithms: min/max	1	2,3	1,2
UNIT 3	Parallel Sorting Networks	8		
	Parallel Sorting Networks	1	4,5	2,3
	Parallel Merging Algorithms on CREW	1	4,5	2,3
	Parallel Merging Algorithms on EREW	1	4,5	2,3
	Parallel Merging Algorithms on MCC	1	4,5	2,3
	Parallel Sorting Networks on CREW	1	4,5	2,3
	Parallel Sorting Networks on EREW	1	4,5	2,3
	Parallel Sorting Networks on MCC	1	4,5	2,3
	Linear array	1	4,5	2,3
UNIT 4	Parallel Searching Algorithm	9		
	Parallel Searching Algorithms	1	4,5	2,3
	Kth element in X+Y on PRAM	2	4,5	2,3
	Parallel matrix transportation	2	4,5	2,3
	Multiplication algorithm on PRAM	1	4,5	2,3
	Multiplication algorithm on MCC	1	4,5	2,3
	Vector-Matrix multiplication	1	4,5	2,3
	Solution of linear equation, root finding	1	4,5	2,3
UNIT 5	Graph Algorithms	8		
	Connected graphs	1	1	4
	Search and traversal	1	1	4
	Combinatorial algorithms-permutation	2	1	4
	Combinatorial algorithms- combinations	2	1	4
	Derangements	2	1	4
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 (20%)		CLA-2 (10%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		20%				30%	
	Understand										
Level 2	Apply	60%		40%		50%		60%		50%	
	Analyse										
Level 3	Evaluate					30%		40%		20%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. M.J. Quinn. Designing Efficient Algorithms for Parallel Computer. Mc Graw Hill.
2. S.G. Akl. Design and Analysis of Parallel Algorithms. Academic Press.
3. Rajasekaran, S. & Reif, J. (20007). Handbook of Parallel Computing: Models, Algorithms and Applications. Chapman and Hall/CRC.
4. Peter Pacheco. (2011). An Introduction to Parallel Programming. Morgan Kaufmann.

Other Resources

1. Leighton, F.T. (1992). Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes. San Mateo, CA:Morgan Kaufmann.

Course Designers

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

Web Services

Course Code	CSC 435	Course Category	Core Elective (CE)	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)	CSC 303	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Learn the overview of service-oriented architecture, service roles and its architectural stack.
2. Comprehend web services and the various ways to implement the web services.
3. Gain Knowledge for the design and implementation of Restful Web Services.
4. Understand the composition of various services.
5. Gain knowledge on Service Component Architecture.

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 service-oriented architecture and service roles in service-oriented architecture	2	70%	65%
Outcome 2	Implement web services	3	70%	65%
Outcome 3	Demonstrate Restful Services	3	70%	65%
Outcome 4	Compare and Contrast web service compositions	3	70%	65%
Outcome 5	Illustrate Service Component Architecture and its importance.	2	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2												1	3	2
Outcome 2	3	3	3	2	3							1	3	3	2
Outcome 3	3	3	3	3	3							1	3	3	2
Outcome 4	3	2	2	2	3							1	3	3	2
Outcome 5	3	2	2	3	3							1	3	3	2
Average	**3**	**2**	**2**	**2**	**2**							**1**	**3**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Introduction to Service Oriented Architecture	8		
	Basics of service-oriented architecture (SAO)	1	1	1
	Goals of service-oriented architecture	1	1	1
	Introduction to services	1	1	1
	Service roles and interaction in the Service Oriented Architecture	1	1	1
	The SOA Architectural Stack	1	1	1
	Service Composition and Data Flow	1	1	1
	Data-Flow Paradigms	1	1	1
	Composition Techniques	1	1	1
Unit II	Web Services	10		
	Introduction to web services	1	2	1, 2
	History of web services	1	2	1
	Basics of Simple Object Access Protocol (SOAP)	2	2	1, 2
	Web Services Description Language (WSDL)	2	2	1, 2
	WSDL Main Elements	1	2	1
	Message Communication Model in SOAP/WSDL	1	2	1
	Develop simple web services	2	2	1
Unit III	Web Services: REST or Restful Services	12		1
	Introduction to REST	1	3	1
	REST Design Principles	2	3	1, 2
	Web API Design for RESTful Services	2	3	1, 2
	Building REST Web Services	2	3	1, 2
	Data Access as a Service and implementing data services	1	3	1, 2
	XML Transformation and Query Techniques	2	3	1
	Consuming data via direct data access to the sources	2	3	1
Unit IV	Web Service Composition	8		
	Introduction to web service composition	1	4	1
	Workflow representation of a composite service	1	4	1
	Web service composition environment with detailed discussion on the benefits of web services	1	4	1
	Web service composition: control flow	1	4	1
	BPEL (Business Process Execution Language)	1	4	1
	BPMN (Business Process Model and Notation)	1	4	1
	Web Service Composition: Data Flows	1	4	1
	Data flow paradigms	1	4	1
Unit V	Service Component Architecture	7		
	Introduction to Service Component Architecture (SCA)	1	5	1
	The SOA Integration Problem	1	5	1
	Overview of SCA	1	5	1
	High-level overview of the assembly model	1	5	1
	Application of SCA to Use Case	1	5	1
	SCA Runtime	1	5	1
	Benefits of SCA	1	5	1
	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%)		CLA-3 (15%)			
		Theory	Prac.	Theory	Prac.	Theory	Prac.	Theory	Prac	Theory	Prac.
Level 1	Remember	40%		50%		30%		30%		30%	
	Understand										
Level 2	Apply	60%		50%		70%		70%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Paik, Hye-young, et al. (2017). Web Service Implementation and Composition Techniques. Vol. 256. Springer International Publishing.
2. Martin Kalin. (2013). Java Web Services: Up and Running. 2nd ed. O'Reilly publishers.

Other Resources

Course Designers

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

Advances in Data Mining

Course Code	CSC 436	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSC 304 MAT 221	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce the basic concepts of data mining techniques
2. Explain the concepts of association rule mining and frequent pattern mining, classification and clustering
3. Discuss and analyse various classification algorithms, clustering algorithms and methods for outlier analysis.

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	Identify and apply appropriate data mining algorithms to solve the given real-world problems.	3	75%	70%
Outcome 2	Compare and evaluate classification and prediction methods.	5	70%	65%
Outcome 3	Compare and evaluate clustering methods.	5	70%	65%
Outcome 4	Compare and evaluate association rule mining methods.	5	70%	65%
Outcome 5	Compare and evaluate outlier detection methods.	5	70%	65%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Lifelong Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	2	2	2	2								2	2	2	2
Outcome 2	2	2	3	3								2	3	2	2
Outcome 3	2	2	3	3								2	3	2	2
Outcome 4	2	2	3	3								2	3	2	2
Outcome 5	2	2	3	3								2	3	2	2
Average	**2**	**2**	**3**	**3**								**2**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction	7		
	What is Data Mining, Compiling need of Data Mining, Business Data Mining	1	1	1
	Data Mining Process, CRISP-DM, Business Understanding, Data Understanding, Data Preparation, Modelling, Evaluation, Deployment.	3	1	1, 2
	SEMMA, Steps in SEMMA Process, Comparison of CRISP & SEMMA, Handling Data	3	1	1, 2
Unit 2	Association Rules in Knowledge Discovery	8		
	Introduction, Market-Basket Analysis	1	1	1
	Mining Frequent Patterns, Associations, and Correlations, Apriori Algorithm	1	1	1
	Pattern-Growth Approach for Mining Frequent Itemsets	1	1	1
	Mining Frequent Itemsets using Vertical Data Format, Mining Closed and Max Patterns	1	1, 2	1
	Pattern Mining in Multilevel, Multidimensional Space	1	1, 2	1
	Constraint-Based Frequent Pattern Mining	1	1, 2	1
	Mining High-Dimensional Data and Colossal Patterns	1	1, 2	1
	Mining Compressed or Approximate Patterns	1	1, 2	1
Unit 3	Classification	10		
	Basic Concepts, Decision Tree Induction	2	1, 3	1
	Bayes Classification Methods: Bayes' Theorem, Na¨ıve Bayesian Classification, Rule-Based Classification	2	1, 3	1
	Model Evaluation and Selection	1	1, 3	1
	Bagging, Boosting and AdaBoost, Random Forests	2	1, 3	1, 3
	Improving Classification Accuracy of Class-Imbalanced Data	1	1, 3	1
	Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches	2	1, 3	1, 2
Unit 4	Cluster Analysis	10		
	Introduction, k-Means, k-Medoids	2	1, 4	1
	Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods	2	1, 4	1
	Multiphase Hierarchical Clustering Using Clustering, Feature Trees	2	1, 4	1
	Multiphase Hierarchical Clustering Using Dynamic Modelling, Probabilistic Hierarchical Clustering	2	1, 4	1
	Density-Based Methods, Grid-Based Methods	2	1, 4	1
Unit 5	Outlier Analysis	10		
	Introduction, Outlier Detection Methods: Supervised, Semi-Supervised, and Unsupervised Methods	3	1, 5	1
	Outlier Detection Methods: Statistical Methods, Proximity-Based Methods, and Clustering-Based Methods	3	1, 5	1
	Mining Contextual and Collective Outliers, Outlier Detection in High-Dimensional Data	2	1, 5	1
	Mining Complex Data Types, Data Mining Applications, Social Impacts of Data Mining.	2	1, 5	1, 2, 3
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%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	20%	-	10%	-	-	-	10%	-	10%	-
	Understand										
Level 2	Apply	40%	-	50%	-	-	-	50%	-	50%	-
	Analyse										
Level 3	Evaluate	40%	-	40%	-	100%	-	40%	-	40%	-
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Jiawei, Han., Micheline, Kamber., & Jian, Pei. Data Mining Concepts and Techniques. 3rd ed.
2. Olson, DL., & Delen, D. Advanced data mining techniques. Springer Science & Business Media.
3. Aggarwal CC. Data mining: the textbook. Springer.

Other Resources

Course Designers

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

Social Network Analysis

Course Code	CSC 437	**Course Category**	Core Elective (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 give details of the key mathematical concepts that characterize a network
2. To explain different analytical tasks on social graphs such as centrality, link prediction and community detection.
3. To demonstrate computational tools for social networks tasks in the real world.
4. To Examine social networks analysis using case studies.

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 understanding of the key mathematical concepts that characterize a network	3	65%	65%
Outcome 2	Develop network models with various topological structures using the main algorithms for graph analysis and implementation.	3	65%	65%
Outcome 3	Demonstrate practical knowledge of analytical and computational tools for complex networks in the real world.	3	65%	65%
Outcome 4	Demonstrate knowledge of recent research in the area and exhibit technical writing and presentation skills..	3	65%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	1	1	1								1	1	1
Outcome 2	3	3	3	3	3						2	3	3	3	3
Outcome 3	3	3	3	3	3						2	3	3	3	3
Outcome 4	3	3	3	3	3						2	3	3	3	3
Average	3	3	3	3	3						2	3	3	3	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	UNIT I: Fundamentals of Network Science	7		
	Networks in the real world: Social networks, Information networks, Technological networks, Biological networks	2	1	1, 3
	The large-scale structure of networks: Components, Shortest paths and small-world effect,	1	1	1, 3
	Degree distributions, Power laws and scale-free networks, Six degrees of separation, Random graphs models of network formation.	1	1	1, 3
	Mathematics of networks: Networks and their representation	1	1	1
	Types of networks: Weighted, directed and hypergraphs, The adjacency, Laplacian, and incidence matrices Degree, paths, components, independent paths, connectivity, and cut sets.	2	1	1
UNIT 2	Centrality measures	10		
	Degree centrality, Closeness centrality	2	2	1, 3
	Homophily, Transitivity and Preferential attachment	2	2	1, 3
	Clustering coefficient and Assortative mixing	1	2	1, 3
	Eigenvector centrality, Katz centrality	2	2	1, 3
	Betweenness centrality Page rank, Hubs and Authorities	3	2	1, 3
UNIT 3	Community Detection in Social Networks	12		
	Detecting communities in social networks, Definition of community, Applications of community detection	3	2	1, 2, 3
	Algorithms for community detection: The Kernighan-Lin Algorithm	2	2	1, 2, 3
	Agglomerative/Divisive Algorithms, Markov Clustering	2	2	1, 2, 3
	Multi-level Graph Partitioning Spectral Algorithms	2	2	1, 2, 3
	Modularity Maximization Other Approaches	2	2	1, 2
	Evaluating communities	1	2	1
UNIT 4	Predictive Analytics in Social Networks	9		
	Link prediction problem, Link prediction measures	1	3	1
	Feature based Link Prediction, Evaluation Node	2	3	1
	classification problem Node classification: Problem definition and applications	2	3	1
	Iterative classification methods; Label propagation method; Graph regularization method; Evaluation	1	3	1
	Motif analysis: Definition of network motifs	1	3	1
	Triangle counting and enumeration algorithms	1	3	1
	Applications of network motifs	1	3	1
UNIT 5	Current Research in Social Networks	7		
	Social Influence Analysis	2	4	1, 3
	privacy in social networks	2	4	1, 3
	Integrating sensors and social networks	1	4	1, 3
	Multimedia information networks in social media and social tagging and applications.	2	4	1, 3
	Total Hours	45		

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%	20%	30%	0%	30%
	Understand					
Level 2	Apply	70%	80%	70%	100%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Newman, M. E. J. (2010). Networks: an introduction. Oxford; New York: Oxford University Press.
2. Aggarwal, C. C. (2011). An introduction to social network data analytics. In Social network data analytics (pp. 1-15). Springer, Boston, MA.
3. Barabási, A. L. (2013). Network science. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 371(1987), 20120375

Other Resources

Course Designers

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

Recommender Systems

Course Code	CSC 438	**Course Category**	Core Elective (CE)	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	Linear Algebra	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand principles behind recommender systems.
2. To design suitable models for applications in various domains.
3. To apply the recommendation models such as content-based, collaborative filtering to real-world applications.
4. Evaluate the performance of various recommendation models for chosen application.

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 principles behind recommender systems.	3	65%	65%
Outcome 2	Design suitable models for applications in various domains	3	65%	65%
Outcome 3	Apply the recommendation models such as content-based, collaborative filtering to real-world applications.	3	65%	65%
Outcome 4	Evaluate the performance of various recommendation models for chosen application.	3	65%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	-	-	-	-	-	-	-	-	1			
Outcome 2	3	3	2	1	2	-	-	-	-	-	-	1			
Outcome 3	2	3	2	1	1	-	-	-	-	-	-	-			
Outcome 4	2	3	3	-	1	2	-	-	-	-	-	-			
Outcome 5	2	3	2	-	-	-	-	-	-	-	-	-			
Average	**3**	**3**	**3**	**1**	**1**							**1**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	**INTRODUCTION**	**6**		
	Introduction to Recommender Systems,	1	1	1
	Applications of Recommender Systems, Goals of Recommender Systems	1		1
	Basic Models of Recommender Systems-I	1	1	1
	Basic Models of Recommender Systems-II	1	1	1
	Domain-Specific Challenges in Recommender Systems	1	1	1
	Exploring Datasets and domains	1	1	1
UNIT 2	**Non-Personalised Recommender Systems**	**9**		2
	Non personalised Recommendation	2	2	2
	Coding demo of Summary statistics based RS	1	2	2
	Guided Activity - 1: Implementation of summary statistics based RS	1	2	3
	Activity - 1: Implementing summary statistics based RS for the dataset of chosen domain	1	2	2
	Guided Activity - 2: Implementation of demographics based RS	1	2	3
	Guided Activity - 3: Implementation of product association based RS	1	2	3
	Activity - 2: Implementation of demographics based and product association based RS for the dataset of chosen domain	2	2	2
UNIT-III	**Neighborhood-Based Recommender Systems**	**13**		
	Key Properties of Ratings Matrices, Ratings, mean-centered ratings	1	3	4
	Introduction to neighborhood-based recommendation	1	3	4
	Variations of neighborhood-based CF solutions	1	3	4
	User-based neighborhod models	1	3	4
	Guided Activity - user-based CF	1	3	6
	Tutorial-7	1	3	6
	Item-based neighborhod models	1	3	4
	Strengths and limitations of neighborhood-based CF models	1	3	4
	Variations of neighborhood-based CF solutions: Dimensinality reduction	1	3	4
	Singular Value Decomposition and Principle Component Analysis	1	3	5
	Bias in the recommendation models, problems and solutions	1	3	5
	Graph Models for neighborhood-based CF	2	3	7
UNIT-IV	**Evaluating Recommender Systems**	**10**		
	Goal of evaluation	1	4	3
	Evaluation taxonomy	1	4	3
	Accuracy and Error metrics - I	1	4	3
	Accuracy and Error metrics - II	1	4	3
	Tutorial	1	4	4
	Decision Support metrics	1	4	4
	Tutorial	1	4	4
	Rank-aware Top-n metrics - I	1	4	4
	Rank-aware Top-n metrics - II	1	4	4
	Tutorial	1	4	4
UNIT-V	**Model-Based Collaborative Filtering**	**6**		
	Geometric Intuition for Latent Factor Models	1	3	6
	Stochastic Gradient Descent	1	3	6
	Guided Activity	1	3	7

	Demo of SVD on toy Movielens dataset	1	3	7
	CLA 3 evaluation	2		
	Total Contact Hours	**44**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (60%)**				**End Semester Exam (50%)**
		CLA-1 (10%)	**Mid-1 (20%)**	**CLA-2 (10%)**	**CLA-3 (10%)**	
Level 1	Remember	30%	20%	30%	0%	
	Understand					
Level 2	Apply	70%	80%	70%	100%	
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Aggarwal, C.C. (2016). Recommender Systems: The Textbook. Springer.
2. Ricci, F., Rokach, L., Shapira, B., & Kantor, P.B. (2010). Recommender Systems Handbook. Springer.
3. Falk, Kim. (2019). Practical Recommender Systems. Simon and Schuster.
4. Schrage, Michael. (2020). Recommendation Engines.
5. Theobald, Oliver. (2018). Machine Learning-Make Your Own Recommender System.
6. Jannach, Dietmar. (2010). Recommender Systems: An Introduction.
7. Agarwal, Deepak K. (2016). Statistical Methods for Recommender Systems.

Other Resources

1. Berkovsky, Shlomo. (2019). Collaborative Recommendations Algorithms: Practical Challenges and Applications.
2. Seaver, Nick. (2022). Computing Taste: Algorithms and the Makers of Music Recommendation.
3. Aristomenis. (2015). Machine Learning Paradigms: Applications in Recommender Systems.
4. Uchyigit, Gulden. (2008). Personalization Techniques and Recommender Systems.

Course Designers

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

Computational and Complexity Theory

Course Code	CSC 439	Course Category	Core Elective (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 clarify the practical view towards the applications of these ideas in the engineering part of computer science.
2. Studies problems that cannot be solved and problems for which it is difficult to design efficient algorithms and how we can recognize such hard problems.
3. Gives a precise definition of what an algorithm is via Turing machines.
4. Learn central complexity classes, in particular NP-complete 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	Identify the methods to prove the limitations of computational models.	1	70%	65%
Outcome 2	Illustrate the ideas of solvability, computational models, and working with Turing Machines.	1	65%	60%
Outcome 3	Classify and apply decision problems into appropriate complexity classes, including P, NP, PSPACE and complexity classes based on randomised machine models	2	65%	60%
Outcome 4	Demonstrate NP-completeness basic hard problems.	2	60%	55%
Outcome 5	Apply interactive proofs in the analysis of optimisation problems.	3	60%	55%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	1	2									3	2	1
Outcome 2	1	2	3	3	1								2	2	1
Outcome 3	1	3	2	3	1								3	2	1
Outcome 4	1	3	2	3	1								3	2	2
Outcome 5	1	3	1	3									2	1	1
Average	**1**	**3**	**2**	**3**	**1**								**3**	**2**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	ContexT Free Grammars	9		
	Ambiguity in context free grammars. Minimisation of Context Free Grammars	1	1,2	1
	Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages	2	1,2	1
	Push down automata	2	1,2	1
	PDA model, acceptance of CFL	2	1,2	1
	Equivalence of CFL and PDA	1	1,2	1
	Introduction to DCFL and DPDA	1	2,3	1
UNIT 2	Turning Machine	8		
	Turing Machine, definition, model,	2	1,2	1
	Computable functions, recursively enumerable languages	2	1,2	1
	types of Turing machines (proofs not required). Universal Turing Machine	2	1,2	1
	linear bounded automata and context sensitive language	1	1,2	1
	Church-Turing Thesis Computational models	1	1,2	1
UNIT 3	Computability	9		
	A recap of automata theory and the Church-Turing Thesis	1	1,2	1
	Computational models: Lambda calculus, Turing machine	1	1,2	1
	Decidability	2	1,2	1
	Reducibility	2	1,2	1
	The PCP problem & Mapping reducibility	1	1,2	1
	The Recursion Theorem	1	2,3	1
	Definition of Information	1	2,3	1
UNIT 4	Time Complexity	10		
	Measuring Complexity, Big-O and small-o notation, Analyzing algorithms.	1	3	1
	Complexity relationships among computational models	1	3	1
	The Class-P, Examples	2	3	1
	The Class-NP, Examples	2	3	1
	The P versus NP question	1	3	1
	NP-completeness	1	3	1
	The Cook-Levin Theorem	1	3	1
	Additional NP-completeness Problems	1	3	1
UNIT 5	Space Complexity	9		
	Space complexity.	1	3	1
	Savitch's Theorem and NL.	2	3	1
	NL-completeness and log-space reductions.	2	3	1
	From P-completeness to PSPACE-completeness.	2	3	1
	The Classes L and NL	1	3	1
	NL completeness, NL equals coNL	1	3	1
	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%)	CLA-3 (15%)	
		Th	Th	Th	Th	Th
Level 1	Remember	80%	80%	65%	65%	60%
	Understand					
Level 2	Apply	20%	20%	35%	35%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Sipser, M. (2012). Introduction to the Theory of Computation (3rd ed.). Publisher.

Other Resources

1. Arora, S., & Barak, B. (2007). Computational Complexity: A Modern Approach. Cambridge University Press.

Course Designers

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

Artificial Intelligence

Course Code	CSC 441	**Course Category**	Core Elective (CE)		**L**	**T**	**P**	**C**
					3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	CSE 413L	**Progressive Course(s)**				
Course Offering Department	CSE	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To enhance comprehension of both the theory that underpins and the accomplishments of artificial intelligence.
2. To introduce the concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems.
3. To review the different stages of development of the AI field from human like behaviour to Rational Agents.
4. To impart basic proficiency in representing difficult real-life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
5. to develop an awareness of the fundamental problems with knowledge representation, logic, blind and heuristic search, and other subjects like minimum, resolution, etc. that are crucial to AI systems.
6. To introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

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	Identify the Intelligent systems and Approaches.	1	75%	65%
Outcome 2	Discuss the building blocks of AI as presented in terms of intelligent agents.	2	75%	65%
Outcome 3	Formalize the problem as a state space, graph, design heuristics and select amongst search or game-based techniques to solve them.	4	75%	65%
Outcome 4	Develop intelligent algorithms for constraint satisfaction problems and intelligent systems for Game Playing.	5	75%	65%
Outcome 5	Implement application-specific intelligent systems	3	75%	65%
Outcome 6	Represent logic-based techniques to perform inference and planning in given problems.	6	75%	65%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Life Long Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	3	3	3	3	3	1			2		2	2	2	2	2
Outcome 2	3	2	3	2	2	1			2		2	3	2	2	2
Outcome 3	3	3	3	3	2	1			2		2	2	2	2	2
Outcome 4	3	3	3	2	3	1			2		3	3	3	2	3
Outcome 5	3	3	3	3	2	1			2		2	3	2	2	2
Outcome 6	3	3	3	3	2	1			2		2	2	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**1**			**2**		**2**	**3**	**2**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**9**		
	What is Intelligence.	1	1	1, 2
	Foundations and History of Artificial Intelligence.	1	1	1, 2
	Applications of Artificial Intelligence.	1	2	1, 2
	Types of Different Intelligent system.	1	2	1, 2
	Intelligent Agents, Structure of Intelligent Agents.	1	1, 2	1, 2
	Introduction to Machine Learning and categorization.	1	1, 2	1, 2
	Introduction to Reinforcement Learning.	1	1, 2	1, 2
	Introduction to Deep Learning.	1	1, 2	1, 2
	Introduction to Agents	1	1	1, 2
Unit 2	**Search Mechanisms & Constraint Satisfaction problems.**	**9**		
	Introduction to Search (Single Agent).	1	1	1, 2
	Introduction to Search (Two Agents).	1	1	1, 2
	Introduction to State space.	1	1	1, 2
	Searching for solutions.	1	2, 3	1, 2
	Uniformed search strategies.	1	3, 4	1, 2
	Informed search strategies.	1	3, 4	1, 2
	Local search algorithms and optimistic problems Adversarial Search.	1	3, 4	1, 2
	Least commitment search.	1	3	1, 2
	Constraint satisfaction problems.	1	2	1, 2
Unit 3	**Knowledge Representation and Reasoning**	**9**		
	Propositional Logic and Inference rules.	1	2	1, 2, 3, 4
	Predicate Logic (first order logic).	1	2, 3	1, 2, 3, 4
	Inference in FOL.	1	2, 3	1, 2, 3, 4
	Rule-based system, Logical Reasoning.	1	2, 3	1, 2, 3, 4
	Forward &Backward Chaining.	1	2, 3	1, 2, 3, 4
	Knowledge Resolution.	1	3, 4	1, 2, 3, 4
	AI languages and tools – Lisp.	1	5	1, 2, 3, 4
	AI languages and tools –Prolog.	1	5	1, 2, 3, 4
	AI languages and tools –CLIPS.	1	5	1, 2, 3, 4
Unit 4	**Problem Solving and planning**	**9**		
	Formulating problems.	1	1, 2	1, 2, 3, 4
	Problem types	1	2	1, 2, 3, 4
	Solving Problems by Searching.	1	3, 4	1, 2, 3, 4
	Heuristic search techniques.	2	2, 3	1, 2, 3, 4
	Constraint satisfaction problems.	1	3, 4	1, 2, 3, 4
	Plan space, partial order planning, planning algorithms	1	3, 4	1, 2, 3, 4
	Stochastic search methods.	1	4	1, 2, 3, 4
	Tabu search, best first search.	1	4	1, 2, 3, 4
Unit 5	**Learning**	**9**		
	Overview of different forms of learning, Inductive tree	1	1	1, 2
	Decision trees, rule- Game playing	1	2, 3	1, 2
	Perfect decision game-based learning.	1	2, 3	1, 2
	Neural networks.	1	3, 4, 5	1, 2
	Reinforcement learning.	1	2, 4, 5	1, 2
	Game playing: Perfect decision game.	1	3, 4	1, 2
	Imperfect decision game.	1	3, 4	1, 2
	Evaluation function.	1	3, 4	1, 2
	Minimax, Alpha-beta pruning.	1	4, 6	1, 2
Total Theory Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (30%)				End Semester Exam (30%)
		CLA-1 (10%)	Mid-1 (10%)	CLA-2 (5%)	CLA-3 (5%)	
Level 1	Remember	40%	50%	40%	50%	30%
	Understand					
Level 2	Apply	40%	40%	40%	30%	50%
	Analyse					
Level 3	Evaluate	20%	10%	20%	20%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Prentice Hall.
2. Charniak, E., & McDermott, D. (2002). Introduction to Artificial Intelligence. Pearson Education.
3. Nilsson, N. J. (2002). Artificial Intelligence: A New Synthesis. Morgan Kaufmann.
4. Pearl, J. (2009). Causality: Models, Reasoning and Inference (2nd ed.). Cambridge University Press.
5. Rich, E., Knight, K., & Nair, S. B. (2017). Artificial Intelligence (3rd ed.). McGraw Hill Education.

Other Resources

Course Designers

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

Machine Learning on Edge Computing

Course Code	CSC 442	**Course Category**	Core Elective (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**	IEEE				

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the limitations of today's Cloud computing models which are not designed for the volume, variety, and velocity of data generated by billions of IoT devices.
2. To understand the features of Edge Computing architecture and analyse the applications of AI in Edge Computing.
3. To familiarize with AI/ML models which can be deployed at edge to handle IoT applications.
4. To understand and develop applications for edge nodes that are closest to the network edge and ingest the data from IoT devices.
5. To understand how inferences can be drawn from ML workloads, performances of edge devices through the case studies.

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 architectural models and design issues in edge computing.	2	70%	65%
Outcome 2	Apply various Edge + IoT communication paradigms for AI/ML applications.	3	70%	65%
Outcome 3	Identify and mitigate resource management and optimization challenges for training of ML models.	3	70%	65%
Outcome 4	Develop efficient ML models for deployment at the IoT-Edge platforms.	3	70%	65%
Outcome 5	Demonstrate case studies and ML simulation frameworks for different real-worldapplications.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	1							3	3	1	2
Outcome 2	3	3	3	2	2	1			3			2	3	2	2
Outcome 3	3	3	3	2	2				3			3	3	2	2
Outcome 4	3	3	3	3	2	1			3			2	3	2	2
Outcome 5	3	3	3	2	2	1			2			2	3	2	2
Average	**3**	**3**	**3**	**2**	**2**	**1**			**3**			**2**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	8		
	Introduction to Computing, Internet of Things (IoT)	1	1	1
	Cloud Computing and its limitations to support low latency use cases.	1	1	1
	Edge Computing and its Ecosystem	2	1	1
	Edge Computing Architecture, Edge ML	2	1	1
	Applications of AI in Edge Computing	2	1	
UNIT 2	Exploring the Landscape of Artificial Intelligence and Machine Learning	12		
	Supervised Learning	2	2	1,2
	Unsupervised Learning	1	2	1,2
	Limited Supervised Learning and Reinforcement Learning,	2	2	1,3
	Regression Analysis	1	2	1,3
	Bayesian Networks	2	2	1,3
	Genetic Algorithms	2	2	1,3
	PSO	2	2	1,3
UNIT 3	Exploring Embedded AI at the Edge	11		
	Systems on a Chip (SoC) and their characteristics	1	3	1,4
	Exploring the Landscape of Embedded AI Devices	1	3	2,3
	Raspberry Pi, Intel Movidius Neural Compute Stick	1	3	1,5
	Google Coral USB Accelerator, NVIDIA Jetson Nano, FPGA + PYNQ	1	3	1,2
	Arduino, A Qualitative Comparison of Embedded AI Devices	1	3	1,3
	Google Colab Machine, GPU/TPUs	2	3	1,4
	IoT-Edge platforms such as Azure IoT hub	2	3	1,2
	IoT-Edge platforms such as AWS IoT platform	2	3	1,2
UNIT 4	Training and Inference of ML workloads in Edge Computing Environments	7		
	Hands-On with the Raspberry Pi	2	4	1,3
	Speeding Up with the Google Coral USB Accelerator	1	4	1,2
	Port to NVIDIA Jetson Nano, Comparing the Performance of Edge Devices,	2	4	1,5
	Case Studies: JetBot, Squatting for Metro Tickets, Cucumber Sorter	2	4	1,3
UNIT 5	Advanced topics in Edge ML	9		
	Different use cases of Edge AI	1	5	1
	Predictive maintenance, image classification, self-driving cars	1	5	1
	Docker container and Kubernetes	2	5	1,2
	MQTT and Kafka for end-to-end IoT pipeline	1	5	1,3
	Federated Edge learning (FEEL)	2	5	1,4
	Challenges and opportunities in Edge ML, Future research directions.	2	5	1,2,3
	Total contact hours	47		

Learning Assessment

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

Recommended Resources

1. Buyya, R., & Srirama, S. N. (Eds.). (2019). Fog and edge computing: Principles and paradigms. Wiley.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
3. Pandey, R., Khatri, S. K., Singh, N. K., & Verma, P. (Eds.). (2022). Artificial intelligence and machine learning for EDGE computing. Academic Press.
4. Koul, A., Ganju, S., & Kasam, M. (2019). Practical deep learning for cloud, mobile, and edge: Real-world AI & computer-vision projects using Python, Keras & TensorFlow. O'Reilly Media.
5. Web resources as per the recommendation of the instructor.

Other Resources

Course Designers

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

Mobile and wireless security

Course Code	CSC 443	**Course Category**	Core Elective (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 terminology and classification associated with various IEEE wireless technology standards.
2. Describe the major software and hardware components and subcomponents used to secure mobile wireless and ad-hoc networks.
3. Describe security issues in resource constraint wireless networks such as: Wireless sensor network and Internet of Things.
4. Understand prevention against security threats using various wireless security protocols and algorithms for different wireless networks.
5. Discuss security & privacy issues of Android Applications. Understand the Android Security Architecture.

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	Identify the main security goals and adversarial models of wireless and mobile networks.	2	70 %	65%
Outcome 2	Analyse security architectures for mobile wireless and ad-hoc networks.	3	70 %	65%
Outcome 3	Analyse wireless security protocols and protection techniques, discuss proposed solutions and their limitations.	3	70 %	65%
Outcome 4	Design lightweight authentication, key management, secure localization, device pairing protocols for wireless networks	4	70 %	65%
Outcome 5	Identify the security and privacy vulnerabilities of mobile application.	4	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	2	2	2			2					3	2	1
Outcome 2	3	3	2	2	2			2					2	2	1
Outcome 3	3	3	3	2	2			2					2	2	1
Outcome 4	3	3	3	2	3			1					2	3	1
Outcome 5	3	3	3	2	2			1	2				2	2	1
Average	**3**	**3**	**3**	**2**	**2**			**2**	**2**				**2**	**2**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction to Mobile and Wireless Security	9		
	WLAN: IEEE 802.11 (a : n)	1	1	1
	WPAN: IEEE 802.15 (Bluetooth & Zigbee)	1	1	1
	WMAN: IEEE 802.16 (WiMAX)	1	1	1
	WMAN mobile: IEEE 802.20 (MBWA)	1	1,2	2
	IEEE 802.21 framework (MIH)	1	1,2	2
	WEP	1	1,2	2
	WEP Tools	1	1,2	2
	WEP Shortcomings	1	1,2	2
	IEEE 802.11i	1	1,2	2
UNIT 2	Next Generation Wireless Networks	9		
	Evolution of mobile networks	1	2	1,2
	Mobility with MIPv6	1	2	1,2
	Mobility with Mobile IPv4	1	2	1,2
	IP mobility with HIP and NetLMM	1	2	2
	Ad Hoc Networks	1	2	2
	Destination Sequenced Distance Vector (DSDV)	1	2,3	2
	Wireless Routing Protocol	1	2,3	1
	Ad Hoc On-demand Distance Vector	1	2,3	1
	Key Management in Ad Hoc Networks	1	2,3	1
UNIT 3	Wireless Sensor Network Security	9		
	Attacks on Wireless Sensor Networks and Countermeasures	1	3	1,2
	Prevention by Authentication and Traffic Protection	1	3	1,2
	Secure Network Encryption Protocol	1	3	1,2
	μTESLA Protocol	1	3	1
	Tinysec Protocol	1	3	1
	Centralized and Passive Intruder Detection	1	3	1
	Decentralized Intrusion Detection	1	3	1
	Intrusion Tolerance with Multiple Routes	1	3	1
	Key Management in WSN	1	3	1
UNIT 4	Preventing Malicious Behaviour	9		
	Naming and addressing	1	3,4	2
	Establishing Security Association: Key Establishment in Sensor Network	1	3,4	2
	Establishing Security Association: Utilizing Mobility	1	3,4	2
	Exploiting the properties of Vicinity and of the radio link	1	3,4	2
	Wormhole Detection: Centralized	1	3,4	2
	Wormhole Detection: Decentralized	1	3,4	2
	Privacy in RFID System	1	3,4	2
	Location Privacy in Vehicular Network	1	3,4	2
	Privacy Preserving Routing in Ad-hoc Networks	1	3,4	2
UNIT 5	Mobile Application Security	9		
	Brief Introduction to Android - I	1	5	3
	Brief Introduction to Android - II	1	5	3
	Android Security Model	1	5	3
	Permission	1	5	3
	Package Management	1	5	3
	User Management	1	5	3
	Cryptographic Providers	1	5	3
	Network Security and PKI	1	5	3
	Credential Storage	1	5	3
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	Th	Th	Th	Th
Level 1	Remember	70%	60%	50%	40%	40%
	Understand					
Level 2	Apply	30%	40%	50%	60%	60%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Boudriga, N. (2010). Security of mobile communications. Springer.
2. Buttyán, L., & Hubaux, J.-P. (2008). Security and cooperation in wireless networks. Cambridge University Press.
3. Elenkov, N. (2014). Android security internals: An in-depth guide to Android's security architecture (1st ed.). No Starch Press

Other Resources

1. Kempf, J. (2008). Wireless Internet security: Architectures and protocols. Cambridge University Press.
2. Doherty, J. (2021). Wireless and mobile device security (2nd ed.). Elsevier.

Course Designers

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

Internet protocols and networking

Course Code	CSC 444	**Course Category**	Core Elective (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 learn architecture, design principles and techniques for internetworking of computer networks.
2. To gain in-depth knowledge on analysing, design, implement, monitor, and test the internetworking systems.
3. To understand the networking algorithms (specifically network, Transport) in the network simulator or through programming languages.

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	Define about basic network principles	1	70%	65%
Outcome 2	Identify network layer architecture(framework) along with its functionalities for network protocol design.	1	70%	65%
Outcome 3	Discuss internetworking protocols for wired and wireless networking.	2	70%	65%
Outcome 4	Discuss the performance of heterogeneous networks with respect to transport layer protocols	2	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	**2**	**1**	**1**									1	2	3
Outcome 2	2	3	3	3	1							1	3	2	3
Outcome 3	2	3	3	3	1							1	3	2	3
Outcome 4	1	3	2	2	2							1	3	2	3
Average	**2**	**3**	**3**	**3**	**1**							**1**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Internetworking models	17		
	Introduction- Networking models.	1	1	1
	Introduction about TCP/IP protocol suite	1	1,2	1
	Overview of Connecting devices	1	1	1
	Overview of Switches(Layer-2)	2	1	1
	Overview of Routers (Layer-3)	2	1	1,2
	Spanning tree for discovering the path in LAN Networks	1	1	1,2
	Introduction to Gateways	1	1,2	1
	Overview of Backbone networks:	1	1	1
	In detail explanation about LAN, MAN and WAN networks	1	1	1
	Lab Experiment : Trace the packet information from Wireshark packet analyser.	2	1,2	1
	Write a NS2 code to design Star topology of wired Networks	2	1,2	1
	Write a NS2 code to design Bus topology of wired Network	2	1,2	1
UNIT 2	Principles of Internetworking	21		
	Overview of connection oriented and Connectionless services : Classless and Classful Addressing	1	2	1,2
	Internet Architecture: Overview of IPv4 and IPv6 addressing	2	2,3	1
	Overview of Transport Layer Services	2	2,3	1
	Overview of UDP and TCP protocols	2	2,3	1
	Introduction to flow control and Error control in Transport layer	1	2,3	1
	Flow control mechanisms in Transport layer	1	1,2	1,2
	Error control and Congestion Control in Transport layer	2	1,2,3	1.2
	Write a NS2 code to implement DSDV routing protocol in wired networks	2	1,2,3	1
	Write a NS2 code to implement AODV routing protocol in Mobile Adhoc networks	2	1,2,3	1
	Write a NS2 code to implement DSR routing protocol in infrastructure based wireless networks	2	1,2,3	1,2
	Write a NS2 code to implement Mobile IP protocol	2	1,2,3	1
	Write a NS2 code to analyse the IPv4 and IPv6 header	2	1,2,3	1
UNIT 3	Traffic management in networking	20		
	Overview of data traffic and different traffic flows	2	3	1
	Different types of congestion control mechanisms	1	3	1
	Congestion control in TCP	2	3	1,2
	Network assisted congestion control	2	3	1
	Introduction to Quality of Service	1	3	1
	Techniques to improve QoS service	1	3,4	1.2
	Introduction to Deterministic traffic flows	2	3,4	1
	Overview of Integrated services and Differentiated services: RSVP protocol	1	3	1,2
	Write a NS2 code to implement TCP protocol in wired network	2	3,4	1,2
	Write a NS2 code to implement UDP protocol in wired network	2	3,4	1,2
	Write a NS2 code to implement TCP protocol in wireless network	2	3	1,2
	Write a NS2 code to implement UDP protocol in wireless network	2	3	1
UNIT 4	Buffer Management	17		
	Overview of Buffer management	2	4	1
	Operation of Drop tail, Drop front and Random drop	2	4	1
	Introduction to Passive buffer management schemes	2	4	1
	Introduction to Active Queue management	1	3,4	1
	Overview of different Queue management mechanisms	1	1,4	1,2
	Overview and operation of Early Random Drop	1	4	1,2
	Overview and operation of Random Early Detection	1	3,4	1,2
	Implementation of RED algorithm in congestion control	1	3,4	1
	Write a Java program to implement client-server programming using TCP as a transport layer protocol	2	1,2	1

	Write a Java program to implement UDP protocol	2	1,2	1
	Write a NS2 code to check the QoS of the TCP, UDP protocol in both wired and wireless networks	2	3	1
Total Contact Hours		75		

Learning Assessment

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

Recommended Resources

1. Comer, D. E. Internetworking with TCP/IP , Volume I PHI.
2. Forouzan, B. A TCP/IP Protocol Suite, TMH, 3rd Edition.

Other Resources

1. Forouzan, B.A. Data communication & Networking, TMH, 4th Edition.
2. Shay, W. A., Understanding communications and Networks, 3rd Edition, Cengage Learning.
3. Kurose, J. F. Ross, K. W. Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education.

Course Designers

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

Mobile application security testing

Course Code	CSC 445	Course Category	Core Elective (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. Students learn cryptography basics (concepts, algorithms, techniques, implementation, and evaluation) for mobile apps.
2. Students learn basic cryptography implementation for Android mobile security.
3. Deal with the various aspects arising in architecting secure complex systems, such as analysing and identifying system threats and vulnerabilities, and investigating operating systems 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	Understanding of Android and iOS ecosystems, exploring key components and security models, laying the groundwork for comprehensive mobile security assessments	2	70%	65%
Outcome 2	Apply mobile pentesting tools, enabling effective setup, session execution, and application attack surface analysis	3	70%	65%
Outcome 3	Obtain analytical skills to assess and counteract diverse mobile threats, including program security vulnerabilities and dynamic analyses for threat mitigation	4	70%	65%
Outcome 4	Obtain critical evaluation skills to address authentication, communication, and privacy vulnerabilities, proposing strategic enhancements for resilient mobile app security	4	70%	65%
Outcome 5	Evaluate advanced mobile security measures, covering robust transport layer protection, countermeasures for client-side injection, secure authentication, and modern cryptographic practices.	5	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	1								3	1	
Outcome 2	2	3	3	3	2								3	3	
Outcome 3	2	3	3	3	2								3	2	
Outcome 4	2	3	3	3	3								2	2	
Average	2	3	3	3	2								3	2	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Android Pentesting	9		
	Android Architecture: Linux Kernel	1	1	1
	Native User space, Dalvik VM	1	1	1
	Java Runtime Libraries	1	1	1
	Android Security -Developing and debugging on Android	1	1	1
	RSA, Review of Cryptography Basics	1	1	1
	Androids Securable IPC mechanisms	1	1	1
	Androids Security Model	1	1	1
	Android Permissions Review–Content Providers	1	1	1,2
	Mass storage - Android Security tools	1	1	1,2
UNIT 2	Android Security Assessment Tools	9		
	Introduction, and Setting up drozer	1	2	2,3
	Running a drozer session	1	2	2,3
	enumerating installed packages, Enumerating activities	1	2	2
	Enumerating activities	1	2	2
	Enumerating content providers	1	2	2,3
	Enumerating services	1	2	2,3
	Enumerating broadcast receivers	1	2	3
	determining application attack surfaces	1	2	3
	launching activities.	1	2	3
UNIT 3	IoSPentesting	9		
	IoS Architecture: Cocoa Touch	1	3	1,2
	Media, Core Services,	1	3	1,2
	Core OS, iOS Security Architecture, Secure Enclave,	1	3	1,2
	Boot ROM, Touch ID, Code Signing	1	3	1
	IoS Security- Introducing	1	3	2,3
	iOS Application Security, Basics of iOS	1	3	2,3
	application development, developing your first iOS app,	1	3	1
	Running apps on iDevice, iOS MVC design,	1	3	2,3
	iOS security model, iOS secure boot chain, iOS application signing	1	3	1,2
UNIT 4	Mobile Malware and App Security	9		
	Program Security: Secure Programs	1	4	1,2
	Non-malicious Program Errors	1	4	1
	Viruses, and Other Malicious Code,	1	4	3,4
	Targeted Malicious Code, and Controls against Program Threats	1	4	2,3,4
	Software vulnerabilities: Buffer and stack overflow,	1	4	1,2
	Cross-site scripting (XSS), and vulnerabilities,	1	4	1,2
	SQL injection and vulnerabilities,	1	4	2,3
	Phishing, Privacy Issues.	1	4	2,3
	Static Analysis, Dynamic Analysis	1	4	1,2,3
UNIT 5	Mobile Risks	9		
	Introduction	1	5	1,2
	Insecure Authentication/Authorization,	1	5	1
	Insecure Communication, Improper Session Handling,	1	5	1,2
	Inadequate Privacy Controls,	1	5	3
	Improper Credential Usage, Insufficient Transport layer protection,	1	5	3
	Client Side Injection, security Misconfiguration	1	5	2,3
	security Misconfiguration, Insufficient Cryptography,	1	5	1,4
	Insecure Data Storage,	1	5	1,2

	Insufficient Binary Protections	1	5	2,3,4
Total Contact Hours		45 Hours		

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%**

Recommended Resources

1. ANDROID SECURITY INTERNALS- An In-Depth Guide to Android's Security Architecture- Nikolay Elenkov, No Starch Press, 2015 edition.
2. Dviwedi, H., Clark Chris and David. Mobile Application Security, Thiel, 1st Edition
3. Keith, M. & Scott Alexander-Bown. (2009). Android Security CookBook:, Packt Publishing Security of Mobile Communications, Noureddine Boudriga.
4. Yermalkar, S. Learning iOS Penetration Testing, Packt Publishing, 1st Edition

Other Resources

1. OWASP TOP 10 Mobile Risks-Research papers

Course Designers

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

IoT security

Course Code	CSC 446	Course Category	Core Elective (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 understanding the security requirements in IoT architecture and the significance of securing the Internet of Things.
2. To explore the cryptographic fundamentals essential for IoT, including encryption, digital signatures, and key management.
3. To gain knowledge about identity and access management solutions tailored for IoT, covering identity lifecycle and access control.
4. Master privacy preservation techniques for IoT, focusing on data dissemination, location privacy, and robust schemes.

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 identify security concerns in IoT applications and propose suitable security measures	2	70%	65%
Outcome 2	Implement cryptographic techniques for data protection in IoT systems.	3	70%	65%
Outcome 3	Possess the skills to design and implement identity and access management solutions for IoT devices and applications.	3	70%	65%
Outcome 4	Develop privacy preservation strategies for IoT scenarios, safeguarding sensitive information.	3	70%	65%
Outcome 5	Understand and evaluate cloud security solutions for IoT, enabling secure integration of IoT devices with cloud services.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2												1	3	
Outcome 2	2	2	3	2	3							1	3	3	
Outcome 3	2	2	3	2	3							1	3	3	
Outcome 4	1	2	2	2	3							1	3	3	
Outcome 5	1	2	2	2	3							1	3	3	
Average	**2**	**2**	**3**	**2**	**3**							**1**	**3**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	9		
	Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications.	2	1	1
	Security Architecture on the Internet of Things, Security Requirements in IoT, Insufficient Authentication/Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability,	3	1	1
	Attacks Specific to IoT. Vulnerabilities, Secrecy and Secret, Key Capacity, Authentication/Authorization for Smart Devices	2	1	1
	Transport Encryption, Attack and Fault trees, The secure IoT system implementation lifecycle.	2	1	1
UNIT 2	CRYPTOGRAPHIC FUNDAMENTALS FOR IOT	8		
	Cryptographic primitives and its role in IoT	2	2	1,2
	Encryption and Decryption, Hashes, Digital Signatures, Random number generation	2	2	1,2
	Cipher suites, Key management fundamentals	2	2	1,3
	Cryptographic controlsbuilt into IoT messaging and communication protocols	1	2	1,3
	IoT Node Authentication	1	2	1,3
UNIT 3	IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT	10		
	Identity lifecycle	2	3	1,3
	Authentication credentials	2	3	2,3
	IoT IAM infrastructure	2	3	1,2
	Authorization with Publish/Subscribe schemes	2	3	1,2
	Access control	2	3	1,3
UNIT 4	PRIVACY PRESERVATION FOR IOT	9		
	Privacy Preservation Data Dissemination	2	4	1,3
	Privacy Preservation for IoT Used in Smart Building	2	4	1,2
	Exploiting Mobility Social Features for Location Privacy Enhancement in Internet of Vehicles	2	4	1,3
	Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing	3	4	1,3
UNIT 5	CLOUD SECURITY FOR IOT	9		
	Cloud services and IoT	2	5	1
	Offerings related to IoT from cloud service providers, Cloud IoT security controls	3	5	1
	An enterprise IoT cloud security architecture	2	5	1,2
	New directions in cloud enabled IoT computing	2	5	1,3
		45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)	
		Theory (30%)				Practical (20%)		
		CLA-1 (5%)	Mid-1 (10%)	CLA-2 (5%)	CLA-3 (10%)		Th	Prac
Level 1	Remember	50%	40%	40%	40%	50%	30%	40%
	Understand							
Level 2	Apply	50%	60%	60%	60%	50%	70%	60%
	Analyse							
Level 3	Evaluate							
	Create							
Total		100%	100%	100%	100%	100%	100%	100%

Recommended Resources

1. Raman, A. C., Raj, P. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Bahga, A. and Madisetti, V. Internet of Things: A Hands-on Approach, Universities Press.
3. Research Papers

Other Resources

Course Designers

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

Biometric Security

Course Code	CSC 447	Course Category	Core Elective (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 fundamentals of biometric technologies and distinguish them from traditional techniques.
2. Analyse the strengths and weaknesses of leading physiological biometrics like finger-scan, facial-scan, and iris-scan.
3. Evaluate the principles and components of behavioural biometrics such as signature-scan and keystroke scan.
4. Assess privacy risks in biometric systems, design privacy-sensitive solutions, and comprehend biometric standards.
5. Gain proficiency in image processing techniques, image enhancement, segmentation, and its application in fingerprint and iris biometrics

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 a comprehensive understanding of biometric fundamentals, technologies, and their applications in security systems	2	75 %	70%
Outcome 2	Evaluate the strengths and weaknesses of different biometric modalities, including physiological and behavioural biometrics	4	70 %	65%
Outcome 3	Privacy risks associated with biometric systems and design privacy-compliant solutions.	2	70 %	65%
Outcome 4	Develop proficiency in image processing techniques, enhancing their ability to process and analyse biometric data.	5	70 %	65%
Outcome 5	Implement fingerprint and iris biometric systems, including minutiae determination and iris recognition.	5	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	3			3					3	2	
Outcome 2	2	2	3	3	3			3					2	2	
Outcome 3	2	3	3	2	3			3					2	2	
Outcome 4	3	3	3	3	3			3					2	3	
Outcome 5	2	3	3	3	3			3					2	3	
Average	**2**	**3**	**3**	**3**	**3**			**3**					**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	Introduction: Biometric Fundamentals and Physiological Biometrics	11	1	1,2
	Biometric fundamentals – Biometric technologies, Biometrics Vs traditional techniques, Characteristics of a good biometric system	2	1	1,2
	Benefits of biometrics, Key biometric processes: verification, identification and biometric matching	1	1	1,2,3
	Performance measures in biometric systems, FAR, FRR, FTE rate, EER and ATV rate, Applications of Biometric Systems, Security and Privacy Issues.	2	1	1,2
	Physiological Biometrics: Leading technologies: Finger-scan, Facial-scan, Iris-scan, Voice-scan, components, working principles,	2	1	1,2,3
	Competing technologies, strengths and weaknesses	1	1,2	1,2,3
	Other physiological biometrics: Hand-scan, Retina-scan –components, working principles, competing technologies, strengths and weaknesses	2	1	1,2
	Automated fingerprint identification systems	1	1	1,2
UNIT II	Behavioural Biometrics and Privacy and Standards in Biometrics	6		
	Leading technologies: Signature-scan, Keystroke scan, components, working principles, strengths and weaknesses.	2	1,2	1,2
	Assessing the Privacy Risks of Biometrics	2	3	1,2
	Designing Privacy Sympathetic Biometric System	1	3	1,2
	Need for standards – different biometric standards.	1	3	1,2
UNIT III	Fundamentals of Image Processing	12		
	Digital Image representation, grayscale image, colour image: RGB, YCbCr, Binary Image	2	4	1,2
	Fundamental steps in Image Processing Image Enhancement: The Spatial Domain Methods,	2	4	1,2
	Image Enhancement: The Frequency Domain Methods	2	4	1,2
	Image Segmentation: Pixel Classification by Thresholding, Histogram Techniques	2	4	1,2
	Smoothing and Thresholding	1	4	1,2
	Gradient Based Segmentation: Gradient Image, Boundary Tracking	2	4	1,2
	Laplacian Edge Detection	1	4	1,2
UNIT IV	Fingerprint Biometrics	9		
	Fingerprint Patterns, Fingerprint Features	2	4	1,2
	Fingerprint Image, width between two ridges	2	4	1,2
	Fingerprint Image Processing	2	4	1,2
	Minutiae Determination	1	4,5	1,2, 3
	Fingerprint Matching: Fingerprint Classification, Matching policies.	2	4,5	1,2, 3
UNIT V	Iris Biometrics	7		
	Iris System Architecture, Definitions and Notations	1	4,5	1,2,3
	Iris Recognition: Iris location, Doubly Dimensionless Projection, Iris code, Comparison	2	5	1,2
	Coordinate System: Head Tilting Problem, Basic Eye Model	2	5	1,2
	Searching Algorithm	1	5	1,2
	Texture Energy Feature	1	4,5	1,2
Total Hours		45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Exam (40%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (25%)	
Level 1	Remember	70%	50%	70%	10%	50%
	Understand					
Level 2	Apply	30%	50%	30%	60%	50%
	Analyse					
Level 3	Evaluate				30%	
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Jain, A. K, Flynn, P., Ross, Arun A. (2008). Handbook of Biometrics, Springer.
2. Jain, A. K., Ross, A. A, Nandakumar, K. (2011). Introduction to Biometrics, Springer.
3. Nanavati, S. Thieme, M. Nanavati, R. (2003). Biometrics – Identity Verification in a Networked World, Wiley-dreamtech India Pvt Ltd, New Delhi.

Other Resources

Course Designers

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

Cyber Law

Course Code	CSC 448	Course Category	Core Elective (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 historical development and significance of Intellectual Property Law and its role in the digital age.
2. Demonstrate knowledge of the trademark registration process, maintenance, and international trademark laws.
3. Comprehend the principles of copyright law, including ownership, duration, and international copyright issues.
4. Analyze the concept of Trade Secrets, their protection, and legal implications, including breach of contract and unfair competition.

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	Apply Intellectual Property Law principles to real-world scenarios effectively.	2	70%	65%
Outcome 2	Navigate trademark registration processes and handle trademark-related legal issues competently.	3	70%	65%
Outcome 3	Interpret copyright laws and address copyright-related disputes and challenges.	3	70%	65%
Outcome 4	Comprehend and engage with patent law, including patent searches and international aspects.	3	70%	65%
Outcome 5	Assess and safeguard trade secrets while understanding the legal consequences of breaches and unfair competition.	4	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2												1	3	
Outcome 2	2	2	3	2	3							1	3	3	
Outcome 3	2	2	3	2	3							1	2	3	
Outcome 4	1	2	3	2	3							1	3	3	
Outcome 5	1	2	2	2	3							1	3	3	
Average	**2**	**2**	**3**	**2**	**3**							**1**	**3**	**3**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Intellectual Property Law**	**7**		
	The Evolutionary Past, The IPR Tool Kit – Para	1	1	1
	Legal Tasks in Intellectual Property Law	2	1	1
	Ethical obligations in Para Legal Tasks in Intellectual Property Law	1	1	1
	Introduction to Cyber Law	1	1	1, 3
	Innovations and Inventions Trade related Intellectual Property Right.	2	1	
Unit 2	**Introduction to Trade Mark**	**8**		
	Trade mark Registration Process	1	2	1,2
	Post registration Procedures	1	2	1,2
	Trade mark maintenance, Transfer of Rights, Inter partes Proceeding	1	2	1,3
	Infringement, Dilution Ownership of Trade mark	1	2	1,3
	Likelihood of confusion, Trademarks claims	2	2	1,3
	Trademarks Litigations, International Trade mark Law	2	2	1,3
Unit 3	**Introduction to Copyrights**	**11**		
	Principles of Copyright Principles	1	3	1,4
	The subjects Matter of Copy right	1	3	2,3
	The Rights Afforded by Copyright Law	1	3	1,5
	Copy right Ownership, Transfer and duration	1	3	1,2
	Right to prepare Derivative works	1	3	1,3
	Rights of Distribution	1	3	1,4
	Rights of Perform the work Publicity Copyright Formalities and Registrations, Limitations	2	3	1,2
	Copyright disputes and International Copyright Law	2	3	1,2
	Semiconductor Chip Protection Act	1	3	1,3,4
Unit 4	**The Law of Patents**	**6**		
	Patent searches	1	4	1,3
	Patent ownership and transfer	2	4	1,2
	Patent infringement	1	4	1,5, 6
	International Patent Law.	2	4	1,3, 6
Unit 5	**Introduction to Trade Secret**	**13**		
	Maintaining Trade Secret	2	5	1
	Physical Security	1	5	1
	Employee Limitation Employee confidentiality agreement	2	5	1,2
	Trade Secret Law	1	5	1,3, 6
	Unfair Competition	2	5	1,4, 6
	Trade Secret Litigation	2	5	1,2,3
	Breach of Contract	1	5	1,2,3
	Applying State Law	2	5	1,2,3
	Total Contact Hours required	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)					End Semester Exam (50%)
		Theory (50%)				Practical	
		CLA-1 (10%)	CLA-2 (10%)	CLA-3 (5%)	Mid-1 (25%)		Thory
Level 1	Remember	50%	40%	40%	50%	--	30%
	Understand						
Level 2	Apply	50%	60%	60%	60%	--	70%
	Analyse						
Level 3	Evaluate						
	Create						
Total		100%	100%	100%	100%	--	100%

Recommended Resources

1. Bouchoux, D. E: Intellectual Property. Cengage learning, New Delhi.
2. Kumar, M.A. and Ali, Mohd.Iqbal: Intellectual Property Right Serials Pub.
3. Cyber Law. Texts & Cases, South-Western's Special Topics Collections.
4. Prabhuddha Ganguli: Intellectual Property Rights Tata Mc-Graw –Hill, New Delhi.
5. Martin, J. and Turner, C. Intellectual Property, CRC Press.
6. Stimm, R. Intellectual Property, Cengage Learning.

Other Resources

Course Designers

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

Ethical Hacking

Course Code	CSC 449	**Course Category**	Core Elective (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 key issues in information security, incident management, and penetration testing.
2. Learn various foot printing techniques, tools, and competitive intelligence gathering methods, along with countermeasures.
3. Explore network scanning and enumeration techniques and their respective countermeasures.
4. Gain expertise in malware analysis, web application attacks, and penetration testing, including SQL injection detection and testing methodologies.

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	Analyze and address security vulnerabilities in information systems effectively.	2	70%	65%
Outcome 2	Conduct ethical hacking assessments and penetration tests with proficiency.	3	70%	65%
Outcome 3	Develop countermeasures against various cyber threats, including foot printing and malware attacks.	3	70%	65%
Outcome 4	Demonstrate expertise in Windows OS security and system hacking techniques.	3	70%	65%
Outcome 5	Apply ethical hacking knowledge to enhance web application security and prevent SQL injection vulnerabilities.	4	70%	65%

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

CLOs	**Program Learning Outcomes (PLO)**														
	Scientific and Disciplinary Knowledge	**Analytical Reasoning and Problem Solving**	**Critical and Reflective Thinking**	**Scientific Reasoning and Design Thinking**	**Research Related Skills**	**Modern Tools and ICT Usage**	**Environment and Sustainability**	**Moral, Multicultural and Ethical Awareness**	**Individual and Teamwork Skills**	**Communication Skills**	**Leadership Readiness Skills**	**Self-Directed and Life Long Learning**	**PSO 1**	**PSO 2**	**PSO 3**
Outcome 1	2												1	3	2
Outcome 2	2	2	3	2	3							1	3	3	2
Outcome 3	1	2	2	2	3							1	3	3	2
Outcome 4	1	2	3	2	3							1	3	3	2
Outcome 5	2	2	2	2	3							1	3	3	2
Average	**2**	**2**	**3**	**2**	**3**							**1**	**3**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction to Information Security and Incident Management	5		
	Key issues plaguing the information security world	2	1	1
	Incident management process	2	1	1
	Penetration testing	1	2	1,2
Unit 2	Foot printing and Competitive Intelligence Gathering	10		
	Various types of foot printing	2	3	1,3
	Foot printing tools	2	3	1,3
	Competitive intelligence gathering	2	3	1,3
	Countermeasures against foot printing	2	3	1,3
	Competitive intelligence gathering	2	3	1,3,5
Unit 3	Network Scanning and Enumeration	8		
	Network scanning techniques	2	2	1,4
	Scanning countermeasures	2	2	2,3
	Enumeration techniques	2	2	1,5
	Enumeration countermeasures	2	2	1,2
Unit 4	System Hacking and Windows OS Security	10		
	System hacking methodology	2	4	1,3,5
	Steganography and steganalysis attacks	2	4	1,2
	Covering tracks	2	4	1,5
	Windows OS security	2	4	1,3
	Hacking into systems by changing passwords and elevating privileges	2	4	1,2
Unit 5	Malware Analysis, Web Application Attacks, and Penetration Testing	12		
	Malware analysis procedure and countermeasures	2	5	1,5
	Web application attacks and hacking methodology	2	5	1,5
	SQL injection attacks and detection tools	2	2,5	1,2,3
	Penetration testing concepts	2	2, 5	1,2,4
	Penetration testing methodologies	2	2, 5	1,2,4
	Penetration testing roadmap	2	2, 5	1,2,4
	Total Contact Hours required	45		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**					**End Semester Exam (50%)**	
		Theory (50%)				**Practical**		
		CLA - 1 (10%)	**CLA - 2 (10%)**	**CLA - 3 (5%)**	**Mid - 1 (25%)**		**Th**	**Prac**
Level 1	Remember	50%	40%	40%	50%	--	30%	
	Understand							
Level 2	Apply	50%	60%	60%	50%	--	70%	
	Analyse							
Level 3	Evaluate							
	Create							
Total		100%	100%	100%	100%	--	100%	

Recommended Resources

1. Dafydd, S. & Marcus, P. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws.
2. David, K., Jim, O., Devon, K., & Mati, A. Metasploit: The Penetration Tester's Guide.
3. Stuart, Mc., Joel, S., & George, K. Hacking Exposed: Network Security Secrets and Solutions .
4. Patri, E. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy
5. Michael, S., & Andrew, H. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software.

Other Resources

Course Designers

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

Security audit and Risk Assessment

Course Code	CSC 450	Course Category	Core Elective (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 information security performance metrics, common issues, and audit methodologies.
2. Learn pre-audit preparations, vulnerability analysis, and post-audit actions, including report writing and result analysis.
3. Explore vulnerabilities, threats, and vulnerability management techniques, including scanning and remediation.
4. Master vulnerability assessments, risk assessment, and management, including risk treatment and feedback loops.
5. Gain insights into configuration management, policy development, and testing for secure environments.

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 report on information security performance metrics and variances effectively	1	70 %	65%
Outcome 2	conduct thorough information security audits, including vulnerability analysis and result interpretation	3	70 %	65%
Outcome 3	manage vulnerabilities, conduct threat assessments, and implement remediation strategies	5	70 %	65%
Outcome 4	perform comprehensive information security risk assessments and managing residual risks.	4	70 %	65%
Outcome 5	demonstrate competence in configuring and managing secure environments through effective configuration reviews and policy development.	2	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2	3			1					3	2	1
Outcome 2	3	3	2	3	3			2					2	2	2
Outcome 3	3	3	3	3	3			2					2	2	2
Outcome 4	3	3	3	3	3			2					2	3	2
Outcome 5	3	3	3	3	3			3	2				2	2	2
Average	**3**	**3**	**3**	**3**	**3**			**2**	**2**				**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Information Security Performance Metrics and Audit**	**9**		
1	Introduction to Security Metrics and Reporting	1	1	1
2	Common Issues and Variances of Performance Metrics	1	1	1
3	Introduction to Security Audit	1	1	1
4	Servers and Storage Devices Security	1	1	1
5	Infrastructure and Network Security	1	1	1
6	Communication Routes and Information Flow	1	1	1
7	Information Security Methodologies (Black-box, White-box, Greybox)	1	1	1
8	Phases of Information Security Audit and Strategies	1	1	1
9	Ethics of an Information Security Auditor and NOS 9003	1	1	1
Unit 2	**Information Security Audit Tasks, Reports and Post Auditing Actions**	**9**		
10	Pre-Audit Checklist and Information Gathering	1	2	1
11	Vulnerability Analysis and Assessment	1	2	1
12	External Security Audit	1	2	1
13	Internal Network Security Audit	1	2	1
14	Firewall Security Audit	1	2	1
15	IDS Security Auditing	1	2	1
16	Social Engineering Security Auditing	1	2	1
17	Web Application Security Auditing	1	2	1
18	Information Security Audit Deliverables & Reporting	1	2	1
Unit 3	**Vulnerability Management**	**9**		
19	Introduction to Information Security Vulnerabilities	1	3	1,2
20	Human-based Social Engineering Techniques	1	3	1,2
21	Computer-based Social Engineering Strategies	1	3	1,2
22	Social Media Countermeasures and Defense	1	3	1,2
23	Vulnerability Management Fundamentals	1	3	1,2
24	Vulnerability Scanning Methods	1	3	1,2
25	Vulnerability Testing and Assessment	1	3	1,2
26	Threat Management and Mitigation	1	3	1,2
27	Remediation and Security Improvement Processes	1	3	1,2
Unit 4	**Information Security Assessments**	**9**		
28	Introduction to Vulnerability Assessment	1	4	1,2
29	Classification of Vulnerabilities	1	4	1,2
30	Types of Vulnerability Assessment	1	4	1,2
31	Vulnerability Assessment Phases	1	4	1,2
32	Vulnerability Analysis Stages	1	4	1,2
33	Characteristics of a Good Vulnerability Assessment Solution	1	4	1,2
34	Considerations in Vulnerability Assessment	1	4	1,2
35	Vulnerability Assessment Reports and Tools	1	4	1,2
36	Information Security Risk Assessment and Management	1	4	1,2
Unit 5	**Configuration Reviews**	**9**		
37	Introduction to Configuration Management	1	5	1,2
38	Configuration Management Requirements and Documentation	1	5	1,2
39	Developing a Configuration Management Plan	1	5	1,2
40	Configuration Control and Change Management	1	5	1,2
41	Creating Configuration Control Policies	1	5	1,2
42	Testing in Configuration Management	1	5	1,2
43	Configuration Audits and Compliance	1	5	1,2
44	Configuration Management Tools and Software	1	5	1,2
45	Best Practices in Configuration Management	1	5	1,2

	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 (20%)	CLA-2 (10%)	CLA-3 (10%)	
		Th	Th	Th	Th	Th
Level 1	Remember	70%	60%	50%	40%	30%
	Understand					
Level 2	Apply	30%	40%	40%	50%	50%
	Analyse					
Level 3	Evaluate	-	-	10%	10%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Vladimirov, A., Gavrilenko, K., & Michalowski, K. Assessing Information Security (strategies, tactics, logic and framework)
2. Peter, S. The Art of Computer Virus Research and Defense.

Other Resources

1. https://www.sans.org/readingroom/whitepapers/threats/implementing-vulnerability-management-process-34180.
2. http://csrc.nist.gov/publications/nistpubs/800-40-Ver2/SP800-40v2.pdf.

Course Designers

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

Digital Forensics and Incident Response

Course Code	CSC 451	**Course Category**	Core Elective (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 fundamentals of incident response, cybersecurity forensics principles, and their relevance to cybersecurity operation.
2. Develop proficiency in preparation, including the formulation of policies, incident handling workflows, and the use of various incident response tools.
3. Gain expertise in the identification phase by mastering techniques for detection, triage, and incident classification, along with the use of indicators of compromise (IOCs).
4. Acquire the skills needed for effective containment, including damage limitation, system isolation, and forensic backup and imaging, while limiting malware spread.
5. Explore the digital forensics investigation process, including applicable laws, evidence collection, chain of custody, and the use of technical forensics tools and techniques, such as those for analysing hard disks, file systems, network devices, and mobile devices.

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	Apply incident response phases, policies, and procedures in real-world cybersecurity scenarios	3	75 %	70%
Outcome 2	Effectively identify and classify security incidents using indicators of compromise (IOCs) and triage techniques.	2	70 %	65%
Outcome 3	Demonstrate proficiency in containing and mitigating security incidents while limiting damage and malware spread.	4	70 %	65%
Outcome 4	Conduct digital forensics investigations in compliance with applicable laws and chain of custody requirements.	3	70 %	65%
Outcome 5	Utilize a range of technical forensics tools and techniques to analyze digital evidence and investigate cyberattacks.	4	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	3			3	3				3	2	2
Outcome 2	2	2	3	3	3			3	3				2	2	2
Outcome 3	2	3	3	2	3			3	3				2	3	2
Outcome 4	3	3	3	3	3			3	3				2	3	2
Outcome 5	2	3	3	3	3			3	3				2	3	2
Average	**2**	**3**	**3**	**3**	**3**			**3**	**3**				**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I	**Introduction**	**08**		
	Definitions of incident response and forensic analysis, relation of incident response to the rest of cybersecurity operations	2	1	1,2
	Incident response phases - preparation, identification, containment, eradication, recovery,	2	1,2	1,2
	Incident response phases- follow-up, indicators of compromise (IOC)	1	1,2	1,2,3
	forensic analysis as an incident response tool and as support for cybercrime investigations	2	1,2	1,2,3
	cybersecurity forensics principles	1	1,2	3,7
UNIT II	**Preparation, Identification, Containment**	**12**		
	Preparation: Policies and procedures, incident workflows, guidelines, incident handling forms, principles of malware analysis	2	3	3,7
	Preparation: log analysis, threat intelligence, vulnerability management, penetration testing	2	3	3,7
	Preparation: digital forensics, incident ticketing systems, incident documentation templates	2	2	3,7
	Identification: Detection, incident triage, information gathering and reporting, incident classification, indicators of compromise (IOC).	2	2	3,7
	Identification: incident classification, indicators of compromise (IOC).	1	2	3,7
	Containment: Damage limitation, network segment isolation, system isolation	1	2,3	3,7
	Containment forensic backup and imaging, use of write blockers, temporary fixes, malware spread limitation.	2	2,3	3,7
UNIT III	**Eradication, Recovery, Follow-up**	**9**		
	Eradication: Actual removal and restoration of affected systems, removal of attack artifacts, scanning of other systems to ensure complete eradication, use of IOCs on other systems and local networks,	2	3	4,5
	Eradication: cooperation with forensic analysis to understand the attack fully.	1	3	4,5
	Recovery: Test and validate systems before putting back into production, monitoring of system behaviour	2	3	4,5
	Recovery: ensuring that another incident will not be created by the recovery process.	1	3	4,5
	Follow-up: Documenting lessons learned	1	3	4,5
	Follow-up: preparatory activities for similar future incident, technical training, process improvement.	2	3	4,5
UNIT IV	**Digital Forensics Investigation Process:**	**6**		
	Applicable laws,	1	4	6,7
	investigation methodology,	1	4,5	6,7
	chain of custody, evidence collection, digital evidence principles	2	4	6,7
	rules and examination process, first responder procedures.	2	4	6,7
UNIT V	**Technical forensics tools and techniques:**	**10**		
	Hard disks, removable media and file systems,	1	4,5	5,6
	Windows forensics, duplication/imaging of forensic data,	2	4,5	4,5,6
	recovering deleted files and hidden or deleted partition	1	4,5	5,6
	steganography and image forensics	2	5	7

	log analysis, password crackers, network device forensics, packet capture analysis,	2	5	5,6
	email tracking, mobile forensics, investigation of attacks, common tools (Encase, FTK, etc.)	2	5	5,6
Total Contact Hours		45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Exam (40%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (25%)	
Level 1	Remember	70%	50%	70%	30%	50%
	Understand					
Level 2	Apply	30%	50%	30%	70%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Jason, T. L., & Matthew, P. Incident Response & Computer Forensics, 3rd ed.
2. Don Murdoch. Blue Team Handbook: Incident Response Edition: A condensed field guide for the Cyber Security Incident Responder.
3. Leighton Johnson. Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response".
4. John Sammons. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics.
5. Cory, A., & Harlan, C. Digital Forensics with Open Source Tools.
6. David, L.W., & Andrew, J. Digital Forensics Processing and Procedures.
7. IEEE Journals and Magazines.

Other Resources

Course Designers

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

Security Analytics

Course Code	CSC 452	Course Category	Core Elective (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 fundamentals of information security and its relevance in modern data-driven environments
2. Explore deep packet inspection techniques for web security, including one-class multi-classifier systems and host intrusion detection.
3. Develop skills in automated correlation for constructing attack scenarios and gain insights into the challenges of privacy in security analytics.
4. Analyse security challenges and solutions for big data environments, including anomaly detection, anonymization, and encryption.
5. Examine the importance of privacy in big data and its legal aspects, covering topics such as GDPR or PDP compliance, digital identity protection, and defense against model poisoning attacks.

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	apply data mining techniques for effective network intrusion detection and web security.	1	70 %	65%
Outcome 2	understand and apply adversarial machine learning concepts to enhance security analytics	3	70 %	65%
Outcome 3	implement security measures for big data, including anonymization and encryption.	5	70 %	65%
Outcome 4	evaluate privacy preservations in big data, compliance data protection laws.	4	70 %	65%
Outcome 5	develop the capability to defend against model poisoning attacks in machine learning for security applications.	3	70 %	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2	3			1					3	2	1
Outcome 2	3	3	2	3	3			2					2	2	2
Outcome 3	3	3	3	3	3			2					2	2	2
Outcome 4	3	3	3	3	3			2					2	3	2
Outcome 5	3	3	3	3	3			3	2				2	2	2
Average	**3**	**3**	**3**	**3**	**3**			**2**	**2**				**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Information Security Performance Metrics and Audit**	**9**		
1	Introduction to Information Security	1	1	1
2	Data Mining for Information Security Fundamentals	1	1	1
3	Signature-Based Network Intrusion Detection (e.g., Snort)	1	1	1
4	Data Mining-Based Network Intrusion Detection (Supervised)	1	1	1
5	Data Mining-Based Network Intrusion Detection (Unsupervised)	1	1	1
6	NIDS Overview and Significance	1	1	1
7	Hands-on with Snort: Signature-Based Detection	1	1	1
8	Building Supervised Data Mining Models for NIDS	1	1	1
9	Unsupervised Data Mining for Network Anomaly Detection	1	1	1
Unit 2	**Information Security Audit Tasks, Reports and Post Auditing Actions**	**9**		
10	Introduction to Deep Packet Inspection (DPI)	1	2	1
11	Alert Aggregation for Web Security	1	2	1
12	One-Class Multi-Classifier Systems for Packet Payload Modeling	1	2	1
13	Network Intrusion Detection with Multi-Classifiers	1	2	1
14	Host Intrusion Detection: Shell Command Sequence Analysis	1	2	1
15	Host Intrusion Detection: System Call Sequence Analysis	1	2	1
16	Host Intrusion Detection: Audit Trails Analysis	1	2	1
17	Insider Threats in Network Security	1	2	1
18	Strategies for Detecting Masqueraders, Impersonators, and Insider Threats	1	2	1
Unit 3	**Vulnerability Management**	**9**		
19	Introduction to Automated Correlation	1	3	1,2
20	Attack Trees: Understanding the Concept	1	3	1,2
21	Building Attack Scenarios from Individual Alerts	1	3	1,2
22	Privacy Issues in Security Analytics	1	3	1,2
23	Introduction to Adversarial Machine Learning	1	3	1,2
24	Overview of Multi-classifier Systems (MCS)	1	3	1,2
25	Advantages of MCS in Security Analytics	1	3	1,2
26	Security Implications of Machine Learning	1	3	1,2
27	Conclusion and Recap of Unit	1	3	1,2
Unit 4	**Information Security Assessments**	**9**		
28	Introduction to Anomaly Detection in Cloud Big Databases	1	4	1,2
29	Data Anonymization and Pseudonymization Techniques	1	4	1,2
30	Understanding Differential Privacy	1	4	1,2
31	Differential Privacy Methods and Algorithms	1	4	1,2
32	Homomorphic Encryption for Data Privacy	1	4	1,2
33	Secure Multiparty Computation (SMC) Fundamentals	1	4	1,2
34	Combining Privacy Techniques for Enhanced Security	1	4	1,2
35	Privacy Challenges in Cloud Big Databases	1	4	1,2
36	Anomaly Detection for Data Protection	1	4	1,2
Unit 5	**Configuration Reviews**	**9**		
37	Introduction to Anomaly Detection in Cloud Big Database Metrics	1	5	3
38	Anonymizing and Pseudonymizing Data for Privacy	1	5	3
39	Understanding Differential Privacy Principles	1	5	3
40	Methods of Implementing Differential Privacy	1	5	3
41	Exploring Homomorphic Encryption for Data Security	1	5	3
42	Secure Multiparty Computation Techniques	1	5	3
43	Data Protection Laws for Big Data and Their Implications	1	5	3
44	Compliance with Data Protection Regulations	1	5	3

45	Ensuring Data Privacy in Big Data: From Personal Data to Model Poisoning Attack Defense	1	5	3
	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 (20%)	CLA-2 (10%)	CLA-3 (10%)	
		Th	Th	Th	Th	Th
Level 1	Remember	70%	60%	50%	40%	30%
	Understand					
Level 2	Apply	30%	40%	40%	50%	50%
	Analyse					
Level 3	Evaluate	-	-	10%	10%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Daniel, B., & SushilJajodia. (2002). Applications of Data Mining in Computer Security, Vol. 6. Springer Science & Business Media.
2. Marcus A. M. (2006). Machine Learning and Data Mining for Computer Security", Springer Science & Business Media.
3. Mark, T., Robert, McP., Miyamoto, I., & Jason, M. (2014). Information Security Analytics: Finding Security Insights, Patterns, and Anomalies in Big Data, Syngress Media, U.S.

Other Resources

1. Vemuri, V. R. (2005). Enhancing Computer Security with Smart Technology, Auerbach Publications.
2. William Stallings. (2010). Cryptography and Network security: Principles and Practices Pearson/PHI, 5th ed.
3. Douglas, R. S. (2006). Cryptography Theory and Practice. Chapman & Hall/CRC, 3rd ed.
4. Siddhartha Bhattacharyya (2017). Frontiers in Computational Intelligence. Vol. 3, De Gruyter.

Course Designers

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Multiview Geometry

Course Code	CSC 453	Course Category	Core Elective (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. Introduce the basic and advanced imaging technique
2. Explain the concepts of 3D modelling using single view to multi view
3. To gain knowledge over accessing and modification of 3D models in real-world scenario

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	Content creation editing and managing of camera model.	3	70%	65%
Outcome 2	Use and examine the inner content of the image for 3D modelling	3	70%	65%
Outcome 3	Use the architecture of 3D mesh, texture, point cloud and make them easy to handle.	3	70%	65%
Outcome 4	Implement systems using multiview and stereo camera system to solve user requirements.	6	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	2	1	2							3	3	2	1
Outcome 2	3	2	1	2	2							3	3	2	2
Outcome 3	3	3	3	2	2							3	3	2	2
Outcome 4	3	3	3	2	3							3	3	3	2
Average	**3**	**2**	**2**	**2**	**2**							**3**	**3**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	UNIT I: Introduction	10		
	Multiple View Geometry	1	1	1
	Projective Geometry	1	1	1
	Transformations and Estimation	1	1	1
	Projective Geometry and Transformations of 3D, Estimation – 2D Projective Transformations	3	1	1
	Algorithm Evaluation and Error Analysis, Feature points (SIFT, SURF, etc)	4	1	1
Unit 2	Camera system	8		
	Camera Models	3	1,2	1
	Computation of the Camera Matrix	3	1,2,4	1
	More Single View Geometry,	2	1,2	1
Unit 3	Epipolar Geometry	9		
	Epipolar Geometry and the Fundamental Matrix	1	2	1
	3D Reconstruction of Cameras and Structure	1	2	1
	Computation of the Fundamental Matrix	1	2,4	1
	Structure Computation	3	2,4	1
	Scene planes and homographies	1	2,3	1
	Affine Epipolar Geometry	2	2	1
Unit 4	Multiple camera	7		
	Three-View Geometry/ multiview geometry	2	3	1
	The Trifocal Tensor	2	3	1
	Computation of the Trifocal Tensor	1	3	1
	Linearities and Multiple View Tensors	1	3	1
	Auto-Calibration	1	3	1
Unit 5	3D Model	11		
	Stereo Calibration	2	3,4	1
	Stereo Modelling	2	4	1
	3D modelling rectification	2	4	1
	Depth Estimation	1	4	1
	Stereo SFM	1	4	1
	3D model application like :planner form from 3D image, crack and fault detection, stereo camera-based 3D inspection	3	4	1
	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 (20%)		CLA-2 (10%)		Mid-2 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		40%		10%	
	Understand										
Level 2	Apply	40%		40%		40%		40%		50%	
	Analyse										
Level 3	Evaluate	20%		20%		20%		20%		40%	
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Richard, H. & Andrew, Z. Multiple View Geometry in Computer Visio. Cambridge press.

Other Resources

1. Recent articles about multimedia (recommended at classes)

Course Designers