Department of Civil Engineering

B.Tech. Civil Engineering
Curriculum and Syllabus

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

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

Department Vision

To emerge as a premier department recognized globally for creating knowledge in the domain of civil engineering through innovative research and disseminating knowledge through a unique learning experience to serve society.

Department Mission

1. Create an interdisciplinary academic environment that strives for excellence to overcome emerging challenges.
2. Cultivate innovative and entrepreneurial spirit by imparting research-based education to solve contemporary real-world problems.
3. Inspire students and faculty to nurture a service attitude by providing a diverse work environment.

Program Educational Objectives (PEO)

1. Develop technically sound Civil Engineers with the knowledge of fundamentals, engineering practice, and contemporary and future research directions.
2. Equip students with all the required tools and provide exposure to the latest technologies in the civil engineering industry.
3. Make successful and innovative Civil Engineers who are familiar with principles of safety, sustainability, economy, and ethics.

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

	PEO 1	PEO 2	PEO 3
Mission Statement 1	3	3	3
Mission Statement 2	2	3	2
Mission Statement 3	3	2	3

Program Specific Outcomes (PSO)

1. Demonstrate applications of civil engineering principles in a multi-disciplinary and interdisciplinary environment.
2. Apply advanced analytical techniques, latest technologies, and management skills in solving real-world challenges of Civil Engineering.
3. Design innovative, sustainable, and cost-effective civil engineering projects by working within the framework of the required safety measures and ethical practices.

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

Program Learning Outcomes (PLO)															
PEOs	POs												PSOs		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
PEO 1	3	3	3	3	2	1	3	2	2	2	2	2	3	3	3
PEO 2	3	3	3	3	3	1	3	1	2	2	3	2	3	3	3
PEO 3	3	3	3	3	2	3	3	3	3	3	3	2	3	3	3

Category Wise Credit Distribution			
Course Sub-Category	**Sub-Category Credits**	**Category Credits**	**Learning Hours**
Ability Enhancement Courses (AEC)		8	240
University AEC	4		
School AEC	4		
Value Added Courses (VAC)		8	240
University VAC	8		
School VAC	0		
Skill Enhancement Courses (SEC)		17	510
School SEC	11		
Department SEC	0		
SEC Elective	6		
Foundation/ Interdisciplinary courses (FIC)		18	540
School FIC	18		
Department FIC	0		
Core + Core Elective including Specialization (CC)		81	2430
Core	66		
Core Elective (Inc Specialization)	15		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		16	480
Internship / Design Project / Startup / NGO	4		
Internship / Research / Thesis	12		
Total		**163**	**4890**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	2	2	2	2	0	0	0	0	8	5
Value Added Courses - VAC	2	2	0	0	0	4	0	0	8	5
Skill Enhancement Courses - SEC	3	2	3	3	3	3	0	0	17	10
Foundation / Interdisciplinary Courses - FIC	12	6	0	0	0	0	0	0	18	11
CC / SE / CE / TE / DE / HSS	0	8	14	15	18	17	9	0	81	50
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	12	16	10
Grand Total	**19**	**20**	**22**	**23**	**24**	**27**	**16**	**12**	**163**	**100**

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

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

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

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

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

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

SEMESTER - I

S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	U AEC	AEC 101	Art of Listening, Speaking and Reading Skills	1	0	1	2
2	VAC	U VAC	VAC 101	Environmental Science	2	0	0	2
3	SEC	S SEC	SEC 101	Analytical Reasoning and Aptitude Skills	1	1	1	3
4	FIC	S FIC	FIC 106	Fundamentals of Chemistry for Engineers	2	0	1	3
5	FIC	S FIC	FIC 103	Calculus for Engineers	3	0	0	3
6	FIC	S FIC	FIC 104	Fundamentals of Computing and Programming in C	3	0	1	4
7	FIC	S FIC	FIC 101	Emerging Technologies	2	0	0	2
				Semester Total	**14**	**1**	**4**	**19**

SEMESTER - II

S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	U AEC	AEC 107	Effective Writing and Presentation Skills	1	0	1	2
2	VAC	U VAC	VAC 102	Universal Human Values and Ethics	2	0	0	2
3	SEC	S SEC	SEC 103	Entrepreneurial Mindset	2	0	0	2
4	FIC	S FIC	FIC 105	Principles of Economics and Management	3	0	0	3
5	FIC	S FIC	FIC 117	Linear Algebra and Differential Equations	3	0	0	3
6	Core	CC	CVE 101	Structural Mechanics	2	1	1	4
7	Core	CC	CVE 102	Fluid Mechanics	2	1	1	4
				Semester Total	**15**	**2**	**3**	**20**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	AEC 103	Problem-Solving Skills	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	S SEC	SEC 115	Data Structures	2	0	1	3
5	Core	CC	CVE 201	Spatial Data Acquisition	2	1	1	4
6	Core	CC	CVE 202	Probability and Statistics	3	0	0	3
7	Core	CC	CVE 203	Civil Engineering Materials	2	0	1	3
8	Core	CC	CVE 204	Analysis of Determinate and Indeterminate Structures	2	1	1	4
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**15**	**2**	**5**	**22**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	AEC 104	Creativity and Critical thinking Skills	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	S SEC	SEC 133	Numerical Methods and its Application in Civil Engineering	1	1	1	3
5	Core	CC	CVE 205	Reinforced Concrete Design	3	0	1	4
6	Core	CC	CVE 206	Soil Behaviour and Engineering	2	1	1	4
7	Core	CC	CVE 207	Modern Highway Engineering	2	1	1	4
8	Core	CC	CVE 208	Engineering Hydrology	1	1	1	3
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**13**	**4**	**6**	**23**

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	CVE 301	Computer Aided Drawing and Estimation	1	1	1	3
5	Core	CC	CVE 302	Geotechnical Analysis and Design	2	1	1	4
6	Core	CC	CVE 303	Physico-chemical Water Treatment: Materials and Processes	2	1	1	4
7	Core	CC	CVE 304	Remote Sensing and GIS	1	1	1	3
8	Core	CC	CVE 305	High-Speed Railways, Airways, and Waterways Engineering	2	1	1	4
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**14**	**5**	**5**	**24**

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	Core	CC	CVE 306	Wastewater, Treatment: Disposal to Resource Recovery	2	0	1	3
5	Core	CC	CVE 307	Building Information Modelling and Management	2	0	2	4
6	Core	CC	CVE 308	Design of Steel Structures	3	0	1	4
7	Elective	CE		Core Elective	2	0	1	3
8	Elective	CE		Core Elective	2	0	1	3
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**17**	**0**	**10**	**27**

SEMESTER - VII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE		Core Elective	2	0	1	3
2	Elective	CE		Core Elective	2	0	1	3
3	Elective	CE		Core Elective	2	0	1	3
4	Elective	OE		Open Elective / Minor	3	0	0	3
5	RDIP	RDIP	CVE 309	Summer Internship	0	0	4	4
				Semester Total	**9**	**0**	**7**	**16**

SEMESTER - VIII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	CVE 310	Major Project	0	0	12	12
				Semester Total	**0**	**0**	**12**	**12**

Core Electives								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE / SE	CVE 424	Environmental Geotechnics	3	0	0	3
2	Elective	CE / SE	CVE 427	Introduction to Structural Dynamics	3	0	0	3
3	Elective	CE / SE	CVE 428	Introduction to Computational Solid Mechanics	3	0	0	3
4	Elective	CE / SE	CVE 430	Introduction to Drone Technology and Applications	2	1	0	3
5	Elective	CE / SE	CVE 431	Design of Hydraulic Structure and Irrigation System	2	0	1	3
6	Elective	CE / SE	CVE 436	Water resource planning and management	2	0	1	3
7	Elective	CE / SE	CVE 437	Advanced Pavement Design and Maintenance	2	0	1	3
8	Elective	CE / SE	CVE 451	Sustainable Waste Management Systems	3	0	0	3
9	Elective	CE / SE	CVE 453	Air Quality in Changing Environments	3	0	0	3
10	Elective	CE / SE	CVE 456	Finite Element Method for Structural Engineers	2	0	1	3
11	Elective	CE / SE	CVE 459	Designing with Geosynthetics	3	0	0	3
12	Elective	CE / SE	CVE 460	Sustainable Pavement Materials and Construction	2	0	1	3

Open Electives								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	OE	OE	CVE 241	Building Information Modelling	3	0	0	3
2	OE	OE	CVE 242	Highway Engineering and Management	3	0	0	3
3	OE	OE	CVE 243	Principles and Practice in Infrastructure and Environment	3	0	0	3
4	OE	OE	CVE 244	Water Resources for Smart and Livable Cities	3	0	0	3
5	OE	OE	CVE 245	Construction Methods and Equipment	3	0	0	3
6	OE	OE	CVE 246	Socio-economic Sustainable Developments	3	0	0	3
7	OE	OE	CVE 247	Remote Sensing and GIS applications in Engineering	3	0	0	3
8	OE	OE	CVE 248	Drones for Asset Management	3	0	0	3
9	OE	OE	CVE 249	Civil Engineering Profession-Developing Nations	3	0	0	3
10	OE	OE	CVE 250	Heritage Structures & Conservation Strategies	3	0	0	3
11	OE	OE	CVE 251	Availability and Management of Groundwater Resources	3	0	0	3
12	OE	OE	CVE 252	Introduction to Reliability Engineering	3	0	0	3
13	OE	OE	CVE 253	Optimization methods for Civil Engineering	3	0	0	3
14	OE	OE	CVE 254	Introduction to Civil Engineering Profession	3	0	0	3

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Art of Listening, Speaking and Reading Skills

Course Code	AEC 101	**Course Category**	AEC		**L**	**T**	**P**	**C**
					1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Literature and Languages	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To develop the students' ability to comprehend spoken language in various contexts
2. To help them build confidence and fluency in speaking through structured activities, discussions, and presentations.
3. To enhance their reading skills by engaging with a variety of texts, including literary works, informational articles, and academic writings.

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 effective listening strategies by accurately summarizing and responding to spoken content in various contexts	2	70%	65%
Outcome 2	Students will be able to critically analyze spoken and written texts to identify underlying themes, arguments, and perspectives.	3, 4	75%	70%
Outcome 3	Students will construct and deliver coherent and engaging oral presentations and written responses that integrate information from multiple sources.	5, 6	70%	60%

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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1		1				1			3	3	1	2			
Outcome 2		2				2			3	3	2	2			
Outcome 3		3				3			3	3	3	2			
Average		**2**				**2**			**3**	**3**	**2**	**2**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Augmenting Listening skills**	**9**		
	Course introduction and objectives: Importance of LSRW	1	1	1 a
	Listening - Barriers to active listening and steps to Overcome	2	1	1 b
	Listening Comprehension How to take/ make notes (different ways)	2	1	1b, 2a, 2c
	Listening practice: Identifying main ideas, supporting details, and inferences and summarizing key points	2	1	1b, 2a, 2c
	Practice sessions: memory games, Chinese whisper	2	1	NA
Unit 2	**Developing Speaking Skills**	**9**		
	Strategies for good speech, Basics of grammatically correct speech	1	2	1a, 2 a, b, c
	Basics of phonetics and intonation	2	2	1a
	Oral presentations: do's and don'ts	1	2	1a
	Speaking Practice: Just a minute/ Impromptu, Story-telling/ Story starters Group discussions,	5	2	NA
Unit 3	**Communication and Persuasion**	**9**		
	Verbal Communication and Nonverbal Communication	2	2, 3	1a
	The art of persuasive communication (Ethos, pathos, Logos)	2	2, 3	1a
	Practice sessions (Convince the other Role plays, Self-introduction, Pitching, extempore, public speaking)	5	2, 3	NA
Unit 4	**Reading**	**9**		
	Reading strategies (Skimming and scanning, extensive and intensive)	2	2	1c
	Reading and analyzing various texts, including articles, essays, and academic papers	3	2	1c
	Reading Comprehension Practice	4	2	1c, 2a
Unit 5	**Integrated Skills and Real-World Application**	**9**		
	Engaging in discussions and debates on current issues	2	3	NA
	Real-world application of language skills (e.g., job interviews, social interactions)	2	3	NA
	Pitching Presentation	5	3	NA
	Total contact hours	45		
	Notional hours	15		
	Total Leaning Hours	**60**		

Learning Assessment

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

Recommended Resources

1a. Shoba, L. (2017). Communicative English: A Workbook. U.K: CambridgeUniversity Press.
1b. Leonardo, N. (2020) Active Listening Techniques: 30 Practical Tools to Hone Your Communication Skills. Rockridge Press
1c. Williams, A.J. (2014) Reading Comprehension: How To Drastically Improve Your Reading Comprehension and Speed Reading Fast! (Reading Skills, Speed Reading)

2a. https://learnenglishteens.britishcouncil.org/
2b. https://www.bbc.co.uk/learningenglish/
2c. https://www.ted.com/?geo=hi

Other Resources

1. -

Course Designers

1. -

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Environmental Science

Course Code	VAC 101	**Course Category**	VAC	**L**	**T**	**P**	**C**
				2	0	0	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Environmental Science and Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To describe the environmental concepts from ecology and earth science to address real-world problems.
2. To interpret the complex interactions within and between environmental systems and to evaluate evolving environmental 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	Comprehend the environmental challenges that need attention.	1	80%	70%
Outcome 2	Summarize the types of environmental pollutions and possible effects to society	2	80%	70%
Outcome 3	Classify the natural environmental resources, present state, rate of depletion and future perspectives	2	80%	70%
Outcome 4	Articulate a project-based learning on existing local to global environmental issues	2	80%	70%

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	-	-	-	-	1	1	2	-	2	1	-	1	-	-	-
Outcome 2	-	1	-	1	1	1	2	-	2	1	-	1	-	-	-
Outcome 3	-	1	-	1	1	1	3	-	2	1	-	1	-	-	-
Outcome 4	1	1	1	2	1	2	3	2	2	2	2	2	-	-	-
Average	1	1	1	1.33	1	1.25	2.5	2	2	1.25	2	1.25	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Human, Environmental Issues, and Climate Change**	**6**	1	1,2,3
	The man-environment interaction	1	1	1,2,3
	Environmental issues and scales	1	1	1,2,3
	Land use and Land cover change	2	1	1,2,3
	Ozone layer depletion	1	1	1,2,3
	Understanding climate change and adaptation	1	1	1,2,3
Unit 2	**Environmental Pollution and Health**	**7**	2	1,2,3
	Understanding pollution; Definitions, sources, impacts on human health and ecosystem	2	2	1,2,3
	Air pollution	1	2	1,2,3
	Water pollution	1.5	2	1,2,3
	Soil pollution	1	2	1,2,3
	Solid waste	1.5	2	1,2,3
Unit 3	**Ecosystems, Biodiversity Conservation, and Sustainable Development**	**9**	3	1,2,3
	Ecosystems and ecosystem services	1	3	1,2,3
	Biodiversity and its distribution	1	3	1,2,3
	Threats to biodiversity and ecosystems	1	3	1,2,3
	Overview of natural resources	1	3	1,2,3
	Biotic resources	1	3	1,2,3
	Water resources; Soil and Energy resources	2	3	1,2,3
	Introduction to Sustainable Development Goals (SDGs)-targets and indicators	2	3	1,2,3
Unit 4	**Environmental Management, Treaties and Legislation**	**8**	4	1,2,3
	Introduction to environmental laws and regulation	2	4	1,2,3
	Environmental management system	2	4	1,2,3
	Pollution control and management	2	4	1,2,3
	Major International Environmental Agreements; Major Indian Environmental Legislations	2	4	1,2,3
Total Contact Hours		30		

Learning Assessment

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

Recommended Resources

1. Rajagopalan, R. (2016) Environmental Studies (3rd edition), Oxford University Press.
2. Sharma, P. D. (2018) Ecology and environment. Rastogi Publications.
3. Anil K. Dey. (2016). Environmental Chemistry. New Age Publisher International Pvt Ltd. ISBN: 9789385923890, 9385923897

Other Resources

Course Designers

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Analytical Reasoning and Aptitude Skills

Course Code	SEC 101	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	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 Time and Distance and Time and work 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)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 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	3			2			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quantitative Aptitude**	**14**		
	Time, speed and distance	5	1,4	1,4
	Time and work, Pipes and cisterns	9	1,4	1,4
Unit II	Numbers, LCM and HCF.	2	1,4	1,4
	P and C	4	1,4	1,4
	Probability, progressions	4	1,4	1,4
Unit III	Geometry, Mensuration	5	1,2	2,3
	Clocks and calendars	4	1,3	1,4
Unit IV	Linear equation and special equations	5	1,2	1,2
	Quadratic equations	2	1,2	1,2
	Inequalities	2	2,3	2,3
	Sets and Venn diagrams	3	1,2	2,4
Total Contact Hours		**45**		

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%		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.

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Fundamentals of Chemistry for Engineers

Course Code	FIC 106	Course Category	FIC	L	T	P	C
				2	0	1	3
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 can predict the structure, electronic and magnetic properties of small molecules.
2. To learn the type of chemical reactions based on the reaction energetics and kinetics. Also interpret stability of the binary materials based on temperature, pressure, and concentration.
3. To gain in-depth knowledge about crystalline materials.
4. To understand the types of polymers and familiar with industrial applications of common synthetic and biodegradable polymers.
5. To learn the formation of proper electrochemical cell. Also, can choose the appropriate indicator for a given acid base titration and may also predict the pH and pOH of the given solutions.

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 also can predict the structure, electronic and magnetic properties of small molecules	2	70%	85%
Outcome 2	Interpret Phase rule and Kinetics based on temperature, pressure, and concentration	2	70%	85%
Outcome 3	Summarize crystalline materials.	2	70%	85%
Outcome 4	Identify the types of polymers and industrial applications of common synthetic and biodegradable polymers	2	70%	85%
Outcome 5	Demonstrate electrochemical cell	3	70%	85%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	2	1	2	1	-	2	-	2	-	1	2	-	-	-
Outcome 2	-	2	3	2	2	-	2	-	2	-	2	1	-	-	-
Outcome 3	-	2	3	2	2	-	2	-	2	-	1	2	-	-	-
Outcome 4	-	2	2	2	2	-	2	-	2	-	2	2	-	-	-
Outcome 5	-	2	2	2	2	-	1	-	1	-	1	2	-	-	-
Average	-	**2**	**2**	**2**	**2**	-	**2**	-	**2**	-	**1**	**2**	-	-	-

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Chemical Bonding**	**13**		
	Ionic, covalent, and metallic bonds	1	1	1, 2, 4
	Theories of bonding: Valence bond theory, nature of covalent bond, sigma (σ) bond, Pi (π) bond.	1	1	1, 2, 4
	Hybridization: Types of hybridization, sp, sp2, sp3, sp3d, d2sp3.	1	1	1, 2, 4
	Shapes of molecules (VSEPR Theory): $BeCl_2$, CO_2, BF_3, H_2O, NH_3, CH_4, PCl_5, XeF_2, SF_6, XeF_4.	4	1	1, 2, 4
	Molecular orbital theory: Linear combination of atomic orbitals (LCAO Method)	1	1	1, 2, 4
	Bond order, homo- nuclear diatomic Molecules (H_2, O_2, N_2)	1	1	1, 2, 4
	Hetero-nuclear diatomic Molecules (NO, CO).	1	1	1, 2, 4
	Non-covalent interactions: Van der Waals interactions	1	1	1, 2, 4
	Dipole-dipole interactions	1	1	1, 2, 4
	Hydrogen bonding	1	1	1, 2, 4
Unit II	**Phase Rule, Thermochemistry and Kinetics**	**9**		
	Phase rule: Introduction	1	2	1, 2, 4
	Definition of the terms used in phase rule with examples	1	2	1, 2, 4
	Application of phase rule to water system water system	1	2	1, 2, 4
	Basics of thermochemistry: Standard terms in thermochemistry and their significance.	1	2	1, 2, 4
	Heat of combustion, formation and sublimation (with examples in fuels and propellants).	2	2	1, 2, 4
	Kinetics: Order and molecularity of reactions	1	2	1, 2, 4
	Zero order and first order reactions	1	2	1, 2, 4
	Second order reactions	1	2	1, 2, 4
Unit II	**Crystalline and Electronic Materials**	**10**		
	Crystal structure: crystal systems	2	3	2,4
	Properties of cubic crystals, Bragg's Law, Bravais lattices	1	3	2,4
	Miller indices	2	3	2,4
	Point defects	1	3	2,4
	Band theory: metals, insulators, and semiconductors.	2	3	2,4
	Band gaps, doping, and devices.	2	3	2,4
Unit IV	**Materials Chemistry**	**9**		
	Classification of polymers: Natural and synthetic.	1	4	1, 3
	Thermoplastic and Thermosetting polymers. Degree of polymerization.	2	4	1, 3
	Properties of polymers: Tg, Tacticity, Molecular weight, weight average.	2	4	1, 3
	Degradation of polymer	1	4	1, 3
	Common Polymers: Elastomer, Conducting polymer, biodegradable polymer.	1	4	1, 3
	Examples: PET (Polyethylene terephthalate), nylon, polystyrene.	1	4	1, 3
	Demineralization of water and Zeolite process.	1	4	1, 3
Unit V	**Electrochemistry**	**4**		
	Electrochemical cells	1	5	1, 2, 4
	Primary and secondary cells	1	5	1, 2, 4
	Lead-acid battery	1	5	1, 2, 4
	Li+ batteries and Fuel cells	1	5	1, 2, 4
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. A. Bahl, B.S. Bahl, G.D. Tuli, Essentials of Physical Chemistry, (2016), S Chand Publishing Company
2. T. Jain, Y. Jain, Engineering Chemistry, 16th Edition (2017), Dhanpat Rai Publication Company
3. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 1986. ISBN: 0-85226-307-4
4. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Edition (2013), Vishal Publication Company

Other Resources

Course Designers

1. Dr. S. Mannathan, Associate Professor, Department of Chemistry, SRM University – AP.
2. Dr. S. Chakrabortty, Assistant Professor, Department of Chemistry, SRM University – AP.
3. Prof. K.C. Kumaraswamy, Professor, Department of Chemistry, University of Hyderabad.
4. Prof. G Ranga Rao, Professor, Department of Chemistry, IITM.

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

Calculus For Engineers

Course Code	FIC 103	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	0	0	3
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. Develop a comprehensive understanding of the fundamental concepts of calculus, including limits, derivatives, and integrals. Apply calculus techniques to solve a wide range of mathematical problems.
2. Utilize calculus to find extreme values of functions and understand the Mean Value Theorem.
3. Apply calculus to analyze monotonic functions, identify inflection points, and sketch curves.
4. Apply Lagrange multipliers to solve optimization problems with single constraints.
5. Calculate double and iterated integrals over various regions and in polar form.
6. Utilize triple integrals in rectangular coordinates and apply them to real-world scenarios to find volumes, masses, and more.

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 functions and their graphs to identify key characteristics such as domain, range, and behaviour.	1	75%	80%
Outcome 2	Calculate derivatives of single-variable functions at specific points and apply various differentiation rules.	2	70%	75%
Outcome 3	Determine definite and indefinite integrals of functions and their applications.	2	75%	80%
Outcome 4	Apply calculus techniques to solve practical problems, including finding extreme values of functions. Utilize the Mean Value Theorem to understand rate of change in real-world applications.	2	72%	75%
Outcome 5	Calculate gradients and directional derivatives and understand their applications in various fields.	2	75%	80%
Outcome 6	Compute double and triple integrals over various regions and apply calculus to real-world problems such as finding volumes, masses, and areas.	2	70%	75%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	2	2	-	-	-	-	-	-	-	-	2	2	2
Outcome 2	2	3	2	2	-	-	-	-	-	-	-	-	2	3	2
Outcome 3	2	3	2	2	-	-	-	-	-	-	-	-	2	2	2
Outcome 4	3	3	3	3	-	-	-	-	-	-	-	-	2	2	3
Outcome 5	2	3	3	2	-	-	-	-	-	-	-	-	2	2	2
Outcome 6	2	3	2	2	-	-	-	-	-	-	-	-	2	2	2
Average	**2**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Limit, Continuity, Derivative, and Integrals of Single Variable**	**10**		
	Functions and Their Graphs,	1	**1**	1
	Limit of a function at a point and limit laws,	2	**1**	1
	Continuity of a function,	1	**1**	1
	Derivative of a function at a point,	2	**2**	1
	Various rules of Derivative,	1	**2**	1
	Definite and indefinite integral,	2	**3**	1
	Fundamental Theorem of Calculus.	1	**3**	1
Unit II	**Applications of Calculus (Single Variable)**	**9**		
	Extreme Values of Functions	2	**4**	1
	The Mean Value Theorem, Monotonic Functions	2	**4**	1
	Concavity and curve sketching	2	**4**	1
	Newton's Method to find roots	1	**4**	1
	Area between curves	1	**4**	1
	Arc length.	1	**4**	1
Unit III	**Limit, Continuity, Partial Derivatives of Multi-Variables Function**	**10**		
	Three-dimensional rectangular coordinate systems	1	**1**	1
	Functions of several variables	2	**1**	1
	Limits and continuity	2	**5**	1
	Partial Derivatives	1	**5**	1
	The Chain Rule, Directional Derivatives,	2	**5**	1
	Gradient.	2	**5**	1
Unit IV	**Extrema of Multi-Variables Function**	**6**		
	Extreme values	1	**4**	1
	Saddle points	1	**4**	1
	Absolute Maxima and Minima on Closed Bounded Regions,	2	**4**	1
	Lagrange multipliers (Single Constraints).	2	**4**	1
Unit V	**Multiple Integrals**	**10**		
	Double and Iterated Integrals over Rectangles	2	**6**	1
	Double Integrals over General Regions.	2	**6**	1
	Area by Double Integration,	1	**6**	1
	Double Integrals in Polar Form	1	**6**	1
	Triple Integrals in Rectangular Coordinates	2	**6**	1
	Applications.	2	**6**	1
Total		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 60%				End Semester Exam 40%
		CLA-1 15%	Mid-1 25%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	30%	40%	40%	20%	40%
	Understand					
Level 2	Apply	40%	30%	30%	40%	30%
	Analyse					
Level 3	Evaluate	30%	30%	30%	30%	30%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Thomas Calculus, 14th Edition, Joel R.Hass, Christopher E.Heil, Maurice D. Weir,2018.

Other Resources

Course Designers

1. Prof. V. Kannan, Dr. Fouzul Atik, Dr. Sazzad Ali Biswas, Dr. Anirban Bose

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Fundamentals of Computing and Programming in C

Course Code	FIC 104	Course Category	FIC	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 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.

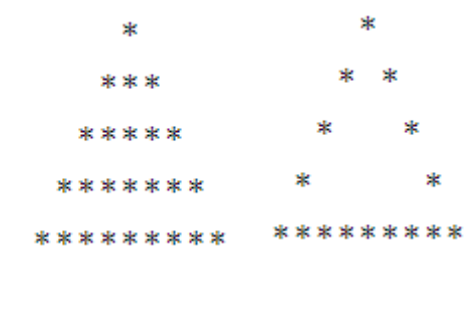
Course Outcomes / Course Learning Outcomes (CLOs)

	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)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 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 1	**Introduction To Computer Science**	**12**	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	1	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
	Lab Experiment 1: GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
	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 2	**C Programming Basics**	**12**		
	Structure of a C program, identifiers Basic data types and sizes. Constants, 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 Conversions Type Conversions,	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, examples, multi-way selection: switch, else-if, examples.	1	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 examples.	1	1,2	1,2
	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.	1	1, 2	1,2
	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
	Lab Experiment 5: Triangle star patterns  I II	2	1, 2	1,2

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 3	**Functions And Arrays**	**12**		
	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.	1	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	1	2,3	1,2
	array operations and examples, character arrays and string manipulations	1	2,3	1,2
	Lab Experiment 6: **a)** (nCr) and (nPr) of the given numbers $1+x+x^2\backslash 2+x^3\backslash 3!+x^4\backslash 4!+\ldots\ldots\ldots X^n\backslash n!$	1	2,3	1,2
	Lab Experiment 7: Interchange the largest and smallest numbers in the array. Searching an element in an array Sorting array elements.	1	2,3	1,2
	Lab Experiment 8: Transpose of a matrix. Addition and multiplication of 2 matrices.	1	2,3	1,2
	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.	1	2,3	1,2
	Lab Experiment 10: Pre-processor directives If Def Undef Pragma	1	2,3	1,2
Unit 4	**Pointers**	**12**		
	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	1	3,4	1,2
	pointers and multi-dimensional arrays, dynamic memory management functions	1	3,4	1,2
	command line arguments	1	3,4	1,2
	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
	Lab Experiment 11: Array of Int and Char Pointers. Array with Malloc(), calloc() and realloc().	2	3, 4	1,2,3
	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 5	**Enumerated, Structure and Union Types**	**12**		
	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,	2	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
	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
	Lab Experiment 14: File copy Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		**60**		

Learning Assessment

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

Recommended Resources

1. The C programming Language by Brian Kernighan and Dennis Richie.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Problem Solving and Program Design in C, Hanly, Koffman, 7th edition, PEARSON 2013.
4. Programming with C by R S Bichkar, Universities Press, 2012.

Other Resources

1. Programming with C, Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016

Course Designers

1. Dr. Ashok Kumar Pradhan, Associate Professor, Department of CSE, SRM University, AP

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

Emerging Technologies

Course Code	FIC 101	**Course Category**	FIC		**L**	**T**	**P**	**C**
					2	0	0	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	ECE	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. Foster a comprehensive grasp of diverse emerging technologies and their transformative impacts on society and industries.
2. Cultivate critical thinking skills to analyze challenges, opportunities, and applications within each technological domain.
3. Develop practical skills through hands-on experiences and assignments, translating theoretical concepts into real-world applications.
4. Raise awareness of ethical considerations, particularly in the context of Artificial Intelligence, encouraging responsible and informed decision-making.

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	Exhibit a thorough understanding of quantum computing principles, including superposition, entanglement, and interference.	1	80%	90%
Outcome 2	Illustrate understanding by explaining the history, synthesis, and applications of nanomaterial and green hydrogen.	1	80%	90%
Outcome 3	Understand and classify 3D printing technologies.	2	75%	85%
Outcome 4	Demonstrate understanding of the evolution, classification, and applications of UAVs.	2	75%	85%
Outcome 5	Apply knowledge of Artificial Intelligence and Machine Learning to address classification, regression, clustering, and decision-making problems.	2	75%	85%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	2	1	1	3	1	1	2	1	3	1	2	1	1	1
Outcome 2	1	2	1	2	1	1	2	2	2	1	1	2	1	1	1
Outcome 3	2	1	2	1	2	2	1	1	1	2	2	1	1	2	2
Outcome 4	3	3	3	2	1	3	2	3	2	1	3	3	2	2	1
Outcome 5	2	3	2	1	1	2	1	3	1	1	2	3	2	2	1
Average	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quantum Computing and Quantum Communications**			
	Quantum Computer and early ideas, classical and quantum computing approaches, superposition, entanglement, and interference in quantum computing.	1	1	1
	QUBITS and their types; representation of data in quantum mechanics.	1	1	1
	Shor's Algorithm, Grover's search algorithm.	1	1	1
	Quantum programming languages; Obstacles in building quantum computers.	1	1	1
	Applications of quantum computers; Opportunities in the field of quantum computing.	1	1	1
	Introduction of quantum communication pillers, quantum network, Heisenberg's uncertainty principle and QKD.	1	1	1
	Challenges in QKD, National Quantum Mission, Future perspectives.	1	1	1
Unit 2	**Unit 2: Nanotechnology and Green Hydrogen**			
	Introduction to the nanometer scale. history of nanomaterials	1	2	2
	Synthesis of nanomaterials: Bottom-up and Top-down approach	1	2	2
	tools & techniques to characterize nanomaterials. Applications of nanomaterials.	1	2	2
	Green Technology: Definition, types of Green Technologies, Green Hydrogen production.	1	2	2
	Challenges involved in the storage of Green Hydrogen produced from PEM based electrolysis.	1	2	2
	Applications of Green Hydrogen.	1	2	2
Unit 3	**3D Printing and Applications**			
	Introduction to 3D printing and additive manufacturing	1	3	3
	Capabilities of 3D printing	1	3	3
	Applications of 3D printing	1	3	3
	Classification based on ASTM	1	3	3
	Working principles of 3D printing technologies	1	3	3
Unit 4	**UAVs, Drones and Applications**			
	Introduction to the evolution of drones	1	4	4
	Classification of drones	1	4	4
	Basic components of drones	1	4	4
	Principles of flight	1	4	4
	Applications of drones	1	4	4
	Drones rules in India, Challenges and future scope.	1	4	4
Unit 5	**Introduction to Artificial Intelligence and Machine Learning**			
	Introduction to Artificial Intelligence, Machine Learning and Deep learning	1	5	5
	Supervised (Classification and regression) learning	1	5	5
	Unsupervised (Clustering) learning	1	5	5
	Reinforcement learning (Decision making)	1	5	5
	Features and Applications of AI and ML	1	5	5
	Threats of AI: Lack of Regulation.	1	5	5
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%					End Semester Exam 50%
		CLA-1 20%	CLA-2 20%	CLA-2 20%	CLA-3 20%	CLA-3 20%	
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. Quantum Computation and Quantum Information by Michael A. Nielsen, Isaac L. Chuang, Massachusetts Institute of Technology.
2. Nanotechnologies: Principles, Applications, Implications and Hands-on Activities – A compendium for educators by Luisa Filipponi and Duncan Sutherland, European Commission Research and Innovation.
3. Additive manufacturing: Principles, Technologies and applications by C.P. Paul and A.N. Jinoop, Publisher: McGraw Hill
4. Make: Getting Started with Drones: Build And Customize Your Own Quadcopter by Terry Kilby and Belinda Kilby.
5. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig

Other Resources

Course Designers

1. Dr. Sunil Chinnadurai, Assistant Professor, ECE Department.
2. Dr. Pardha Saradhi Maram, Associate Professor, Chemistry Department.
3. Dr. Sangjukta Devi, Assistant Professor, Mechanical Department.
4. Dr. Harish Puppala Assistant Professor, Civil Department.
5. Dr. Ravi Kumar, Assistant Professor, Physics Department.

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Effective Writing and Presentation Skills

Course Code	AEC 107	**Course Category**	AEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)	AEC 101	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Literature and Languages	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To demonstrate proficiency in written communication, including the ability to compose clear, grammatically structured writing.
2. To critically analyse information from various sources, conduct research effectively, and use evidence to support their arguments in both written assignments and oral presentations.
3. To enhance students' ability to express ideas clearly, engage an audience, and deliver persuasive and impactful messages in both written and spoken formats.

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 coherent and well-structured written communication by generating clear and concise written content with logical organization, appropriate grammar, vocabulary, and sentence structure.	1, 2	70%	60%
Outcome 2	Recognize and analyze the expectations of specific target audiences by adjusting tone, language and style to suit the intended purpose of the message and tailoring written content to various formats such as reports, essays, emails, and professional correspondence.	3, 4	70%	60%
Outcome 3	Increased Confidence in Public Speaking with the ability to deliver structured, well-organized, and persuasive presentations by employing visual and interactive aids, storytelling techniques.	5, 6	70%	70%
Outcome 4	Develop strong critical thinking and research skills, enabling students to evaluate information critically, synthesize sources effectively, and provide well-reasoned arguments in their written work and presentations.	3, 4, 5, 6,	60%	60%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	-	-	-	-	-	-	-	3	3	1	2	-	-	-
Outcome 2	-	2	-	-	-	1	-	-	3	3	2	2	-	-	-
Outcome 3	-	2	-	-	-	2	-	-	3	3	3	2	-	-	-
Outcome 4	-	2	-	-	-	3	-	-	-	-	-	-	-	-	-
Average	-	**2**	-	-	-	**2**	-	-	**3**	**3**	**2**	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Basics of Grammatically correct writing**	**9**	1	
	SVO	1	1	1a, 2a,b
	Punctuation	3	1	1a, 2a,b
	Articles and Preposition	2	1	1a, 2a, b
	Tense and Apostrophe	1	1	1a, 2a, b
	Subject-Verb-Agreement	2	1	1a, 2a, b
Unit 2	**Categories of Writing**	**9**		
	Emails – different types (Official mails : Requesting Leave/ Enquiring vacancy/ Resigning from job/ requesting internship etc.)	3	1, 2	1b, c
	Notice and Agenda,	2	1, 2	1b, c
	Minutes of Meeting	2	1, 2	1b, c
	Paragraph writing	2	1, 2	1b, c
Unit 3	**Advanced Writing**	**9**		
	Writing Cover Letters	3	1, 2	1e
	Resume writing	2	1, 2	1d
	SOP, Abstract	2	1, 2	1g
	Project Report Writing	2	1, 2	2, d
Unit 4	**Effective Presentation Techniques**	**9**		
	Understanding the elements of successful presentations – Non-verbal communication in presentaions	3	2,3, 4	1f, 2c
	Creating engaging PPTs	2	2,3, 4	1f, 2c
	Structuring presentations for clarity and impact - Logical flow of topics and connected writing in line with storyboard	2	2, 3, 4	1f, 2c
	Handling Questions and Answers	2	2, 3, 4	1f, 2c
Unit 5	**Project Based Learning**	**15**		
	Community Based Project	15	1, 2, 3, 4	NA
	Total Learning Hours	**60**		

Learning Assessment

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

Recommended Resources

1a) Swan, M. (2005). Practical English usage (Vol. 688). Oxford: Oxford university press.
1b) Fenning, C. (2023). Effective Emails: The secret to straightforward communication at work: 1 (Business CommunicationSkills): Sanage Publishing University Press.
1c) Talbot, F. (2009). How to Write Effective Business English: The Essential Toolkit for Composing Powerful Letters, Emails and More, for Today's Business Needs. Kogan Page Publishers
1d) Yate, M. (2016). Knock'em Dead Resumes: A Killer Resume Gets More Job Interviews! Simon and Schuster.
1e) Yate, M. J. (2018). Ultimate Cover Letters: Master the Art of Writing the Perfect Cover Letter to Boost Your Employability (Vol. 5). Kogan Page Publishers.
1f) Carnegie, D. (2013). The Art of Public Speaking. Wyatt North Publishing, LLC.
2a. https://learnenglishteens.britishcouncil.org/
2b. https://www.bbc.co.uk/learningenglish/
2c. https://www.ted.com/?geo=hi
2d .https://www.tifr.res.in/~cccf/data/InternDocs/How_to_write_a_structured_Project_Report.pdf

Other Resources

Course Designers

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

Universal Human Values and Ethics

Course Code	VAC 102	**Course Category**	VAC		**L**	**T**	**P**	**C**
					2	0	0	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Psychology Department	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To cultivate deep understanding of human values by teaching students the core principles of universal human values and their significance.
2. To promote ethical decision-making skills by equipping the students with the ability to make ethical choices in life, work, and society.
3. To foster a diverse and inclusive ethical perspective by sensitizing the students to diversity, equity, inclusion, gender, and cultural differences.
4. To highlight the relevance of ethics in society and professions by showcasing the practical importance of ethics in personal, societal, and professional contexts.
5. To address common challenges by preparing the students to overcome obstacles to ethical behaviour, fostering a commitment to universal values.

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	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	3	70%	80%
Outcome 2	Students will foster diverse and inclusive perspectives, contributing to more equitable and harmonious communities and workplaces	2	70%	70%
Outcome 3	Students will be able to apply ethical principles effectively in their personal and professional lives, leading to improved relationships and ethical practices in society	3	60%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	3				2	3	3	1	1	3			
Outcome 2		2	3				1	3	3	1		3			
Outcome 3	2	3	3					3	3	1	1	3			
Average	**2**	**2**	**3**				**1**	**3**	**3**	**1**	**1**	**3**			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Fundamentals of Human Values and Ethics**	**7**	1	1, 2, 3, 4, 5
	Introduction to human values and ethics.	1		
	Theory of wellbeing	2		
	Purpose and relevance of human values	4		
Unit 2	**Culture and Ethical Principles**	**5**	**2**	
	Culture and ethics.	2		
	Ethics in the community and society	3		
Unit 3	**Ethics and Inclusivity**	**6**	**2**	
	Ethics and diversity & inclusion	3		
	Equity, equality, and addressing violence	3		
Unit 4	**Ethics in various life spheres**	**6**	**3**	
	Ethics in family, society, and workplace	4		
	Ethics in IPR and plagiarism	2		
Unit 5	**Overcoming ethical challenges**	**6**	**3**	
	Identifying common challenges	3		
	Strategies to overcome challenges	3		
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)		
		CLA-1 (10%)	CLA 2 (20%)	CLA-3 (20%)
		Theory	Theory	Theory
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. Landau, RS. Living Ethics. New York: Oxford University Press, 2019.
2. Nagarazan, R.S. Ethics and Human Values, New Delhi: New Age International
3. Limited.
4. Rachels, J. The Elements of Moral Philosophy. New York: McGraw Hill. 2003.
5. Singer, P. Applied Ethics. Oxford: Oxford University Press, 1986.
6. Ethics: Contemporary Readings. Edited by Harry Gensler, Earl Spurgin, James Swindle. New York, Routledge. 2004

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Entrepreneurial Mindset

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

Course Objectives / Course Learning Rationales (CLRs)

1. To develop a foundation in innovation and entrepreneurship among the students.
2. To enhance analytical skills of students for practical application of their ideas.
3. To make students proficient in designing solutions.
4. To introduce students to different phases of entrepreneurship.

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 and classify the basic concepts of Innovation and Entrepreneurship	2	90%	80%
Outcome 2	Discuss the concept of Design Thinking and prototyping	2	80%	70%
Outcome 3	Apply design thinking to generate innovative ideas and strategize implementation plan	3	65%	60%
Outcome 4	Prepare a business plan by assessing customer segment, market validation and product development	4	60%	60%

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

CLOs	Program Learning Outcomes (PLO)													
	Management Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Strategic Thinking and Logical Reasoning	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	-	-	-	-	-	-	-	-	2	3	2
Outcome 2	2	2	2	-	2	-	2	-	-	-	-	3	2	2
Outcome 3	1	3	3	2	-	-	-	3	-	3	3	-	3	2
Outcome 4	2	3	3	2	-	-	-	3	2	3	3	3	-	3
Average	**2**	**2**	**3**	**2**	**1**	**-**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Entrepreneurship & Inventions**	**5**		
	Entrepreneurship and Types of Entrepreneurship	2	1	3,4
	Entrepreneurs and their Characteristics	1	1	3,4
	Innovation & its Types	2	1	1
Unit 2	**Exploration & Summarizing Facts**	**3**		
	Structured exploration and quantifying the data	2	3,4	3,4
	Analysing the data	1	3,4	3,4
Unit 3	**Reflection, Synthesizing and ideating**	**3**		
	Summarizing facts and designing a workable model	3	3,4	3,4
Unit 4	**Prototyping**	**8**		
	Definition and Basics of Prototyping	2	2,3,4	2
	Types and methods of Prototyping	4	2,3,4	2
	Innovations in prototyping	2	2,3,4	2
Unit 5	**Concept Ideation & Design Thinking**	**8**		
	Importance of Idea	1	3,4	1,2
	Idea Generation Techniques	1	3,4	1,2
	Validating the idea	1	3,4	1,2
	Definition and Basics of Design Thinking	2	2	5
	Stages of Design Thinking	3	2	5
Unit 6	**Market Validation**	**5**		
	Concept of Market Validation and its importance	2	3,4	3,4
	Customer survey	1	3,4	3,4,5
	Feedback and modifying the idea	2	3,4	3,4,5
Unit 7	**Segmentation of the potential users/ customers**	**3**		
	Customer segment and its types	2	4	3,4
	Understanding niche customer segment	1	4	3,4
	Reaching the real customers	1	4	3,4
Unit 8	**Industry Validation**	**2**		
	Industry validation and mentoring	2	3,4	3,4,5
Unit 9	**Solution Design**	**8**		
	Generate an Innovative Idea	3	3,4	1,2,5
	Develop a Business Plan	5	4	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%	CLA-2 20%	Mid-term 20%	
Level 1	Remember	90%	50%	60%	40%
	Understand				
Level 2	Apply	10%	50%	40%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

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

Other Resources

Course Designers

1. Mr Udayan Bakshi, Assistant Professor, Paari School of Business, SRM University, A.P.

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

Principles of Economics and Management

Course Code	FIC 105	Course Category	FIC	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Economics	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. This course will provide the basic understanding of concept of economics. Its analysis the choice and decision to manage the scare resources.
2. To understand consumer behaviour; how the demand and supply works in market.
3. To understand producer behaviour. How producer will behave with limited resources. How cost can be minimised
4. To understand the nature of market. How to identify the market and how different markets works.
5. To understand the concepts of macroeconomics and how economy as a whole works.

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 and explain how microeconomic models can be used to consider fundamental economic choices of households and firms.	2	70%	65%
Outcome 2	Describe and explain how macroeconomic models can be used to analyse the economy as a whole.	2	70%	65%
Outcome 3	Describe and explain how government policy influences microeconomic choices and macroeconomic outcomes.	3	70%	65%
Outcome 4	Interpret and economic models, diagrams and tables and use them to analyse economic situations.	4	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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	1	-	-	-	-	-	-	2	-	-	-
Outcome 2	3	3	3	3	2	1	-	-	2	-	-	2	-	-	-
Outcome 3	3	3	3	3	2	-	-	-	2	-	-	2	-	-	-
Outcome 4	3	3	3	3	2	1	-	-	3	-	-	2	-	-	-
Average	**3**	**3**	**3**	**3**	**2**	**1**	-	-	**2**	-	-	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	COs Addressed	References Used
Unit I	**Exploring the subject matter of Economics:**	**5**		
	Definition; Scope and method of economics; the economic problem	2	1	1
	Science of economics; the basic competitive model; prices,	1	1	1
	Opportunity cost; economic systems; reading and working with graphs	2	1	1
Unit II	**Supply and Demand**	**14**		
	How Markets Work, Markets and Welfare	1	1,4	1
	Markets and competition;	1	1,4	1
	Concept of Demand and supply	2	1,4	1
	Equilibrium of market	2	1,4	1
	The concept of elasticity	2	1,4	1
	Controls on prices; taxes and the costs of taxation;	1	1,4	1
	Consumer Surplus	2	1,4	1
	Utility Analysis: Ordinal and cardinal utility analysis	2	1,4	1
Unit III	**The Households**	**6**		
	The consumption decision: budget constraint	1	1,4	1, 2
	Consumption and income/price changes	1	1,4	1, 2
	Demand for all other goods and price changes	1	1,4	1, 2
	Description of preferences	1	1,4	
	Properties of indifference curves	1	1,4	1, 2
	Consumer ‘s optimum choice	1	1,4	1, 2
Unit IV	**Theory of production, cost & market**	**10**		
	Theory of production: short and long run	2	1,4	1, 2
	Theory of cost	1	1,4	1, 2
	Types of cost, short run and long run	2	1,4	1, 2
	The Firm and Perfect Market Structure	1	1,4	1, 2
	Behaviour of profit maximizing firms and the production process	2	1,4	1, 2
	Monopoly	2	1,4	1, 2
Unit V	**Macroeconomics**	**10**		
	GDP- definition and concepts	2	2, 3	1, 3
	Measurement of National Income: Different methods	2	2, 3	1, 3
	Consumption function	1	2, 3	1, 3
	Investment	1	2, 3	1, 3
	Demand for money	1	2, 3	1, 3
	Supply of Money	1	2, 3	1, 3
	Inflation	1	2, 3	1, 3
	Unemployment	1	2, 3	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%	Mid-2 15%	
Level 1	Remember	40%	90%	40%	80%	70%
	Understand					
Level 2	Apply	60%	10%	60%	20%	30%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition,
2. Principles of Economics, Case Karl E, Fair Ray C; Oster Sharon M , Publisher: Pearson tenth edition
3. Economics, Samuelson P A and Nordhus W D; Publisher: McGraw-Hill Irwin

Other Resources

Course Designers

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

Linear Algebra and Differential Equations

Course Code	FIC 117	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	MAT 111	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To make students understand the central ideas of linear algebra like solving linear equations performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors.
2. Equip the student with various solution techniques and modelling of linear and non-linear first and second-order differential equations, including systems of equations.

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 the systems of linear equations for solving given problems in science and engineering.	2	80%	70%
Outcome 2	Demonstrate the procedures of solvin g linear equations.	3	80%	70%
Outcome 3	Performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors.	3	80%	70%
Outcome 4	Demonstrate the qualitative nature of system of differential equations using matrix algebra.	3	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
Outcome 2	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
Outcome 3	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
Outcome 4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
Average	**2**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Matrices and Gaussian elimination**	**10**		
	Introduction, Geometry of Linear Equations	1	1	1
	Gaussian Elimination	2	1,2	1
	Matrix Notation and Matrix Multiplication	2	2	1
	Triangular Factors and Row Exchanges	3	1,2	1
	Inverses and Transposes	2	3, 4	1
Unit II	**Vector spaces**	**9**		
	Vector spaces and Subspaces	1	1,2	1
	Solving Ax = 0 and Ax = b	2	1,2	1
	Linear Independence, Basis and Dimension	2	1,2	1
	The Four Fundamental Subspaces	2	1,2	1
	Graphs and Networks, Linear Transformations	2	2	1,2
Unit III	**Orthogonality**	**8**		
	Orthogonal Vectors and Subspaces	1	1,2	1
	Cosines and Projections onto Lines	2	,2,3	1
	Projections and Least Squares	3	2	1,2
	Orthogonal Bases and Gram-Schmidt	2	1,3	1,2
Unit IV	**Determinants**	**8**		
	Introduction	1	3	1
	Properties of the Determinant	2	1,3	1
	Formulas for the Determinant	2	1,3	1
	Applications of Determinants	3	1,3	1,2
Unit V	**Eigenvalues and eigenvectors**	**10**		
	Introduction, Diagonalization of a Matrix	3	3	1,2
	Difference Equations and Powers Ak	2	3	1,2
	Differential Equations and etA and phase portrait	3	3,4	1,2
	Complex Matrices, Similarity Transformations	2	3	1,2
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. Gilbert Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007
2. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.

Other Resources

Course Designers

1. Dr. Tapan Kumar Hota, Assistant Professor, Mathematics Department, SRM University AP

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Structural Mechanics

Course Code	CVE 101	Course Category	CC	L	T	P	C
				2	1	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Civil Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To learn the fundamental concepts of free body diagrams of different systems, and rigid and deformable body mechanics.
2. To introduce to various physical engineering systems mathematically and encourage them to predict the behaviour of materials through the concept of Engineering Mechanics and to understand the stresses, strain, and stress-strain relationship through experimental techniques.
3. To understand axial force, shear force, bending moment, flexural and shear stresses in various members of structures like cantilever beams, simply supported beams, overhang beams, and different portal frame structures, bending and shear stress.

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	Calculate force and moment using equilibrium equations	3	70%	70%
Outcome 2	Demonstrate stress, strain, constitutive relationship and Impact behaviour of the material	3	70%	70%
Outcome 3	Compute shear force and bending moment of the structural system	3	70%	70%
Outcome 4	Calculate the bending stress developed in the beam based on the bending equation	3	65%	60%
Outcome 5	Compute shear stress in rectangular beam, I beam, and T beam	3	65%	60%
Outcome 6	Apply torsion in circular shaft for given scenario and buckling behaviour	3	60%	60%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	3	-	-	-	-	-	-	-	-	3	3	3
Outcome 2	3	3	2	3	-	-	-	-	-	-	-	-	2	3	3
Outcome 3	2	3	2	3	-	-	-	-	-	-	-	-	2	3	2
Outcome 4	2	3	2	3	-	-	-	-	-	-	-	-	2	3	1
Outcome 5	3	2	2	3	-	-	-	-	-	-	-	-	3	3	2
Outcome 6	3	2	2	3	-	-	-	-	-	-	-	-	3	3	1
Average	**3**	**3**	**2**	**3**	-	-	-	-	-	-	-	-	**3**	**3**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Fundamental Principles of Mechanics**	**6**		
	Introduction, Basic concepts	1	1	1, 2
	The Concept of Force, The Moment of a Force, Conditions for Equilibrium, Free Body Diagram and Engineering Applications	2	1	1, 2
	Statically Determinate and Statically Indeterminate Structures, Bars of varying section–composite bars	2	1	1, 2
	Strain energy; Resilience – Gradual, sudden, impact and shock loadings.	1	1	1, 2
Unit 2	**Stress and Strain**	**10**		
	Introduction, Stress, Plane Stress, Equilibrium of a Differential Element in Plane Stress	1	2	1, 2
	Stress Component in an Arbitrarily Oriented Faces in Plane Stress Condition	1	2	1, 2
	Mohr's Circle Representation of a 2-D State of Stress Element	2	2	1, 2
	Analysis of Deformation, Definition of Strain Components, Relation between Strain and Displacement in Plane Strain,	2	2	1, 2
	Mohr's Circle Representation of Plane Strain, Measurement of Strains, Concept of Strain Rosette	2	2	1, 2
	Stress-Strain Relationship and Generalized Hooke's law	2	2	1, 2
Unit 3	**Forces and Moment Transmitted by the Slender Members**	**10**		
	Introduction to different types of supports and loadings conditions	1	3	1, 2
	Concept of Axial Force, Bending Moment, and Shear Force and corresponding diagrams	2	3	1, 2
	Cantilever, simply supported and overhanging beams subjected to point loads, UDL, uniformly varying loads and combination of these loads	6	3	1, 2
	Differential Equilibrium Relationships	1	3	1, 2
Unit 4	**Bending and Shear Stresses**	**14**		
	Theory of simple bending, assumptions and Geometry, Bending Equation and Neutral Axis.	2	4	1, 2
	Section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections.	5	4	1, 2
	Theory and derivation of Shear stress distribution formula	2	5	1, 2
	Shear stress distribution of rectangular, circular, triangular, I, T angle sections, built-up beams	5	5	1, 2
Unit 5	**Torsion In Circular Shafts**	**5**		
	Introduction of torsion	1	6	1, 2
	Pure torsion; Assumptions	1	6	1, 2
	Derivation of torsion equation for circular shafts	1	6	1, 2
	Torsional rigidity and polar modulus, power transmitted by a shaft.	2	6	1, 2
Total Contact Hours		**45**		

Course Unitization Plan Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Tensile test on Mild steel rod	6	1-2	1,3
2	Compression test of Concrete cubes and cylinders	6	1-2	3
3	Test on open coil and closed coil Helical springs	6	1-2	3
4	Izod & Charpy impact test	6	1-2	3
5	Torsion test on Graded steels	6	1-2	1,3
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 35%
		CLA-1 10%	Mid-1 25%	CLA-2 15%	CLA-3 15%	
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. An Introduction to the Mechanics of Solids, by Crandall and Dahl, Tata McGraw Hill Pvt Ltd
2. Mechanics of materials, Russel C. Hibbeler, 9th Ed., Pearson publications.
3. Strength of Materials Lab Manual, Anand Jayakumar A, Notion Press.

Other Resources

1. Elements of strength of materials, S. P. Timoshenko and D. H. Young, 5th Ed., East-West press.
2. Mechanics of materials, Ferdinand P. Beer, E. Russell Johnston and Jr. John T. DeWolf, 3rd Ed., Tata McGraw-Hill.

Course Designers

1. Dr. Arijit Saha, Assistant Professor, Department of Civil Engineering, SRM University AP

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

Fluid Mechanics

Course Code	CVE 102	**Course Category**	CC		**L**	**T**	**P**	**C**
					2	1	1	4
Pre-Requisite Course(s)	Basics of mathematics and physics from high school	**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students to the fundamental concepts of fluid flow.
2. To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyse and appreciate the complexities involved in solving the fluid flow problems.
3. To enable students to understand the concept of fluid mechanics and apply it to solve the related problems in hydrostatic pressure, hydraulic machines, pumps and pipes, open channel flow etc.

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 solids and fluids based on the concepts of Fluid Mechanics.	2	80%	75%
Outcome 2	Understand and calculate gauge and differential pressures in fluids for given problem	3	70%	70%
Outcome 3	Apply hydrostatic forces and Archimedes principle for locating the point of application of force for floating and immersed bodies.	3	75%	70%
Outcome 4	Compute the estimation possibility of flow based on velocity potential and stream function, understand the application of pipe flow, open channel flow, flow measurement devices.	3	70%	70%
Outcome 5	Analyse fluid flow with the mass and energy equations for determining analytical solutions of given fluid flow problem, acquainted with the working principle of hydraulic machinery.	4	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	Modem Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	-	2	2	-	-	-	-	-	-	-	2	3	2	3
Outcome 2	2	3	2	2	-	-	-	-	-	-	-	1	2	3	2
Outcome 3	2	3	2	2	-	-	-	-	-	-	-	2	2	3	2
Outcome 4	2	2	2	2	-	-	-	-	-	-	-	2	2	3	2
Outcome 5	3	2	2	3	-	-	-	-	-	-	-	1	3	3	2
Average	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	Resources Used
Unit 1	**Introduction to the basic concepts**	**4**		
	Basic principles relating to features including surface tension, capillarity, vapour pressure,	2	1	1,3
	kinds of fluids, mass density, weight density, specific gravity, specific volume, viscosity, compressibility, and elasticity.	2	1	1,3
Unit 2	**Kinematics and dynamics of fluid flow**	**15**		
	Fluid statics includes Pascal's law, Absolute, ambient, gauge pressure, and manometer-based pressure measurements.	1	2	1,2
	Total pressure and centre of pressure, total pressure on horizontal, vertical, and inclined plane surfaces,	2	2	1,2
	centre of pressure for both vertical and inclined plane surfaces, and real-world uses of total pressure and centre of pressure on dams, gates, and tanks.	4	2	1,2
	Different types of fluid flows, descriptions of flow patterns, Lagrangian and Eulerian methods, continuity equation,	2	3	1,2
	velocities and velocities of fluid particles, stream functions, streamlines, streak lines, path lines, equipotential lines, and flow nets, as well as rotational and irrotational motions, circulation, and vorticity.	2	3	1,2
	Control volume and control surface, forces affecting a moving fluid, Euler's Equation of Motion,	2	4	1,3,4
	The Bernoulli Theorem and how it was derived, Bernoulli's equation for real and compressible fluid.	0(Self-learn)	4	1,3,4
	Lab experiment on visualisation of Bernoulli's theorem.	2		
Unit 3	**Flow Measurement Devices**	**14**		
	Measurement of flow through Pipes – methods and various devices, Discharge through Venturi meter; Discharge through orifice meter, Numerical problems. Practical to be conducted in lab on calibration of Venturimeter, orifice meter.	10	5	1,2
	Measurement of velocity by Pitot tube. Determination of coefficients for an orifice. Numerical problems, Flow through large rectangular orifice; Flow through submerged orifice, Classification of mouthpieces.	4	5	1,2,4
Unit 4	**Flow through notches and weirs**	**8**		
	Flow through rectangular channels, Flow through triangular and trapezoidal notches and weirs, Cippoletti Weir; End contractions, Velocity of approach; Broad crested weir,	8	5	2,3,6
Unit 5	**Flow through pipes**	**12**		
	Loss of head through pipes, Darcy-Weisbach equation, minor and major losses. Hydraulic gradient line and energy gradient line, pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flow through branched pipes, three reservoir problem, siphon, Practical to be conducted in lab on major and minor losses in pipe flow.	12	5	1,4,6
Unit 6	**Dimensional analysis and similitude**	**6**		
	Dimensional homogeneity, Buckingham's π theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies.	6	5	2,4,6,7
Unit 7	**Hydraulic machine and pumps**	**16**		
	Pumps: theory and lab experiment on pumps in series and parallel. Turbines: theory on Kaplan, Francis, Pelton turbine. Practical to be conducted in lab on Pelton turbine and Fransis turbine.	16	5	2,5,7
Total Contact Hours		**75**		

Learning Assessment

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

Recommended Resources

1. Fluid Mechanics: Including Hydraulic Machines, by A. K. Jain; Khanna, Publishers; 2008.
2. Hydraulics and Fluid Mechanics Including Hydraulics Machines, by P. N. Modi; Standard Book House; 2009., ISBN: 8189401262, ISBN-13: 9788189401269.
3. Fluid Mechanics by R. K. Rajput; S. Chand; 2011, ISBN: 81-219-1666-6
4. Fluid Mechanics, by Frank White; Tata McGraw Hill Education Pvt. Ltd.; 2011.
5. Fluid Mechanics and Machinery by C.S.P.Ojha et.al, Oxford University Press, 2010, ISBN: 0-19-569963-7.
6. Fluid Mechanics by R. C. Hibbeler, Pearson Press, 2017, ISBN: 978-93-325-4701-8.
7. Fluid Mechanics by Streeter, V.L. and Benjamin, W.E., McGraw-Hill.

Other Resources

1. NPTEL :: Civil Engineering - NOC: Fluid Mechanics

Course Designers

1. Dr. Ainal Hoque Gazi, Assistant Professor, Department of Civil Engineering, SRM University-AP

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Problem Solving Skills

Course Code	AEC 103	Course Category	AEC	L	T	P	C
				1	0	1	2
Pre-Requisite Course(s)	SEC 101	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 Time and Distance and Time and work from company specific and other competitive tests.	3	65%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	60%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	65%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	2	2	2	1	-	-	-	1	-	-	-	2	2	2
Outcome 2	-	2	1	2	1	-	-	-		-	-	-	2	2	2
Outcome 3	-	3	2	2	-	-	-	-	1	-	-	-	2	2	2
Outcome 4	-	3	1	2	-	-	-	-		-	-	-	2	2	2
Average	-	**3**	**2**	**2**	**1**	-	-	-	**1**	-	-	-	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Clocks, Calendars	2	1,4	2,3
	Logical Reasoning Basics, Linear Arrangements, Circular Arrangements	3	1,4	2,3
	Logical Reasoning – Selections, Distributions, Selection decision table, Circular / Tabular arrangements	6	1,4	2,4
	Direction Sence, Blood Relations, Directions, Blood Relations, Problems based on dice and cubes	5	1,4	2,3
Unit 2	Data interpretation – Introduction, Line Graph	3	1,4	1,3
	Data interpretation – Bar Graph, Pie-Charts	3	1,4	1,3
	Data Interpretation – Tables, Case lets	3	1,4	1,3
Unit 3	Statistics: Basics, Concept Review Questions	2	1,2	4
	Mean, Median, Mode, QD, MD, SD, Advanced Problems.	3	1,2	4
	Functions Basics, Graphs Basics, Functions and Graphs-Advanced.	3	1,2	5
Unit 4	Geometry and Mensuration	3	1,2	1
	Venn diagram with two variables and three variables, logical deductions	3	1,2	2,3
Unit 5	Coding Maths – problems based on Number System Coding Maths - Pigeon Hole Principle	3	2,3	1,5
	Coding Maths - Discrete Math Graph Theory	3	1,2	5

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	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. Logical Reasoning and Data Interpretation for CAT, By Nishit K. Sinha
4. Basic Statistics - B.L. Agarwal.
5. Graph Theory and Its Applications – Jonathan L. Gross

Other Resources

1. Geeks for Geeks
2. Indiabix.
3. M4maths.com

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

Data Structures

Course Code	SEC 115	Course Category	SEC	L	T	P	C
				2	0	1	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	CSE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To 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)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	-	-	-	-	-	-	-	-	1	3	3	3
Outcome 2	3	3	2	1	-	-	-	-	-	-	-	1	3	3	3
Outcome 3	3	3	2	1	-	-	-	-	-	-	-	1	3	3	3
Outcome 4	3	3	1	-	-	-	-	-	-	-	-	1	3	3	3
Average	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**3**

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	1	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	1	1	1,2
	Week 1 & 2: Simulate the following operations: Conversion of infix expression to postfix expression Evaluation of expressions **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: **a)** Only one disk can be moved at a time. **b)** 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. **c)** No disk may be placed on top of a smaller disk **d)** 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	1	1	1,6
	Week 3 & 4: Simulate the following tasks: **a)** Implementation the following operations: enqueue, dequeue and finding an element: **I.** Linear Queue using arrays **II.** Circular queue arrays **III.** 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.	1	1	1,6
Unit 2	**Linked lists**	**9**		
	Linked lists: Single linked lists representation	1	1	1,2
	Implementation of linked list various operation using C	1	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 No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Week 5 &6: Demonstrate the following though simulation: a) Create a singly linked list and perform the following operations: I. Add an element at the end of the list II. Delete an element from the beginning of the list III. Find the middle element of the list IV. Search the given key form the list V. Polynomial addition using linked list VI. Sparse matrix operations using linked list **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. Simulate the given scenario using and write the output for different inputs.	3	1	1,6
Unit 3	**Trees**	**9**		
	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	1	2	1
	Tree Traversals, Construction of tree using traversals	1	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
	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. **b)** Implementation of Binary tree traversals techniques – pre-order, in-order, and post-order. **c)** Implementation of AVL tree and its operations **d)** Assignment-4: Given a mathematical expression, evaluate it using appropriate tree structure.	1	2	5
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)	1	3	3

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Topological sorting	1	3	3
	Priority Queues: Heap structures	1	3	5
	Binomial heaps, leftist heaps		3	2
	Shortest path algorithms.	1	3	2
	Implementation of shortest path algorithm using C	1	3	2
	Week 9: Write a C program for implementation of Graph traversals techniques (BFS and DFS).	1	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
Unit 5	**Sorting and Searching techniques**	**9**		
	Bubble sort,selection sort and their algorithm analysis	1	4	2
	Insertion sort and its algorithm analysis		4	2
	Quick sort and its algorithm analysis	1	4	2,3
	Merge sort and its algorithm analysis		4	3
	Heap sort and its algorithm analysis	1	4	3
	Radix sort and its algorithm analysis		4	5
	Linear and binary search methods and its algorithm analysis.	1	4	5
	Hashing techniques and hash functions	1	4	5
	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?	1	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?	1	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
Total Contact Hours		**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%	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. "Data structure using C", Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
2. "Data structures and Algorithm Analysis in C", Mark Allen Weiss, Pearson publications, Second Edition.
3. "Fundamentals of data structure in C" Horowitz, Sahani & Anderson Freed, Computer Science Press.
4. "Fundamental of Data Structures", (Schaums Series) Tata-McGraw-Hill.
5. "Data Structures and Algorithms: Concepts, Techniques & Algorithm" G.A.V.Pai: Tata McGraw Hill.
6. "Data Structures and Program Design in C" Robert Kruse, C L Tondo, Bruce Leung and Shashi Mogalla. For pseudocode

Other Resources

1. "Programming with C", Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016
2. "Programming in C". P. Dey and M Ghosh, Second Edition, Oxford University Press.

Course Designers

1. Dr Mahesh Kumar Morampudi, Assistant Professor, Dept of CSE, SRM University AP.

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

Spatial Data Acquisition

Course Code	CVE 201	**Course Category**	OE	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. This course is targeted to discuss advanced tools and its comparison with conventional tools for acquiring geospatial data.
2. To get hands on experience in using advanced tools with the help of field trips.
3. To develop maps by using obtained geospatial data.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Apply the basic principles of surveying for spatial data acquisition.	3	80%	70%
Outcome 2	Operate and use different instruments and techniques to collect spatial data.	3	80%	70%
Outcome 3	Demonstrate advanced equipment in preparing maps.	4	80%	70%
Outcome 4	Prepare maps/plans from the collected field data.	6	80%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	-	-	-	-	-	-	1	-	1	-	3	3	2
Outcome 2	3	2	2	3	3	-	-	-	2	-	1	1	3	3	3
Outcome 3	2	2	1	2	3	-	-	-	2	-	1	1	3	3	3
Outcome 4	1	2	3	1	3	-	-	-	1	-	1	1	3	3	3
Average	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**1**	**1**	**3**	**3**	**3**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to mapping and spatial data acquisition**	4	1,2	1,2
	Introduction to Maps, Types of maps, scale, classification of maps, spatial data, Surveying as an art to collect spatial data, need of surveying and spatial data.	2		
	Potential applications of surveying, Primary Divisions of Survey, Principles of Surveying, Data and types, Units of Measurements, Plans and Maps, Scales, Errors, Accuracy, and Errors, Sources of Errors. Introduction to surveying equipment.	2		
Unit 2	**Distance Measurements**	4	2,3	1,2
	Distance measurement conventions and methods; use of chain and tape	2		
	electronic distance measurements (EDM)- principles of electro optical EDM-errors and corrections to linear measurements. Hands-on sessions	2		
Unit 3	**Angular Measurements**	3	1,2,3	1,2
	Compass survey – Meridians, Azimuths and Bearings, declination, computation of angle. Traversing – Purpose-types of traverse-traverse computation – traverse adjustments	3		
Unit 4	**Levelling and Contouring**	6	3,4	1,2
	Concept and Terminology, Levelling Instruments, and their Temporary and permanent adjustments- method of levelling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.	6		
Unit-5	**Total Station**	15	3,4	1,2
	Description to Total station, Comparison of total station with conventional equipment,	6		
	principles-uses and adjustments – temporary and permanent, measurement of horizontal and vertical angles, areas, height of buildings.	9		
Unit 6	**Sensors for Geospatial Data Acquisition**	6	3,4	1,2 ,3
	Introduction to Sensors, types of sensors, calibration, accuracy, precision, resolution, sensitivity, range, and response time	3		
	Data loggers and data acquisition systems, Data acquisition using sensors, Data Visualization, photospheres.	3		
Unit-7	**Remote data acquisition using open-source tools and UAVs**	7	3,4	1,2,3
	Introduction to google earth, measurement of distance and area, creating web maps, Introduction to drones, types and classification of drones, drone deployment, data processing and visualization, linear measurements using drone,	3		
	Aerial measurements using drone, measuring, height of buildings.	2		
	Introduction to GPS and Differential GPS, waypoint collection using GPS, length and aerial computations using GPS, preparation of maps.	2		
	Total Contact Hours	**45**		

Course Unitization Plan Practical

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Error Mapping: Understanding Surveyor Challenges in Field Map Creation	2	1,2	1,2
2	Capturing the spatial characteristics using GPS device	4	3,4	1,2
3	Data acquisition using sensors and creating spatial database	2	1,2	1,2
4	Contouring using traditional and advanced methods, data visualisation and comparison	4	1,2	1,2
5	Area computation using way points and open-source earth explorer	2	3,4	1,2
6	Traversing using total station	4	3,4	1,2
7	Determining the height of objects using total station	2	3,4	1,2
8	Integration of total station and QGIS	8	3,4	1,2
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 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	50%	50%	50%	50%	50%
	Understand					
Level 2	Apply	25%	25%	25%	25%	25%
	Analyse					
Level 3	Evaluate	25%	25%	25%	25%	25%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) ltd., New Delhi.
2. Duggal S K, "Surveying (Vol – 1 & 2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
3. Surveying and levelling by R. Subramanian, Oxford university press, New Delhi

Other Resources

1. Surveying Theory and Practice, James, M Anderson & Edward M., Tata Mc Graw Hill, 2012
2. Elementary Surveying, Charles D Ghilani, Paul R Wolf., Prentice Hall, 2012

Course Designers

1. Dr Harish Puppala, Assistant Professor, Department of Environmental Science and Engineering, SRM University-AP.

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

Probability and Statistics

Course Code	CSE 202	Course Category	CC	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	ECE	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the basics of probability.
2. To understand the concepts of random variables.
3. To learn the computation of statistical averages.
4. To understand the concepts of random process in time and frequency domain analysis.
5. To have a basic understanding of applying probability concepts in communication and signal 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	Solve the given probability problems	3	85%	80%
Outcome 2	Apply and analyze the concept of random variables	4	80%	75%
Outcome 3	Apply and analyze the concepts of statistical averages	3	85%	70%
Outcome 4	Apply and model the random variables in communication and signal Processing applications	3	80%	70%
Outcome 5	Apply and model the random processes in communication and signal Processing applications	4	75%	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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	1	1	1	1	-	-	-	-	-	-	1	1	1	1
Outcome 2	2	3	2	3	2	-	-	-	2	1		1	1	2	3
Outcome 3	2	2	2	3	3	-	-	-	-	-	-	-	1	2	2
Outcome 4	2	3	3	3	3	-	-	-	2	1	-	1	2	3	3
Outcome 5	3	3	2	3	3	-	-	-	2	1	-	2	2	2	2
Average	**2**	**3**	**2**	**3**	**3**	-	-	-	**2**	**1**	-	**1**	**1**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	COs Addressed	References Used
Unit 1	**Review of Basic Probability Theory**	**9**		
	Definition and axioms of probability	1	1	1, 2
	Probability spaces	2	1	1, 2
	Joint and conditional probabilities	2	1	1, 2
	Independent events	2	1	1, 2
	Total probability theorem – Bayes' theorem.	2	1	1, 2
Unit 2	**Random Variables**	**9**		
	Introduction to the concept of random variables, Continuous and Discrete random variables,	1	2	1, 2
	Probability (Cumulative) distribution function (CDF), Probability Distribution Function (PDF)	3	2	1, 2
	Joint distribution function of two random variables. Conditional CDF and PDF	3	2	1, 2
	Independent random variables, Various Continuous and Discrete random distributions (Special focus is on Uniform, Gaussian, Poisson random variables).	2	2	1, 2
Unit 3	**Statistical Averages**	**9**		
	Introduction to the concept of statistical averages	1	3	1, 2
	Various statistical averages	1	3	1, 2
	Expectation	1	3	1, 2
	Variance	1	3	1, 2
	Covariance	1	3	1, 2
	Mean square	1	3	1, 2
	Chebyshev inequality	1	3	1, 2
	Central limit theorem	1	3	1, 2
	Central limit theorem	1	3	1, 2
Unit 4	**Random Processes: Time Domain Analysis**	**9**		
	Introduction to the concept of random process, Classification of random processes	1	4	2, 3
	Stationary random processes, Ergodic random processes	2	4	2, 3
	Correlation functions and their properties	2	4	2, 3
	Gaussian and Poisson random process	1	4	2, 3
	Sample t-tests	2	4	2, 3
	Analysis of statistical means	1	4	2, 3
Unit 5	**Random Processes: Frequency Domain Analysis**	**9**		
	Introduction to the concept of Power Spectral Density	1	5	2, 4
	Noise: White and Coloured, Linear Time Invariant (LTI) systems with random processes as inputs	1	5	2, 4
	Noise bandwidth, Band pass, Band limited and narrow band processes	4	5	2, 4
	Relation between Power spectral density and auto correlation function – Wiener Kinchine Theorem.	3	5	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%	Mid-1 15%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	40%	60%	40%	60%	30%
	Understand					
Level 2	Apply	60%	40%	60%	40%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Probability theory, Random variables and Random signal principles, Peebles, 4th Edition, TMH.
2. Communication Systems, Simon Haykin, 4th Edition, John Wiley & Sons.
3. Probability and Random Processes for Electric and Computer Engineers, John A Gubner, 1stEdition, CAMBRIDGE University press.
4. Probability, Random variables and Stochastic processes – A Papoulis and Unnikrishnan Pillai, 4th Edition, Mc Grahill Publishers.

Other Resources

Course Designers

1. Dr. V Sateeshkrishna Dhuli, Asst. Professor. Dept. Of ECE. SRM University – AP.

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

Civil Engineering Materials

Course Code	CVE 203	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	0	1	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students various materials required for making concrete and their properties.
2. To make the students conversant with the philosophy of mix design of concrete.
3. To encourage the students to evaluate the different properties of concrete using various types of laboratory tests.

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	Know the various constituent elements in concrete and their role.	1	65%	55%
Outcome 2	Explain the properties of coarse aggregates, fine aggregates, cements and binders	2	60%	60%
Outcome 3	Demonstrate the role of water, aggregate, admixtures, curing conditions and environmental conditions on the properties of concrete.	3	55%	50%
Outcome 4	Carry out the mix design of concrete.	3	65%	60%
Outcome 5	Determine the properties of concrete using laboratory tests.	2	60%	55%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	1	-	-	-	-	-	-	-	-	1	1		1
Outcome 2	2	-	1	-	-	-	-	-	-	-	-	1	1		1
Outcome 3	2	1	1	1	-	-	-	-	-	-	-	1	2	2	1
Outcome 4	3	3	1	2	-	-	1	-	2	-	-	1	3	3	3
Outcome 5	3	2	1	2	3	-	-	-	1	-	-	1	3	3	2
Average	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**2**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Overview of Concrete and Construction Materials**	**04**	**1,2**	**1,3**
	Nature and advantages of concrete, Overview of various construction materials	02	1	1,3
	Overview of Cement Overview of fine and coarse aggregates	01	1	1,3
	Properties of water, Role of chemical and mineral admixtures.	01	1,2	1,3
Unit 2	**Cement**	**06**	**1,2,3,5**	**2,3**
	Manufacture and composition of cement, Modified Portland cements, Specifications, and tests for Portland cements	01	1,2,5	2,3
	Chemistry of hydration, Properties of hydration products	02	2,3	2,3
	Microstructure and properties of hydrated cement paste	02	2,3	2,3
	Blended cements, fly ash and slag, Effect of fly ash and slag on properties of fresh and hardened concrete.	01	2,3	2,3
Unit 3	**Water, Aggregates and Admixture**	**05**	**2,3,5**	**2,3**
	Water quality	01	3	2,3
	Classifications and properties of aggregates, nonstandard aggregates	02	2,5	2,3
	Use of chemical admixture, water reducing admixture, water, admixture for set control	02	3,5	2,3
Unit 4	**Properties of Concrete, Curing Conditions and Mix Design**	**09**	**3,4,5**	**1,2,3**
	Workability and properties of fresh concrete, Factors influencing workability.	01	3,5	1,3
	Setting of concrete and tests for fresh concrete, finishing of concrete and role of curing temperature.	02	3,5	1,3
	Tests for compressive strength, Quality assessment of concrete and other methodologies.	03	5	2,3
	Fundamentals of mix design, Mix design as per BIS Method.	03	4	1,3
Unit 5	**Durability and Special Concretes**	**06**	**1,3,5**	**1,2**
	Permeability of concrete, Physical attack.	01	3,5	1,2
	Chemical attack-carbonation, Sulphate attack and chloride attack,	02	3,5	1,2
	High strength concrete, Self-compacting concretes, Lightweight concretes and other concretes.	03	1,5	1,2
Total Contact Hours		**30**		

Course Unitization Plan Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Determination of fineness of cement	2	2,5	1,3
2	Determination of consistency of cement	2	2,5	1,3
3	Determination of initial and final setting time of cement	2	2,5	1,3
4	Determination of specific gravity of cement, fine and coarse aggregates	2	2,5	1,3
5	Determination of fineness modulus of coarse aggregates	2	2,5	1,3
6	Determination of slump and compaction factor of fresh concrete	2	3,5	1,3
7	Determination of crushing strength of coarse aggregate	2	3,5	1,3
8	Determination of impact resistance of coarse aggregate	2	3,5	1,3
9	Determination of abrasion resistance of coarse aggregate	2	3,5	1,3
10	Determination of flakiness and elongation index of course aggregate	2	3,5	1,3
11	Determination of compressive strength of concrete cube	2	4,5	1,3
12	Determination of permeability of concrete using rapid chloride penetration test	2	3,5	1,3
13	Determination of flexural strength of concrete.	2	4,5	1,3
14	Determination of split tensile strength of concrete	2	4,5	1,3
15	Determination of impact strength of concrete practically in lab	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 15%	CLA-2 10%	CLA-3 15%	
Level 1	Remember	80%	60%	60%	60%	50%
	Understand					
Level 2	Apply	20%	40%	40%	40%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Learning Assessment Lab

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

Recommended Resources

1. Shetty, M. S., And Jain, A K., "Concrete Technology: Theory And Practice", 8th Edition, S,Chand Publications., New Delhi, 2019.
2. Nevelli, A.M., "Properties Of Concrete", – 5th Ed, Prentice Hall Publishers, 2012.
3. Gambhir, M.L., "Concrete Technology", Tata Mc Graw Hill Publishers – 2012.

Other Resources

1. Mindess, Sidney., Young, J.F., Darwin, D., "Concrete", Pearson Education, 2003.

Course Designers

1. Dr. GVP Bhagath Singh, Associate Professor, Department of Civil Engineering, SRM University-AP

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Analysis of Determinate and Indeterminate Structures

Course Code	CVE 204	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students about the fundamental concepts of structural analysis.
2. To enable students to solve various problems associated with determinate structures.
3. To encourage students to solve various problems associated with indeterminate structures
4. To introduce the students about the fundamental concepts of structural analysis.
5. To encourage students to develop numerical skill for the analysis of structures.
6. To enable students, enhance analytical and critical thinking in structural 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 the basic concepts of structural idealization, equation of equilibrium, stable and unstable structures, statically determinate and indeterminate structures.	2	80%	75%
Outcome 2	Analyze statically determinate structures (Trusses, Beams and Frames)	3	70%	70%
Outcome 3	Determine the deflection of the structures	3	70%	70%
Outcome 4	Analyze statically indeterminate structures (Trusses, Beams and Frames) using Force based methods	3	70%	70%
Outcome 5	Analyze statically indeterminate structures (Beams and Frames) using Displacement based methods	3	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	-	2	1	2	-	-	-	-	-	-	-	3	3	2
Outcome 2	2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
Outcome 3	2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
Outcome 4	2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
Outcome 5	3	2	2	3	2	-	-	-	-	-	-	-	3	3	2
Average	**2**	**3**	**2**	**2**	**2**	-	-	-	-	-	-	-	**2**	**3.0**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Basics of Structural Analysis**	**5**	**1**	**1**
	Semester Interaction Class	1	1	1
	Introduction to structural Analysis: Introduction to types of structures and loads, Classification of structures	2	1	1
	Basic Concept of structural Analysis: Idealisation of structures, Concepts of statically determinate structures, equation of equilibrium and its application	1	1	1
	Problem Solving Session: Determinacy and stability	1	1	1
	Determinacy and stability	1	1	1
Unit 2	**Analyzing Statically Determinate Structures**	**8**	**2**	**1,2**
	Analysis of statically determinate Trusses: Introduction to trusses, types of trusses	1	2	1,2
	Methods to analyze statically determinate Truss: Method of Joints	1	2	1,2
	Problem Solving Session	1	2	1,2
	Methods to analyze statically determinate Truss: Method of Sections	**1**	**2**	1,2
	Analysis of statically determinate Beams and Frames: Introduction to internal loading developed in a structural member	1	2	1,2
	Shear force and Bending function	1	2	1,2
	Problem Solving Session	1	2	1,2
	Shear force and bending moment diagrams for Beams	1	2	1,2
Unit 3	**Determining Deflection in Structures**	**11**	**3**	**1,2**
	Deflections: Introduction to deflections, defection diagrams and elastic curves	1	3	1,2
	Problem Solving Session	1	3	1,2
	Elastic beam theory and double integration method	1	3	1,2
	Double integration method	1	3	1,2
	Moment-Area theorems	1	3	1,2
	Problem Solving Session	1	3	1,2
	Conjugate beam method	2	3	1,2
	Strain energy method	1	3	1,2
	Problem Solving Session	1	3	1,2
	Virtual work method	2	3	1,2
Unit 4	**Force Method for analyzing Statically Indeterminate Structures**	4	4	1,4
	Analysis of Statically Indeterminate Structures by the Force Method- Introduction to Statically indeterminate structures, Maxwell's Theorem of Reciprocal Displacements; Betti's Law	1	4	1,4
	Problem Solving Session	1	4	1,4
	Force method of analysis for Beams	1	4	1,4
	Force method of analysis for Frames and Trusses	1	4	1,4
Unit 5	**Displacement Method for analysing Statically Indeterminate Structures**	9	5	1,4
	Analysis of Statically Indeterminate Structures by the Slope deflection Method: General Procedures	1	5	1,4
	Problem Solving Session	2	5	1,4
	Slope deflection method	2	5	1,4
	Analysis of Statically Indeterminate Structures by the Moment Distribution Method: General Principles and Definitions	**1**	5	1,4
	Problem Solving Session	1	5	1,4
	Moment distribution method	2	5	1,4
Unit 6	**Analysis of Structures by Influence Line Diagrams**	**7**	**2-4**	**1,4**
	Influence lines- Introduction to Influence lines and procedure for analysis	1	2	1,4
	Problem Solving Session	1	2	1,4
	Influence lines for Beams	1	2	1,4
	Influence lines for Floor Girders	1	2	1,4
	Influence lines for Trusses	1	2	1,4
	Problem Solving Session: Staad Pro labs from Exploring Bentley's Staad Pro.- Staad Pro lab	2	2-4	1,4
Total Contact Hours		**45**		

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	**Introduction to Professional Software Package**	**6**	**1-6**	**1-3**
2	**Analysis and Design of Determinate Structures in Professional Software Package**	**9**	**1-3, 6**	**1-3**
	Modelling of Beam in software package	3	1-3, 6	**1-3**
	Modelling of Frames in software package	3	1-3, 6	**1-3**
	Modelling of Truss in software package	3	1-3, 6	**1-3**
3	**Analysis and Design of Indeterminate Structures in Professional Software Package**	**9**	**4-5, 6**	**1-3**
	Modelling of Beam in software package	3	**4-5, 6**	**1-3**
	Modelling of Frames in software package	3	**4-5, 6**	**1-3**
	Modelling of Truss in software package	3	**4-5, 6**	**1-3**
4	**Introduction to the Special Topics in Professional Software Package**	**4**	**1-6**	**1-3**
	Modelling of Multi-storied Structures	4	1-6	**1-3**
	Toal Contact Hours	**30**		

Learning Assessment

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

Recommended Resources

1. R.C. Hibbeler, Structural Analysis, Pearson Education
2. C.S. Reddy, Basic Structural Analysis, Tata McGraw Hill
3. C.H. Norris, J.B. Wilbur, S.Utku, Elementary Structural Analysis, Tata McGraw Hill
4. W. Weaver and J. M. Gere, "Matrix analysis of framed structures", CBS

Other Resources

1. L. S. Negi and R. S. Jangjid, Structural Analysis, Tata Mc. Graw
2. D.S. Prakash Rao, Structural analysis: Unified approach, Universities Press

Course Designers

1. Dr. Nishant Sharma, Assistant Professor, Department of Civil Engineering, SEAS, SRMAP

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

Creativity and Critical Thinking Skills

Course Code	AEC 104	**Course Category**	AEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Literature and Language	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Identify key concepts associated with creative problem-solving and critical analysis.
2. Interpret and summarize various models and frameworks used in fostering creative and critical thinking skills.
3. Apply divergent thinking methods to generate innovative solutions to multifaceted problems.
4. Assess and compare the strengths and weaknesses of various critical thinking approaches in decision-making.

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 and describe fundamental concepts and theories related to creativity and critical thinking.	1	80%	80%
Outcome 2	Explain the significance of creativity and critical thinking in problem-solving and decision-making processes.	2	80%	60%
Outcome 3	Implement critical thinking strategies to analyse and evaluate information and arguments effectively.	3	80%	70%
Outcome 4	Analyse and assess the effectiveness of specific creative thinking methods in addressing real-world problems.	4	80%	70%

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	Modem Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	-	-	1	3	3	-	-	3	-	3	-	3	-	-	-
Outcome 2	-	3		3	3	-	-	3	-	3	-	3	-	-	-
Outcome 3	-	3	3		3	-	-	3	-	3	-	3	-	-	-
Outcome 4	-	3	3	3	3	-	-	3	-	3	-	3	-	-	-
Average	**-**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**-**	**-**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to Creativity and Critical Thinking**	**6**		
	Introduction to key concepts	2	1,3	1
	Importance in personal and professional contexts	2	1,3	1,2
	Understanding the differences	1	2,3	1,4
	Real-world applications	1	1,3	1,3
Unit II	**Overcoming Mental Blocks**	**6**		
	Identifying and addressing barriers	3	1	14
	Exercises for mental flexibility	3	4	1,2
Unit III	**Critical Thinking Skills**	**6**		
	Recognizing common pitfalls	1	1,3	1,2
	Examples and group discussion	1	2,3	1,2
	Techniques for assessing information credibility	2	1,3	1
	Case studies and research exercises	2	1,3	3
Unit IV	**Application of Creative Solutions**	**6**		
	Practical problem-solving exercises	1	1,3	1,4
	Group projects and case studies	2	2,3	2,3
	Integrating ethics into creative and critical thinking	1	1,3	1
	Discussions on ethical dilemmas and decision-making	2	1,3	3
Unit V	**Application of Creative Solutions**	**6**		
	Quizzes on concepts and techniques	1	1,3	1,2
	Individual and group assignments	1	2,3	1,2
	Applying creativity and critical thinking to a real-world scenario	2	1,3	1
	Presentation and peer evaluation	2	1,3	3
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 75%			
		CLA-1 20%	**CLA-2 20%**	**CLA-3 20%**	**Project Work 45%**
Level 1	Remember	30%		10%	
	Understand				
Level 2	Apply	70%	100%	90%	100%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelley and David Kelley
2. Critical Thinking: An Introduction by Alec Fisher
3. Think Like a Freak: The Authors of Freakonomics Offer to Retrain Your Brain by Steven D. Levitt and Stephen J. Dubner
4. Creative Intelligence: Harnessing the Power to Create, Connect, and Inspire by Bruce Nussbaum

Other Resources

Course Designers

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

Numerical Methods and its application in Civil Engineering

Course Code	SEC 118	**Course Category**	SEC	**L**	**T**	**P**	**C**
				1	1	1	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce the basic concepts of Numerical methods and their applications in civil engineering.
2. Gain knowledge on formulating engineering problems as mathematical models.
3. Learn how to solve the formulated mathematical models and determine optimal values.
4. Understand the interface of MATLAB and use it to solve the mathematical models.

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 significance of numerical methods in context of solving engineering problems	2	70%	75%
Outcome 2	Conceptualise the engineering problems into mathematical models to perform optimisation.	2	70%	70%
Outcome 3	Apply the solution methodologies of numerical methods to solve theoritical problems.	2	75%	70%
Outcome 4	Apply the solution methodologies of numerical methods to solve Civil Engineering problems.	2	75%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	1	-	-	-	-	-	-	-	-	-	2	2	2
Outcome 2	2	2	1	1	-	-	-	-	-	-	-	-	2	2	2
Outcome 3	2	2	1	2	2	-	-	-	-	-	-	-	2	1	1
Outcome 4	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3
Average	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1		03		
	Introduction, Kinds of errors in numerical procedures, measurement of efficiency of numerical procedures, order of accuracy, and Interface of MATLAB	1	1,2	CHAP 1, 3, 4 TB1
Unit 2		06		
	Bisection, secant, method of false – position, Newton's method, Fixed point iteration method, Order of convergence, multiple roots.	1	1,2	CHAP 5, 6, 8 TB1
Unit 3		06		
	The Elimination method, Gaussian Elimination, Other direct methods, Pathology in linear systems-singular matrices, Determinants and matrix inversions, Tri-diagonal systems, Thomas algorithm, Norms, condition numbers and errors in computed solutions, Jacobi's method, Gauss Seidel method, Newton's methods, fixed-point methods for non-linear systems	1	1,2	CHAP 9, 10, 11, 12 TB1
Unit-4		04		
	Least square regression, Existence and Uniqueness of interpolating polynomial, Lagrange polynomials, divided differences, evenly space points, error of interpolation		2,3	CHAP 17, 18 TB1
Unit 5		06		
	Derivatives from difference table, Higher order derivatives, Newton Cotes Integration formulas, The Trapezoidal rule - a composite formula, Simpsons rule, Gaussian Quadrature, Richardson Extrapolation	2	2,3	CHAP 21, 22, 23, 24 TB1
Unit 6		05		
	Taylor series method, Euler, and Modified Euler's method, Runge Kutta (RK) Methods, Multistep methods: Milne's method, Adams Moulton method, Predictor – corrector formulas, System of equations and higher order equations, stiffness.	1	4	CHAP 25, 26 TB1
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 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	70%	70%	70%	70%	70%
	Understand					
Level 2	Apply	30%	30%	30%	30%	30%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Numerical Methods for Engineers by Steven C. Chapra, Raymond P. Canale, Tata McGraw-Hill Edition, 6th Edition, 2012.

Other Resources

1. Applied Numerical Analysis by Curtis F. Gerald, Patrick O. Wheatley, Pearson Education, 7th Edition, 2003.
2. Numerical Methods for Engineers and scientists by J. D. Hoffman, 2nd Edition. CRC 2010.
3. Introduction to Numerical Analysis 3rd Edition, Devi Prasad, Narosa 2006.

Course Designers

1. Dr. Harish Puppala, Assistant Professor, Dept of Civil Engineering, SRM University-AP

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

Reinforced Concrete Design

Course Code	CE 205	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CE 201	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the basic material properties of Reinforced Concrete structure and different design philosophies.
2. To explain the structural behaviour of different reinforced concrete sections and principles behind select code provisions
3. To ensure the safety and serviceability of structural elements using IS 456:2000 codal provisions.
4. To fix the dimensions of different structural elements satisfying the criteria of safety, serviceability and economy.
5. To explain the detailing of the structural components together.

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 basic properties of RCC materials.	1	65%	55%
Outcome 2	Explain the different design philosophy for RCC	2	60%	60%
Outcome 3	Design different reinforced concrete structural elements under different loading conditions.	3	55%	50%
Outcome 4	Apply the knowledge of IS 456:2000 - Codal provisions to ensure the safety and serviceability of structural elements.	4	65%	60%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	-	1	-	-	-	-	-	-	-	-	1	1	-	1
Outcome 2	2	1	3	-	-	-	-	-	-	-	-	1	1	-	1
Outcome 3	2	2	3	2	-	-	1	-	-	-	-	1	2	2	1
Outcome 4	3	3	3	3	-	-	1	-	-	-	-	2	3	3	3
Average	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction of RCC Materials**	**05**	**1**	**2**
	Review of Concrete making materials, Structural concrete Grades, Properties of Concrete, Modulus of elasticity-flexural strength	02	1	2
	Characteristic and Design values, Partial safety factor	03	1	2
Unit 2	**Design of Beams**	**12**	**2,3,4**	**1,2**
	RCC- Limit State method- Assumptions, Stress-Strain behaviour of Steel and Concrete	02	2	1,2
	Working stress method- comparison of design process	02	2	1
	Analysis and Design of Singly Reinforced Beams, Analysis of Singly Reinforced RC Section- Neutral axis-Balanced-Under Reinforced-Over Reinforced Sections- Moment of Resistance- Design parameters, Design examples	05	3,4	1,2
	Necessity of Doubly Reinforced sections, Analysis of Doubly Reinforced RC Section-Moment of Resistance, Design parameters and design Examples	03	3,4	1,2
Unit 3	**Design of Slabs**	**10**	**3,4**	**1,2**
	Design of One-way slab	04	3,4	1,2
	Design of Two-way slabs, Effect of edge conditions- Moment of resistance-Torsion reinforcement at corners, Design examples	03	3,4	1,2
	Design of Continuous Slab/Beam	03	3,4	1,2
Unit 4	**Design of Columns**	**10**	**3,4**	**1,2**
	Design principles of RC columns, Assumptions- Rectangular and Circular columns- Helical reinforcement	05	3,4	1,2
	Minimum eccentricity-Use of Interaction diagrams for Axial load and Moment.	05	3,4	1,2
Unit 5	**Design of Footings**	**08**	**3,4**	**1,3**
	RC footings, Minimum depth of footing, Safe bearing capacity	05	3,4	1,3
	Shear in Two way- Transfer of load at base of column.	03	3,4	1,3
Total Contact Hours		**45**		

Guided Study

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction of RCC Materials**	**05**	**1**	**2**

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 10%	CLA-2 10%	Project 20%	
Level 1	Remember	80%	60%	60%	60%	50%
	Understand					
Level 2	Apply	20%	40%	40%	40%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. IS-456-2000, IS 3370(Part-IV), BIS 2000.
2. Reinforced Concrete Design- S Unnikrishna Pillai and Devdas Menon
3. Design of Reinforced Concrete Structures (Limit State) – A.K.Jain, 1st Edition, Nemchand Brothers, Roorkee.

Other Resources

1. RCC Designs-B.C.Pummia, A.K.Jain and A.K.Jain, 10th edition Lakshmi Publications Ltd, New Del.

Course Designers

1. Dr. GVP Bhagath Singh, Associate Professor, Department of Civil Engineering, SRM University-AP

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

Soil Behaviour and Engineering

Course Code	CVE 206	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**	IS 2720 parts, ASTM D Series (Soil Tests)				

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students about the concepts of soil behaviour under various conditions
2. Develop a comprehensive understanding of soil fundamentals, acquire proficiency in analyzing soil-water flow behavior, gain expertise in laboratory tests.
3. Master the principles of compaction, consolidation, and stress-strain behavior in soils.

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	Upon completion of the course, students will be able to demonstrate a deep understanding of soil fundamentals, including formation processes, composition, and basic relationships crucial for engineering applications.	3	75%	75%
Outcome 2	Students will acquire the skills to analyze and predict soil-water interactions, including the behavior of water flow, permeability, and potential issues like liquefaction and quicksand conditions in different soil types.	3	70%	70%
Outcome 3	Students will be proficient in evaluating compaction and consolidation behavior of soils, applying laboratory and field methods, and understanding the structure and engineering properties of soils under various stress conditions.	3	70%	70%
Outcome 4	Students will be capable of analyzing stress-strain behavior in soils, conducting triaxial tests, and interpreting strength principles for different loading scenarios.	3	70%	70%
Outcome 5	Upon completion of the course, students will possess a comprehensive understanding of soil conductivity behavior, and the environmental implications of soil conductivity.	3	70%	70%

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	Modem Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2	-	-	1	1	-	-	-	-	3	1	3
Outcome 2	3	3	2	2	-	-	1	1	-	-	-	-	3	2	3
Outcome 3	3	3	2	2	-	-	-	1	-	-	-	-	3	2	3
Outcome 4	3	3	2	2	1	-	-	1	-	-	-	-	3	2	3
Outcome 5	2	1	1	-	1	-	1	1	-	-	-	-	1	-	3
Average	**3**	**3**	**2**	**2**	**1**	-	**1**	**1**	-	-	-	-	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction & Classification**	**17**		
	Soil formation; Soil Composition	1	All	1,2
	Water Absorption, Clay-water Forces, Soil Structure	1	1	1,2
	Basic Definitions and Relationships-Soil as three- phase system	2	1	1,2
	Mass-volume relationships; Relative density	2	1	1,2
	Determination of Moisture content; Specific gravity;	1	1	1,2
	Unit weight; Physical characterization of soil	1	1	1,2
	Soil Classification Tests: IS and USCS	2	1	1,2
	Determination of Index properties	3	1, 2	2, 3
	Soil Gradation and Classification	3	1, 2	2, 3
	Determination specific gravity by density bottle and pycnometer	3	1, 2	2, 3
Unit 2	**Soil-Water Flow Behaviour**	**14**		
	One dimensioned flow	1	2	1,2
	Seepage and Permeability	1	2	1,2
	Factors affecting permeability	1	2	1,2
	Permeability of stratified soil masses	1	2	1,2
	Laboratory permeability tests	2	2	1,2
	Liquefaction and Quicksand Conditions	2	2	1,2
	Determine the coefficient of permeability of soil using constant head permeability test	3	2, 3	2,3
	Determine the coefficient of permeability of soil using falling head permeability test	3	2, 3	2,3
Unit 3	**Compaction & Consolidation Behaviour**	**20**		
	Mechanism of compaction; factors affecting;	1	3	1,2
	Laboratory tests, Structure and Engineering Properties, Effective Stress with S < 100%	2	3	1,2
	Stress history and Spring Analogy	2	3	1,2
	Amount of 1-D Settlement (Preconsolidation Mechanisms and Measurement, Disturbance, Creep, etc.)	2	3	1,2
	Rate of 1-D Consolidation	1	3	1,2
	Secondary Compression	1	3	1,2
	Determination of unit weight by core cutter method	2	1, 3	2,3
	Determination of unit weight by sand replacement method	2	1, 3	2,3
	Determination of relative density by vibration table test	2	1, 3	2,3
	Determination of maximum dry density of soil using standard proctor compaction	2	2, 3	2,3
	Determination of maximum dry density of soil using standard proctor compaction	3	2, 3	2,3
Unit 4	**Stress-Strain Behaviour of Soil**	**12**		
	Stresses in soils;	1	4	1,2
	Types of Triaxial Tests and Strength Principles	2	4	1,2
	Drained and Undrained Strength Analysis Overview (Classes of Probems, Types of Analyses and Corresponding Strength Parameters for UU, CU and CD Cases)	2	4	1,2
	Box Shear Mechanisms of Volume (Pore Pressure) Change in Clays and Sands	2	4	1,2
	Behavior of Normally Consolidated Soil Behavior of Overconsolidated Soil	2	4	1,2
	Hvorslev Parameters	1	4	1,2
	Introduction to Cam-Clay Model	2	4	1,2
Unit 5	**Soil Conductivity Behaviour**	**12**		
	Electrical Conductivity (EC)	2	5	1,2
	Effect of Soil Types Ion Content, Temperature	2	5	1,2
	Saturation Extract Conductivity (Ece)	2	5	1,2
	Effect of Bulk Density Soil pH	2	5	1,2
	Electrical resistivity testing	3	5	1,2
	Soundness and Profiling	1	5	1,2
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 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	40%	30%	40%	40%	35%
	Understand					
Level 2	Apply	60%	70%	60%	60%	65%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Soil Mechanics, Craig R.F., Chapman & Hall An Introduction to Geotechnical Engineering, Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ.
2. Principles of Geotechnical Engineering, Braja M. Das, Cengage Learning.
3. Experimental Soil Mechanics, J. P. Bradet, Prentice Hall, Upper Saddle River, NJ.
4. Basic and Applied Soil Mechanics, Gopal Ranjan and A. S. R. Rao, New Age International Publishers.

Other Resources

1. Fundamentals of Soil Engineering, Taylor, John Wiley & Sons.
2. Soil Mechanics in Engineering Practice, Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.

Course Designers

1. Dr. Raviteja KVNS, Asst. Professor, Dept. of Civil Engineering, SRM University – AP.

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

Modern Highway Engineering

Course Code	CVE 207	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To familiarize with the highway planning and projects.
2. To gain knowledge of modern pavement materials, design, construction, and maintenance
3. To explore highway traffic analysis and design.
4. To learn highway geometric design and analysis.
5. To familiarize with emerging transportation technologies

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 highway planning and projects.	2	80%	75%
Outcome 2	Analyse highway geometric, traffic, and pavement related aspects.	4	80%	75%
Outcome 3	Design highway geometric, traffic, and pavement infrastructure facilities.	4	75%	70%
Outcome 4	Demonstrate emerging technologies in transportation engineering	2	80%	75%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	-	-	1	-	-	-	-	-	3	2	1
Outcome 2	2	3	2	2	1	-	1	-	-	-	-	-	1	3	2
Outcome 3	2	2	3	3	1	-		-	-	-	-	-	1	2	3
Outcome 4	3	2	1	2	-	-	2	1	-	-	-	-	3	2	1
Average	**3**	**2**	**2**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction – Transportation Engineering	1		
	Highway Planning and Highway Projects	**6**		
	History – Road Development in India, Road Classification and Patterns	1	1	1,2
	Highway Planning – Introduction, Planning Strategies, Economic and Environmental Assessment	1	1	1,2
	Traffic Demand Analysis	1	1	1,2
	Highway Projects – Alignment Requirements, Engineering Surveys, and Reports	2	1	1,2
	Highway Projects – Economic & Environmental Appraisal	1	1	1,2
Unit 2	**Geometric Alignment and Design**	**11**		
	Basics: Highway Cross Section Elements, Design Speed, and Sight Distance	1	2	1,2
	Design of Horizontal Alignment- Super Elevation	2	2,3	1,2
	Design of Horizontal Alignment- Transition Curves, Extra widening, and Set-back distance	2	2,3	1,2
	Design of Horizontal Alignment- Extra widening, and Set-back distance	1	2,3	1,2
	Design of Vertical Alignment-Grades and Grade Compensation, Types of Vertical Curves and Design	1	2,3	1,2
	Design of Vertical Alignment-Types of Vertical Curves and Design	2	2,3	1,2
	Guest Lecture - MX Road/Civil 3D Software	2		
Unit 3	**Traffic Analysis and Design**	**12**		
	Basic Elements of Traffic Analysis – Traffic Surveys: Volume, Speed, Delay, etc	1	1,2	2,3
	Traffic Stream Parameters and their Fundamental Relationships	2	2	2,3
	Traffic Queuing Analysis	1	2	2,3
	Highway Capacity and LOS – Introduction	1	1,2	2,3
	Highway Capacity and LOS – Interrupted and Un-Interrupted Traffic Flows	1	1,2	2,3
	Design of Highway Intersections – Types of Intersections, Design Un-Signalized Intersections	1	2,3	2,3
	Design of Highway Intersections –Design of Signalized Intersections	2	2,3	2,3
	Highway Safety, Public Transportation	1	1,2	2,3
	Guest Lecture – VISSIM /Traffic Software	2		
Unit 4	**Pavement Materials, Testing and Design of Pavements**	**11**		
	Highway Materials – Desirable Properties and Quality Control Tests	1	2	4,5
	Marshall Method of Bituminous Mix Design	2	2,3	4,5
	Types of Pavement Structures, Factors Controlling Design of Pavements, Stresses in Pavements	1	2	4,5
	Design of Flexible Pavements- IRC and AASHTO Method of Design.	2	2,3	4,5
	Design of Rigid Pavements- IRC and AASHTO Method of Design	2	2,3	4,5
	Construction Equipment and Procedures – Flexible & Rigid pavements	1	1,2	4,5
	Pavement Maintenance, Functional and Structural Evaluation	2	1,2	4,5
Unit 5	**Emerging Technologies in Transportation**	**4**		
	Autonomous Vehicles, Intelligent Transportation Systems (ITS), Internet of Things (IoT), Drones	2	4	1,3
	Sustainability in Transportation Engineering	2	4	1,3
Total Contact Hours		**45**		

Course Unitization Plan Practical

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
I	**Laboratory - Pavement Materials and Mix Design**	**8**		
1	Aggregate Quality Control Tests	2	2	6,7
2	Bitumen Quality Control Tests	2	2	6,7
3	Aggregate Proportioning-Bailey Method	2	2,3	1,4

4	Marshall Bituminous Mix Design	2	2,3	6,7
II	**Field Studies**	**4**		
1	Traffic Studies – Volume and Speed Counts	2	2	1,6
2	Pavement Condition Survey	2	2	8
III	**Hands-on Sessions: Industry Standard Software**	**8**		
1	Highway Geometric Design	2	2	1,2
2	Traffic Simulations	2	2	2,3
3	Pavement Design	2	2	9,10
4	Pavement Management	2	2	1,4
IV	**Project** (Identified and Assigned in groups based on the topics covered in the Lecture & Laboratory sessions)	**10**	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 15%**	**CLA-2 10%**	**CLA-2 15%**	
Level 1	Remember	60%	40%	50%	30%	60%
	Understand					
Level 2	Apply	40%	60%	50%	70%	40%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Learning Assessment Practical

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**			**End Semester Exam (50%)**
		Lab Performance (20%)	**Observation Notes (10%)**	**Model Exam (20%)**	
Level 1	Remember	40%	50%	40%	50%
	Understand				
Level 2	Apply	60%	50%	60%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Martin Rogers, Bernard Enright, Highway Engineering – Wiley Publishers, 3rd edition.
2. S. K. Khanna., C. E. G. Justo and A. Veeraragavan, Highway Engineering- Nem Chand Bros, India.
3. Roger P. Roess, Elena S. Prassas, and William R. McShane, Traffic Engineering, Pearson Publishers, 5th edition.
4. Partha Chakraborty and Animesh Das, Principles of Transportation Engineering, Prentice Hall India.
5. Yang H. Huang, Pavement Analysis and Design, Pearson Publishers, 2nd edition.
6. S. K. Khanna., C. E. G. Justo and A. Veeraragavan, Highway Material Testing- Nem Chand Bros, India.
7. Ministry of Road Transport and Highways- Specifications for Roads and Bridge Works, Fifth Revision, IRC, New Delhi, India-2013.
8. IRC 82-2023: Maintenance of Bituminous Road Surfaces.
9. IRC 37-2018: Guidelines for the Design of Flexible Pavements.
10. IRC 58-2015: Guidelines for the Design of Plain Jointed Rigid Pavements for Highways.

Other Resources

1. FHWA Distress Identification Manual for Long-Term Pavement Performance Program

Course Designers

1. Dr. A. Uma Maheswar, Asst. Professor, Dept. of Civil Engineering, SRM University – AP.

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

Engineering Hydrology

Course Code	CVE 208	**Course Category**	CC	**L**	**T**	**P**	**C**
				1	1	1	3
Pre-Requisite Course(s)	CVE 102	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the importance of hydrological processes and space-time scales associated with them.
2. Estimate the design parameters for the hydrological problems based on both constant risk and dynamic risk associated with changing climate conditions.
3. Learn the relevant processes for the given water management issues by choosing appropriate space-time scales to estimate them.

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 importance of hydrological cycles and the measurement of rainfall data.	2	80%	75%
Outcome 2	Compute the losses for evaporation, evapotranspiration, infiltration for a catchment area	3	70%	70%
Outcome 3	Calculate the quantity of runoff generated from a catchment.	3	75%	70%
Outcome 4	Illustrate the hydrographs to measure the stream flow	3	70%	70%
Outcome 5	Analyse the flood flows using control measures	4	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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	-	2	2	-	-	-	-	-	-	-	3	3	3	2
Outcome 2	2	3	2	2	-	-	-	-	-	-	-	1	2	3	2
Outcome 3	2	3	2	2	-	-	-	-	-	-	-	2	1	3	2
Outcome 4	2	2	2	2	-	-	-	-	-	-	-	3	1	3	2
Outcome 5	3	2	2	3	-	-	-	-	-	-	-	1	3	3	2
Average	**2**	**3**	**2**	**2**	-	-	-	-	-	-	-	**2**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction**	**6**		
	Hydrologic cycle, Water-budget equation, Applications in engineering, Sources of data, Precipitation: Forms of precipitation, characteristics of precipitation in India.	3	1-3	1, 2
	Measurement of precipitation, rain gauge network Mean precipitation over an area. Depth-Area-Duration relationships Depth-Duration-Frequency relationships	3	1-3	1, 4
Unit 2	**Abstractions from precipitation**	**10**		
	Evaporation process, Evaporimeters, analytical methods of evaporation estimation Reservoir evaporation and methods for its reduction, Evapotranspiration, measurement of evapotranspiration	5	2	1, 2
	Evapotranspiration equations, Potential evapotranspiration over India and actual evapotranspiration, Interception, depression storage. Infiltration, infiltration capacity, measurement of infiltration.	5	2	2, 5
Unit 3	**Runoff**	**9**		
	Runoff volume, SCS-CN method of estimating runoff volume, Flow duration curve, flow-mass curve, Hydrograph, factors affecting runoff hydrograph, Components of hydrograph. **Integration with GIS and Remote Sensing:** Modern advancements to integrate Geographic Information Systems (GIS) and Remote Sensing technologies with the Soil Conservation Service Curve Number (SCS-CN) method for more accurate estimation of runoff volume.	4	3	1, 3
	Unit hydrograph from direct runoff hydrograph S-Hydrograph Surface water resources of India, environmental flows.	5	3	1, 3
Unit 4	**Ground water and well hydraulics**	**10**		
	Ground water hydrology, Occurrence, movement and distribution of ground water	3	4	1, 3
	Aquifers – Types, specific yield, permeability, Darcy's law, Advanced Aquifer Testing Tools.	3	4	1, 3
	Well hydraulics: Steady state flow in wells, Equilibrium equations for confined and unconfined aquifers, aquifer tests, Well constants, a brief idea on IoT-enabled devices for real-time monitoring of aquifer parameters during pump tests.	4	4	1, 3
Unit 5	History of the Flood and Drought Forecasting Models, Flood Mitigation Structures: Discussion on modern flood barriers, urban flood management, and sponge city concepts. Drought Mitigation Strategies: Discussion on advancements in rainwater harvesting, desalination, and water reuse technologies.	10	5	1-5
Unit 6	Project: Integrated Hydrological Modeling and Water Resource Management for Sustainable Development.	15	5	1-5
Total Contact Hours		**60**		

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%	
Level 1	Remember	70%	60%	60%	60%	65%
	Understand					
Level 2	Apply	30%	40%	40%	40%	35%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. K. Subramanya, Hydrology (Tata Mc Graw Hill Education).
2. S. K. Garg, Irrigation engineering and hydraulic structures (Khanna publishers).
3. V.P. Singh, Elements of Engineering Hydrology (Tata Mc Graw Hill Education).
4. K.N. Duggal and J.P. Soni, Elements of Water Resources Engineering (New age international)
5. K. Subramanya, Flow in open channels (Tata McGraw-Hill Education)

Other Resources

1. NPTEL: Civil Engineering - NOC: Engineering Hydrology

Course Designers

1. Dr. Ainal Hoque Gazi, Assistant Professor, Department of Civil Engineering, SRM University-AP

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Computer Aided Drawing and Estimation

Course Code	CVE 301	Course Category	CC	L	T	P	C
				1	1	1	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Computer Aided Drawing and Estimation	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students to computer-aided drafting with the help of a professional software package.
2. To encourage the students to use computer-aided drafting for drawing the plan, elevation, and sectional views of residential and public buildings.
3. Students will have the ability to prepare an estimation and rate for a building or a bridge by taking off quantities with appropriate units from computer-aided drawings.

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 use of computer-aided drafting and prepare orthographic and isometric projections	L4	70%	70%
Outcome 2	Prepare the plan, elevation, and sectional views of residential and public buildings	L4	70%	70%
Outcome 3	Demonstrate the detailed estimation of a given building or bridge from the given plan	L3	80%	80%
Outcome 4	Describe the rate analysis for a given Civil Engineering structure	L2	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2					2		2		3	2	2
Outcome 2	3	2	2	2					2		2		3	2	2
Outcome 3	3	3	2	2					2		3		3	2	2
Outcome 4	3	3	2	2					2		3		3	3	2
Average	**3**	**3**	**2**	**2**					**2**		**2.5**		**3**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Computer-Aided Drafting (CAD)**	**5**		
	Generation of points, lines, curves, polygons, dimensioning	2	1	1
	Types of modelling: object selection commands – edit, zoom, cross-hatching, pattern filling, utility commands	3	1	1
Unit 2	**Orthographic Projection**	**7**		
	Introduction	1	1	1
	Selection of scale, Principle of projection, method and plane of projection	2	1	1
	Four quadrants, first and third angle projections using CAD	4	1	1
Unit 3	**Isometric Projection**	**8**		
	Introduction	1	3	2,3
	Isometric axes, lines, and planes	2	3	2,3
	Isometric scale, Isometric drawings, and isometric view	5	3	2,3
Unit 4	**Planning of Different Types of Buildings**	**15**		
	Introduction to line diagram	1	4	1
	Residential building: Planning of low, middle and high-income group housing	4	4	1
	Public buildings: Planning of educational institutions	2	4	1
	Public buildings: Planning of hospitals and dispensaries	2	4	1
	Public buildings: Planning of office buildings and banks	2	4	1
	Public buildings: Planning of industrial buildings	2	4	1
	Public buildings: Planning of hotels, motels and buildings for recreation	2	4	1
Total Contact Hours		**30**		

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Detail estimation of buildings**	**8**		
	Long wall and short wall method	1	3	4, 5
	Example	2	3	
	Centre line method	1	3	4, 5
	Reinforcement quantity estimation	2	3	4, 5
	Quantity estimation in bridges and culverts	2	3	4, 5
Unit 2	**Rate Analysis**	**7**		
	Introduction	1	4	4, 5
	General procedure for rate analysis	3	4	4, 5
	Rate analysis for common items	3	4	4, 5
Total Contact Hours		**15**		

Learning Assessment (Tutorial and practical)

Bloom's Level of Cognitive Task		Continuous Learning Assessments 65%			End Semester Exam 35%
		Tutorial Performance 25%	Lab Performance 25%	Observation Notes 15%	
Level 1	Remember	50%	30%	50%	50%
	Understand				
Level 2	Apply	50%	70%	50%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Building Planning and Drawing, N. Kumara Swamy, A. Kameswara Rao,
2. Engineering drawing by N.D Bhatt, Charotar publications.
3. Building planning and drawing by M. Chakravarthi.
4. B. N. Dutta, Estimating and Costing in Civil Engineering, 27th Revised Edition, New Delhi: UBS Publishers & Distributors Ltd.
5. M. Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Kolkata.

Other Resources

1. National Building Code (latest).
2. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
3. Times Saver standards of Architectural Design Data by Callender, Tata McGaw Hill.
4. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings.
5. Development plan and DCP Rules of urban local body, New Delhi, Volume 12.
6. Model building bye laws by MoUD, GoI.

Course Designers

1. Dr. Arijit Saha, Asst. Professor, Dept. of Civil Engineering, SRM University – AP.

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

Geotechnical Analysis and Design

Course Code	CVE 302	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)	CVE 206	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**	IS 2720 parts, ASTM D Series (Soil Tests)				

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students about the concepts of soil bearing capacity and shear failures.
2. To encourage the students to assess the safe bearing capacity of soil and to design shallow footings/foundations accordingly considering safety and economic viability.
3. To encourage the students to evaluate the load carrying capacity of single pile columns and pile groups.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Students will be able to conduct and plan geotechnical investigations, utilizing various exploration methods and field tests. They will be proficient in preparing comprehensive soil investigation reports.	3	75%	75%
Outcome 2	Graduates will have a deep understanding of earth pressure theories and their practical application in the design of retaining structures. They will be capable of analyzing earth pressures in layered soils.	3	70%	70%
Outcome 3	Students will acquire the skills to design different types of retaining walls, considering various failure modes and site-specific conditions. They will be adept at reading and interpreting bore logs for effective design decisions.	3	70%	70%
Outcome 4	Participants will be proficient in analyzing the stability of slopes, including both infinite and finite slopes. They will apply different methods to assess the stability of slopes under various conditions.	3	70%	70%
Outcome 5	Graduates will possess a thorough understanding of shallow foundations, and analytical methods for determining bearing capacity. They will be capable of conducting plate load tests to assess safe bearing capacity and settlement.	3	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2	-	-	1	1	-	-	-	-	3	1	3
Outcome 2	3	3	2	2	-	-	1	1	-	-	-	-	3	2	3
Outcome 3	3	3	2	2	-	-	-	1	-	-	-	-	3	2	3
Outcome 4	3	3	2	2	1	-	-	1	-	-	-	-	3	2	3
Outcome 5	2	1	1	-	1	-	1	1	-	-	-	-	1		3
Average	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Geotechnical Investigation**	**9**		
	Need – Methods of soil exploration	1	All	1,2
	Boring and Sampling methods	1	1	1,2
	Field tests – Penetration Tests	2	1	1,2
	Pressure meter	2	1	1,2
	planning of Programme	1	1	1,2
	preparation of soil investigation report	1	1	1,2
	Reading Bore log	1	1	1,2
Unit 2	**Earth Pressure Methods**	**9**		
	Introduction	2	2	1,2
	Types of failures	1	2	1,2
	Rankine's theory of earth pressure	1	2	1,2
	Coulomb's theory of earth pressure	1	2	1,2
	Culmann's graphical method	2	2	1,2
	Earth pressures in layered soils	2	2	1,2
Unit 3	**Analysis of Retaining Walls**	**10**		
	Wall Types	1	3	1,2
	Failure Modes	3	3	1,2
	Design of Gravity wall	2	3	1,2
	Design of Cantilever Wall	2	3	1,2
	Bulk heads	1	3	1,2
	Anchored heads & Braced cuts	1	3	1,2
Unit 4	**Slope Stability Analysis**	**8**		
	Introduction	1	4	1,2
	Infinite and finite earth slopes in sand and clay	1	4	1,2
	Types of failures – factor of safety of infinite slopes	1	4	1,2
	stability analysis by Swedish arc method, standard method of slices	1	4	1,2
	Taylor's Stability Number	1	4	1,2
	Stability of slopes of dams and embankments	2	4	1,2
	Stability under different conditions	1	4	1,2
Unit 5	**Shallow Foundations**	**9**		
	Types of foundations and factors to be considered in their location	3	5	1,2
	Bearing capacity – criteria for determination of bearing capacity	2	5	1,2
	Factors influencing bearing capacity	1	5	1,2
	analytical methods to determine bearing capacity	1	5	1,2
	Terzaghi's theory - IS Methods	1	5	1,2
	Safe bearing pressure based on N- value – allowable bearing pressure; Safe bearing capacity and settlement from plate load test	1	5	1,2
Total Contact Hours		**45**		

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Determine the coefficient of consolidation of soil using consolidometer	6	1, 2	2,3
2	Determine the shear strength of soil using unconfined compressive triaxial test.	3	1, 3	2,3
3	Determine the shear strength of soil using unconsolidated undrained triaxial test	3	1, 4	2,3
3	Determine the shear strength of soil using consolidated undrained triaxial test	6	1, 3	2,3
4	Determine the shear strength of soil using vane shear test	3	1, 4	2,3
6	Determine the CBR ratio of soil using California Bearing Ratio Test	3	1, 5	2,3
7	Determination of soil electrical conductivity in field (sounding and profiling), Wenner and Schlumberger methods	6	1, 2	
	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 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	40%	30%	30%	40%	35%
	Understand					
Level 2	Apply	40%	50%	50%	40%	45%
	Analyse					
Level 3	Evaluate	20%	20%	20%	20%	20%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Principles of Foundation Engineering, Braja M. Das, Cengage Learning.
2. Foundation Analysis and Design – J.E. bowles, McGraw – Hill Publishing Co.,
3. Experimental Soil Mechanics, J. P. Bradet, Prentice Hall, Upper Saddle River, NJ.

Other Resources

1. Foundation Design and Construction – M.J. Tomlinson, Pitma
2. Pile Foundation Analysis & Design by Poulos and Davis.

Course Designers

1. Dr. Raviteja KVNS, Asst. Professor, Dept. of Civil Engineering, SRM University – AP.

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

Physico-Chemical Water Treatment: Materials and Processes

Course Code	CVE 303	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)	CHE 103	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Students will have the ability to be conversant with sources of water and its demand.
2. Students will be able to understand the basic characteristics of water and its determination.
3. Students will have adequate knowledge about the water treatment processes and its design.
4. Students will have adequate knowledge regarding residual management and an overview of some advanced treatment techniques.
5. Students will have adequate knowledge on distribution network and water supply to buildings.

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	Assess the characteristics of different water sources and interpret their significance.	2	80%	80%
Outcome 2	Determine the flow rates and various quality (physical, chemical and biological) aspects in water systems.	3	70%	70%
Outcome 3	Plan and design components of water treatment systems through physical, chemical and biological unit operations and processes involved.	4	70%	70%
Outcome 4	Analyze methods for removal of selected critical components affecting water use through advanced/non-conventional techniques.	4	70%	70%
Outcome 5	Analyze different methods for residual management and get an overview of different distribution networks used in public water supplies.	4	70%	70%

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	Modem Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	-	-	3	**S**	-	-	-	-	1	1	1
Outcome 2	3	3	3	3	-	-	3	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	-	-	3	-	-	-	-	-	3	3	3
Outcome 4	3	2	1	1	-	-	3	-	-	-	-	-	3	2	2
Outcome 5	3	2	2	2	-	-	3	-	-	-	-	-	3	3	3
Average	**3**	**2**	**2**	**2**	-	-	**3**	-	-	-	-	-	**3**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Water Quality and quantity**	**9**		
	Evolution of Water Treatment Technology Traditional Technologies Introduction of Additional Treatment Technologies Developments Requiring New Approaches and Technologies Revolution Brought about by Use of Membrane Filtration	**1**	**1**	**1**
	Selection of Water Treatment Processes	**1**	**1**	**1, 2, 3**
	Physical Aggregate Characteristics of Water Absorbance and Transmittance Turbidity Particles Colour Temperature Taste and Odour Gases in water	1	2	1, 2, 3
	Inorganic Chemical Constituents Major Inorganic Constituents Minor and Trace Inorganic Constituents Inorganic Water Quality Indicators	**1**	**2**	**1, 2, 3**
	Organic Chemical Constituents Definition and Classification Sources of Organic Compounds in Drinking Water Natural Organic Matter Organic Compounds from Human Activities Organic Compounds Formed During Water Disinfection Surrogate Measures for Aggregate Organic Water Quality Indicators	**1**	**2**	**1, 2, 3**
	Bacteria of Concern in Drinking Water Classic Waterborne Bacterial Pathogens Modern Waterborne Bacterial Pathogens Bacterial Pathogens of Emerging Concern Bacteria and Terrorism in Water Supplies	**1**	**2**	**1, 2, 3**
	Viruses of Concern in Drinking Water Non gastrointestinal Viruses Viral Gastroenteritis Other Viruses Associated with Fecal–Oral Route	**1**	**2**	**1, 2**
	Algae of Concern in Drinking Water Algae Ecology and Nomenclature Algal and Lake Trophic Status Harmful Algal Blooms Algae and Filter Clogging Enumeration of Algae in Water Supplies	**1**	**2**	**1, 2**
	Assessing the Presence of Pathogens in Source Water Use of Coliform as an Indicator of the Presence of Wastewater Viable But Not Culturable Bacteria	**1**	**2**	**1, 2, 3**
Unit 2	**Introduction to Water Treatment**	**4**		
	Development of Systems for Water Treatment	2	3	1, 2, 3

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	General Considerations Involved in the Selection of Water Treatment Processes Synthesis of Water Treatment Trains Treatment Processes for Residuals Management Hydraulic Sizing of Treatment Facilities and Processes Pilot Plant Studies Removal Efficiency and the Log Removal Value			
	Types of Reactors Used in Water Treatment Types of Reactors Reactors Characterized by Operation Pattern Reactors Characterized by Hydraulic Characteristics Reactors Characterized by Unit Process Reactors Characterized by Entrance and Exit Conditions	2	3	1, 2
Unit 3	**Unit operations and processes in water treatment**	**20**		
	1. Coagulation and Flocculation Stability of Particles in Water Particle–Solvent Interactions Electrical Properties of Particles Particle Stability Compression of the Electrical Double Layer	1	3	1, 2, 3
	Coagulation Theory Adsorption and Charge Neutralization Adsorption and Interparticle Bridging Precipitation and Enmeshment	1	3	1, 2, 3
	Coagulation Practice Inorganic Metallic Coagulants Prehydrolyzed Metal Salts Organic Polymers Coagulant and Flocculant Aids Jar Testing for Coagulant Evaluation Alternative Techniques to Reduce Coagulant Dose	1	3	1, 2, 3
	Flocculation Theory Mechanisms of Flocculation Particle Collisions Flocculation of Spherical Particles Fractal Flocculation Models Floc Breakup Use of Spherical Particle Models for Reactor Design	1	3	1, 2, 3
	Flocculation Practice Alternative Methods of Flocculation Vertical Turbine Flocculators Horizontal Paddle Wheel Flocculators Hydraulic Flocculation Essential Design Features in Flocculation	1	3	1, 2, 3
	2. Gravity Separation **Classification of Particles for Settling** Principles of Discrete (Type I) Particle Settling Settling Velocity of Discrete Particles Brownian Motion	1	3	1, 2, 3
	Discrete Settling in Ideal Sedimentation Basins Rectangular Sedimentation Basins Circular Sedimentation Basins	1	3	1, 2, 3
	Conventional Sedimentation Basin Design	2	3	1, 2, 3

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Presedimentation Facilities Rectangular Sedimentation Basins Circular Sedimentation Basins and Upflow Clarifiers Square Sedimentation Basins			
	High-Rate Sedimentation Processes Tube and Lamella Plate Clarifiers Solids Contact Clarifiers Ballasted Sedimentation	1	3	1, 2, 3
	Physical Factors Affecting Sedimentation Density Currents Wind Effects Inlet Energy Dissipation Outlet Currents Equipment Movement	1	3	1, 2, 3
	3. Granular Filtration **Principal Features of Rapid Filtration** Uniformity of Filter Media Coagulation Pretreatment Basic Process Description Filtration Effectiveness During the Filtration Stage Classifications of Rapid Filtration Systems	1	3	1, 2
	Properties of Granular Filter Media Materials Used for Rapid Filtration Media Effective Size and Uniformity Coefficient Grain Shape Material Density Material Hardness Granular Bed Porosity Granular Bed Specific Surface Area	1	3	1, 2
	Hydraulics of Flow through Granular Media Head Loss through Clean Granular Filters Backwash Hydraulics	3	3	1, 2
	Other Filtration Technologies and Options Pressure Filtration Biologically Active Filtration Slow Sand Filtration Greensand Filtration Diatomaceous Earth Filtration Bag and Cartridge Filtration	2	3	1, 2
	4. Disinfection **Disinfection with Free and Combined Chlorine** Chemistry of Free Chlorine Chemistry of Combined Chlorine Forms of Chlorine (Liquid, Gas, Hypochlorite, etc.) Liquid Chlorine Control of Gas Chlorination Sodium Hypochlorite Ammonia	1	3	1, 2, 3
	Other Disinfection methods Generation of Chlorine Dioxide Sodium Chlorite Disinfection with Ozone and UV	1	3	1, 2, 3
Unit 4	**Removal of specific constituents**	**7**		

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Softening Sources of Hardness Softening by Chemical Precipitation Chemistry of Water Softening by Precipitation Kinetics of Lime Softening and Recarbonation Types of Softening Process Configurations Chemical Dose Calculations for Lime–Soda Ash Softening	2	4	1, 2, 3
	Iron and Manganese Removal Iron Manganese Treatment Strategies for Iron and Manganese	1	4	1, 2, 3
	Adsorption Fundamentals of Adsorption Interfacial Equilibria for Adsorption and Other Solute Surface Phenomena Important Factors Involved in Adsorption Surface Chemistry and Forces Involved in Adsorption	1	4	1, 2, 3
	Manufacture, Regeneration, and Reactivation of Activated Carbon Manufacture from Raw Materials Regeneration and Reactivation of Spent GAC	1	4	1, 2, 3
	Development of Isotherms and Equations Used to Describe Adsorption Equilibrium Equilibrium Isotherm Langmuir Isotherm Equation Freundlich Isotherm Equation Brunauer–Emmett–Teller Isotherm Equation	2	4	1, 2, 3
Unit 5	**Residuals Management**	**3**		
	Physical, Chemical, and Biological Properties of Residuals Physical Properties Chemical Properties Biological Properties	1	5	1, 2, 3
	Alum and Iron Coagulation Sludges Estimating Quantities of Coagulant Sludges Physical Properties of Coagulant Sludges Chemical Properties of Coagulant Sludges	1	5	1, 2, 3
	Lime Precipitation Sludges Estimating Quantities of Lime Sludges Physical Properties of Lime Sludges Chemical Properties of Lime Sludges	1	5	1, 2, 3
Unit 6	**Water Distribution Network Systems**	**2**		
	Types of WDNs, their advantages and disadvantages	1	5	1, 2, 3, 5
	Types of analyses in WDNs	1	5	1, 2, 3, 5
Total Contact Hours		**45**		

Course Unitization Plan Theory

Unit No.	Unit Name	Contact Hours	Non-Contact Hours	CLOs Addressed	References Used
Unit 1	**Project**	**5**	**25**	1-5	1-3

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%	Project 15%	
Level 1	Remember	100%	80%	70%	40%	30%
	Understand					
Level 2	Apply		20%	30%	60%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. MWH's Water Treatment: Principles and Design, Third Edition, John Wiley & Sons, Inc.
2. P.N. Modi, Water Supply Engineering, Standard Book House
3. Howard Peavy, Donald Rowe, George Tchobanoglous, Environmental Engineering, Tata McGraw Hill

Other Resources

1. NPTEL Course: Water Supply Engineering (NPTEL:: Civil Engineering - NOC: Water Supply Engineering
2. CPHEEO Manual on Water Supply and Treatment, Third Edition

Course Designers

1. Dr. Siddhant Dash, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Remote Sensing and GIS

Course Code	CE 304	**Course Category**	CC	**L**	**T**	**P**	**C**
				1	1	1	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce the basic concepts of Remote Sensing and GIS.
2. Gain knowledge of different types of platforms and sensors.
3. Learn the function and use of Data reception, Data processing & Data generation.
4. Understand the interface of QGIS/ArcGIS and explore its applications in preparation of maps and drawing solutions to spatial 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	Understand the concepts of GIS and compare the use of geospatial data over the conventional field surveying	2	70%	75%
Outcome 2	Apply the knowledge of Remote sensing and GIS to solve real world problems	3	70%	70%
Outcome 3	Analyse the satellite imagery, high resolution images captured using UAV's, terrestrial data sets.	3	75%	70%
Outcome 4	Applying the location allocation algorithms to determine the ideal locations for facility management	3	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	-	1	-	1	-	-	-	-	-		2	-	-	-
Outcome 2	2	2	1	1	1	-	-	-	1	-	1	1	-	-	-
Outcome 3	2	2	1	2	2	-	-	-	1	-	1	1	-	-	-
Outcome 4	2	2	-	2	2	-	-	-	-	-	-	2	-	-	-
Average	**2**	**2**	**1**	**2**	**2**	-	-	-	**1**	-	**1**	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Remote sensing**	**04**		
	Introduction to Remote Sensing.	1	1,2	1,2,3
	Development of remote sensing, and components	1	1,2	1,2,3
	Basic Principles of Optical Remote Sensing	1	1,2	1,2,3
	Data collection and transmission, Sensors and satellite imageries	1	1,2	1,2,3
Unit 2	**Energy sources and radiation principles,**	**03**		
	Electromagnetic energy and spectrum, Wavebands,	1	1,2	4,5,6
	Interactions of electromagnetic energy with atmosphere and earth's surface	1	1,2	1,2
	Geometric and radiometric qualities of images	1	1,2	3,4,5
Unit 3	**Handling satellite data**	**09**		
	Multi-spectral, thermal and Hyperspectral remote sensing: Across track scanning, along track scanning, operating principles, thermal radiation principles,	1	1,2	5,6,7
	Digital Image Processing, Image rectification and restoration, image enhancement, contrast manipulation, multi-image manipulation,	2	1,2	1,3,4,5
	Image classification, Classification accuracy assessment, Image transmission and compression	2	1,2	1,2,4,5
	Microwave and lidar sensing: Radar development, Side-looking radar system, Synthetic Aperture Radar, Characteristics of Radar imagery, Radar image interpretation	3		
Unit 4	**Data Products**	**06**		
	Data Products, Satellite data, Data formats, Data acquisition for natural resources management;	2	2,3	2,3
	Digital processing of satellite images:	1	3,4	2,5
	Geometric rectification, spatial and radiometric enhancement,	1	1,2	2,3,5
	Edge detection, band ratio, false colour composites, Principal component analysis,	1	1,4	2,3,4,5
	Spectral domain enhancement, Supervised and unsupervised classification for thematic map generation	1	3,4	2,3,5
Unit 5	**Geographic Information Systems**	**12**		
	Introduction to Geographic Information Systems and QGIS	1	4	2,3
	Exploring the interface of QGIS	1		
	Geographic concepts for GIS.	2	4	2,3
	Settingup the workspace of QGIS	1		
	Spatial data models, Raster and Vector data structures and algorithms	1	4	2,3
	Creating geospatial data and data conversion using QGIS	3		
	Spatial relationships, topology, spatial patterns	1	4	2,3
	Data storage, data structure, non-spatial database models.	1	4	2,3
	Populating GIS data, digitizing data exchange, data conversion.	2	4	2,3
	Digital Elevation Models (DEM) and their application, Triangulated Irregular Network (TIN) model. GIS application areas	1	4	2,3
	Analysing DEMs using QGIS	2		
	Spatial analysis, quantifying relationships, spatial statistics, and spatial search, Decision making in GIS context	1	4	2,3
	Performing spatial analysis using QGIS and solving decision making probelms using the concepts of GIS	2		
	Global Positioning Systems; Surveying with GPS; GIS and GPS integration.	1	4	2,3
	Introduction to Unmanned aerial vehicles, types, classification, and a glimpse of available open-source packages used to process the collected information.	1	4	2,3
	Data processing of drone based imagery using WebODM (Open source software)	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%	
Level 1	Remember	50%	75%	50%	50%	75%
	Understand					
Level 2	Apply	30%	15%	30%	30%	15%
	Analyse					
Level 3	Evaluate	20%	10%	20%	20%	10%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Elachi, C., & Van Zyl, J. J. (2021). Introduction to the physics and techniques of remote sensing. John Wiley & Sons.
2. Chandra A.M and Ghosh S.K., "Remote Sensing & Geographical Information System", Narosa Publishing House, 2006, 1st ed
3. Geomatics Engineering by Manoj K. Arora and R.C.Badjatia published by Nemchand & Bros, Civil Lines, Roorke-247667, First edition 2011.
4. Remote Sensing and Geographical information system,by M. Anji Reddy, ; B.S. Publications, 2012.
5. Basics of Remote Sensing and GIS by S.Kumar
6. Remote Sensing and GIS by Basudev Batta
7. Basic Concept of Remote Sensing, GPS and GIS by Shivam pandey and Shasikant Tripathi.
8. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image Interpretation, John Wiley & Sons, New York, 1994.
9. R.P. Gupta, Remote Sensing Geology, Springer-Verlag, Berlin, Germany, 1991 Georgr Joseph, Fundamentals of Remote Sensing, Universities Press, Delhi, 2005

Other Resources

1. Thomas M Lillesand, and Ralph W Kiefer; "Remote sensing and Image Interpretation", John Wiley & Sons, 1994, 3rd ed.
2. Michael F. Worboys, "GIS: A Computing Perspective", Taylor & Francis Ltd; 1995,1st ed.
3. Maling D.H., "Coordinate Systems and Map Projections", Pergamon; 1992, 2nd ed.
4. Lawrence Letham, "GPS Made Easy: Using Global Positioning Systems in the Outdoors" Mountaineers Books, 2003, 4th Revised edition.
5. DeMers, M. N. 2000. Fundamentals of Geographic Information Systems, 2nd Edition, John Wiley & Sons

List of major software exercises

Georeferencing using GCPs, Georeferencing Map to Map, Creating a point shapefile, Creating a polyline shapefile, Creating a polygon shapefile, KML/KMZ to shapefile conversion, Rotation of created features, Adding/Deleting fields, Editing vertices, Split line features, Split features, Projections, Random points by extent, Random points within polygon, Random points on line, Computation of length and Area, Symbology, Thematic Maps, Linking Attribute table, Query Building, Union operator, Buffer tool, Intersection tool, Clipping, Symmetrical Difference, Accessing WMS data from Bhuwan portal, Accessing DEM from Bhuwan portal, Mosaic of DEMs, 3D rendering of DEM, Processing the extent of DEM, Delineation of rivers, Kriging interpolation, IDW interpolation, Developing a composite image.

Course Designers

1. Dr. Harish Puppala, Assistant Professor, Dept of Civil Engineering, SRM University-AP

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

High-Speed Railways, Airways, and Waterways Engineering

Course Code	CVE 305	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To familiarize with railway engineering design and construction aspects.
2. To learn airport engineering runway geometric design aspects.
3. To upskill highway pavement engineering knowledge base for airport pavements.
4. To gain exposure into waterway engineering.

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 other modes of transportation engineering streams such as railways, airways, and waterways	2	80%	75%
Outcome 2	Analyse various features of railway and airport engineering	4	80%	75%
Outcome 3	Design and maintain railway and airport infrastructure facilities	4	75%	70%
Outcome 4	Discuss various aspects of waterways engineering	2	75%	75%

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	Modem Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	-	-	1	1	-	-	-	-	3	2	1
Outcome 2	2	3	2	2	1	-	1	-	-	-	-	-	1	3	2
Outcome 3	2	2	3	3	1	-	-	-	-	-	-	-	1	2	3
Outcome 4	3	2	1	1	-	-	2	1	-	-	-	-	3	2	1
Average	**3**	**2**	**2**	**2**	**1**	**-**	**1**	**1**	-	-	-	-	**2**	**2**	**2**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Hi-Speed Railway (HSR) Engineering**	**15**		
	Hi-Speed Railway (HSR)- An Overview	1	1	1,2
	Track Geometry for Hi-Speed Railways	4	1	1,2
	Track Components for HSR- Rails, Sleepers, Fastenings, etc.	2	1	1,2
	Laying HSR Track – Subgrade, Ballast, Geotextiles, etc	1	1	1,2
	Signalling & Telecommunication	1	1	1,2
	Rolling Stock & Operating Conditions	1	1	1,2
	HSR Track Maintenance	2	1	1,2
	Characteristics of the Transverse Section and the Infrastructure – Tunnels and Bridges	1		
	Other Modern railway systems – Suburban, Metro, Tramway, Monorail, Cable-propelled	2	1	1,2
Unit 2	**Next-Gen Airport Systems Engineering**	**7**		
	Introduction – ICAO Annexures and FAA Standards	2	1	3,4
	Aircraft Characteristics and Airport System Planning	1	1	3,4
	Airport Master Plan and Site Selection	1	1	3,4
	Airside Configuration and Geometric Design	1	1	3,4
	Airport Safety, Passenger Terminal, Air Cargo Facilities	1	2,3	3,4
	Heliports and vertiports	1	1,3	3,4
Unit 3	**Airfield Pavement Engineering**	**9**		
	Airfield vs Highway Pavements	1		
	Airfield Pavement Design – Flexible and Rigid using Industry Standard Software	2		
	Aircraft & Pavement Classification Rating (ACR&PCR)	2		
	Airfield Pavement Maintenance – Falling Weight Deflectometer (FWD) Studies and Foreign Object Debris (FOD) on Runways	2		
	Airfield Pavement Materials and Quality Control as per ICAO and FAA standards	2		
Unit 4	**Modern Waterways Engineering**	**14**		
	Ports and Modern Waterways Systems	2		
	Port planning and layout	2		
	Container and other terminals	1		
	Inland waterway transport network and fleet	2		
	Dimensions of waterways – inland and sea	1		
	Ship-waterway and ship-ship interactions	1		
	Traffic Management -Vessel Traffic Services	1		
	Hydrodynamic effects- locking and mooring operations	2		
	Performance of port and waterway systems – energy consumption&emission performance	1		
	Multi-model corridor analysis	1		
Total Contact Hours		**45**		

Course Unitization Plan Theory

Unit No.	Unit Name	Contact Hours	Non-Contact Hours	CLOs Addressed	References Used
Unit 1	**Project**		30	1-4	1-5

Projects in this course will be assigned after completion of each topic such as Hi-speed railways, Airways, and Waterways Engineering. The nature of the projects includes but is not limited to the following:

- Visiting a nearby railway station, and documenting the observations followed by the seminar
- Exploring case studies/literature on hi-speed railways and bullet trains followed by the seminar
- Performing pavement condition surveys followed by the seminar
- Exploring case studies/literature on hi-speed railways and bullet trains followed by the seminar
- Exploring case studies/literature on ports and waterways followed by the seminar

Learning Assessment Theory

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

Learning Assessment Project

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)	Project-External (50%)
		Mid-Sem Internal Evaluation	
Level 1	Remember	40%	50%
	Understand		
Level 2	Apply	60%	50%
	Analyse		
Level 3	Evaluate		
	Create		
Total		**100%**	**100%**

Recommended Resources

1. Christos N. Pyrgidis, Railway Transportation Systems Design, Construction and Operation, CRC Press, 2nd edition
2. Satish Chandra and M.M. Agarwal, Railway Engineering, Oxford Publishing, 2nd edition
3. Norman J Ashford, Airport Engineering – Planning, Design and Development of 21st Century Airports, Wiley Publishers
4. Airport Planning and Design by S.K. Khanna and Arora; Nem Chand Bros.
5. Koningsveld, et al., Ports and Waterways -Navigating the changing world, TU Delft Open, Feb 2023.

Other Resources

1. Railway, Bridge, and Tunnel Engineering by Ketki B. Dalal (K.S. Rangwala); 2nd Edition or Latest; Charotar Publishing House Pvt. Ltd.
2. Pavement Engineering: Principles and Practice by Mallick & El-Korchi, CRC Press
3. ICAO Annexures

Course Designers

1. Dr. Uma Maheswar Arepalli, Assistant Professor, Civil Engineering Department, SRM University AP

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

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%**

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

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%**

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Wastewater Treatment: Disposal to Resource Recovery

Course Code	CVE 401	Course Category	CC	L	T	P	C
				2	0	1	3
Pre-Requisite Course(s)	CVE 301	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Civil Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Students will have the ability to learn the basics of sewage composition and its characteristics.
2. Students will have adequate knowledge about various sewage treatment processes and their design, including sewer networks.
3. Students will adequate information on various disposal standards for effluents and their effective disposal methods to the receiving environment.
4. Students will have adequate knowledge about Wastewater reclamation and reuse.

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	Assess the characteristics of wastewater and interpret their significance.	2	80%	80%
Outcome 2	Determine the flow rates and various constituent loadings in wastewater systems.	3	70%	70%
Outcome 3	Plan and design components of wastewater treatment systems through physical, chemical and biological unit operations and processes involved.	4	70%	70%
Outcome 4	Analyze methods for water reuse through various reclamation policies.	4	70%	70%
Outcome 5	Analyze different methods for biosolids treatment and management.	4	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	-	-	3	-	-	-	-	-	1	1	1
Outcome 2	3	3	3	3	-	-	3	-	-	-	-	-	3	3	3
Outcome 3	3	3	3	3	-	-	3	-	-	-	-	-	3	3	3
Outcome 4	3	2	1	1	-	-	3	-	-	-	-	-	3	2	2
Outcome 5	3	2	2	2	-	-	3	-	-	-	-	-	3	3	3
Average	**3**	**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 Wastewater Engineering**	**8**		
	Terminologies	0.5	1	1, 2, 3
	Impact of Regulations on wastewater engineering	0.5	1	1, 2
	Health and environmental concerns in wastewater management	1	1	1, 2
	Wastewater characteristics	0.5	1	1, 2
	Wastewater treatment methods	0.5	1	1, 2
	Wastewater constituents	1	2	1, 2, 3
	Physical characteristics	1	2	1, 2, 3
	Inorganic non-metallic constituents	0 (Self-learn)	2	1, 2, 3
	Metallic constituents	0 (Self-learn)	2	1, 2, 3
	Aggregate organic constituents	1	2	1, 2, 3
	Individual organic compounds	1	2	1, 2, 3
	Biological characteristics	1	2	1, 2, 3
Unit 2	**Introduction to Process Analysis and Selection**	**4**		
	Reactors used for the treatment of wastewater	0.5	3	1, 2
	Mass balance analysis	0.5	3	1, 2
	Modelling ideal flow in reactors	1	3	1, 2
	Reactions, reaction rates and reaction rate coefficients	1	3	1, 2
	Treatment processes involving mass transfer	1	3	1, 2
Unit 3	Physical and chemical unit operations	**3**		
	Screening	0 (Self-learn)	3	1, 2
	Coarse solids reduction	0 (Self-learn)	3	1, 2
	Flow equalization	1	3	1, 2
	Mixing and flocculation	0 (Self-learn)	3	1, 2
	Gravity separation theory	0 (Self-learn)	3	1, 2
	Grit removal	1	3	1, 2
	Primary sedimentation	0 (Self-learn)	3	1, 2
	High-rate clarification	0.5	3	1, 2
	Role of chemical unit processes in wastewater treatment	0.5	3	1, 2
	Fundamentals of chemical coagulation	0 (Self-learn)	3	1, 2
Unit 4	**Introduction to biological treatment of wastewater**	**7**		

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
	Composition and classification of microorganisms	0.5	3	1, 2
	Introduction to biological metabolism	0.5	3	1, 2
	Bacterial growth and energetics	1	3	1, 2
	Microbial growth kinetics	0.5	3	1, 2
	Modelling suspended growth treatment processes	1	3	1, 2
	Substrate removal in attached growth treatment processes	1	3	1, 2
	Aerobic biological oxidation	0.5	3	1, 2
	Biological nitrification and denitrification	0.5	3	1, 2
	Biological Phosphorus removal	0.5	3	1, 2
	Anaerobic fermentation and oxidation	1	3	1, 2
Unit 5	**Disinfection**	**3**		
	Disinfection theory	1	3	1, 2
	Kinetics of Disinfection	1	3	1, 2
	Disinfection methods	1	3	1, 2
Unit 6	**Biosolids management**	**4**		
	Solids processing flow diagrams	0.5	5	1, 2, 3
	Thickening	0.5	5	1, 2, 3
	Sludge Stabilization	0.5	5	1, 2, 3
	Anaerobic digestion	0.5	5	1, 2, 3
	Aerobic digestion	0.5	5	1, 2, 3
	Sludge Conditioning	0.5	5	1, 2, 3
	Sludge dewatering	0.5	5	1, 2, 3
	Heat drying	0.5	5	1, 2, 3
	Solids mass balances	0.5	5	1, 2, 3
Unit 7	**Water reuse**	**1**		
	Wastewater reclamation and reuse	1	4	1, 2
Total Contact Hours		**30**		

Course Unitization Plan Theory

Unit No.	Unit Name	Contact Hours	Non-Contact Hours	CLOs Addressed	References Used
Unit 1	**Project**	5	25	1-5	1-4

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 50%	Mid-1 15%	CLA-2 10%	Project 15%	
Level 1	Remember	100%	80%	70%	40%	30%
	Understand					
Level 2	Apply		20%	30%	60%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Metcalf & Eddy, Inc, Wastewater Engineering: Treatment and Reuse (4th Edition), Tata McGraw Hill

Other Resources

1. P.N. Modi, Sewage Treatment & Disposal & Wastewater Engineering, Standard Book House
2. Howard Peavy, Donald Rowe, George Tchobanoglous, Environmental Engineering, Tata McGraw Hill
3. Mackenzie L. Davis, Water and Wastewater Engineering, Tata McGraw Hill
4. NPTEL Course: Wastewater Treatment and Recycling (NPTEL:: Civil Engineering - NOC: Wastewater Treatment and Recycling)
5. CPHEEO Manual on Sewerage and sewage treatment systems, Part – A: Engineering
6. Standard methods for the examination of water and wastewater, Washington: APHA, 2012, 21st Edition
7. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition
8. Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, McGraw Hill Education, 2017,1st Edition
9. Introduction to Environmental Engineering and Science, G.B. Masters, Pearson, 2013, 3rd Edition
10. Environmental Engineering (Vol. II): Sewage Waste Disposal and Air Pollution Engineering, S.K. Garg (1999), Khanna Publishers, 2018, 40th Edition
11. Paul L. Bishop, Pollution Prevention: Fundamental and Practice, McGraw Hill, International, 2000. Freeman, H.M., Industrial Pollution Prevention Handbook, McGraw Hills 1995

Course Designers

1. Dr. Siddhant Dash, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Building Information Modelling and Management

Course Code	CVE 402	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	0	2	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students with the application of BIM Principles to Design, Construction, and Management Phases.
2. To expose the students to legal and ethical Considerations in BIM Implementation.
3. To encourage to use BIM softwares for effective 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	Demonstrate the fundamentals of BIM	1	65%	55%
Outcome 2	Illustrate the application of BIM in design and construction	2	60%	60%
Outcome 3	Demonstrate the management of data in BIM	3	55%	50%
Outcome 4	Explain legal and ethical aspects of BIM	3	65%	60%
Outcome 5	Demonstrate proficiency in BIM softwares	2	60%	55%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	1	-	-	-	-	-	-	-	-	1	2	2	1
Outcome 2	2	1	1	-	-	-	-	-	-	-	-	1	2	2	1
Outcome 3	2	1	1	-	-	-	-	-	-	-	-	1	2	3	1
Outcome 4	1	2	1	1	-	-	-	3	-	-	-	1	1	3	3
Outcome 5	1	1	1	1	3	-	-		-	-	-	1	3	3	1
Average	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**3**	**1**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Bim Fundamentals**	**06**	**1**	**1,2**
	Introduction to Building Information Modelling (BIM)	1	1	1,2
	Historical Development of BIM	1	1	1,2
	Evolution of BIM in the Construction Industry	1	1	1,2
	Key Components of BIM	1	1	1,2
	Benefits and Challenges of Implementing BIM	1	1	1,2
	BIM in the Building Lifecycle	1	1	1,2
Unit 2	**Bim In Design and Construction**	**08**	**2**	**1,2**
	BIM in Architectural Design	1	2	1,2
	BIM in Structural Design	2	2	1,2
	Construction Sequencing using BIM	2	2	1,2
	Scheduling and Clash Detection in BIM	1	2	1,2
	Real-World Applications of BIM in Design and Construction	1	2	1,2
	Review of BIM-Enabled Projects	1	2	1,2
Unit 3	**Bim Data Management and Intergration**	**08**	**3**	**3**
	Principles of Data Management in BIM	1	3	3
	Integrating BIM with Construction Management Systems	2	3	3
	BIM and Facility Management	2	3	3
	Data Exchange Standards (IFC, COBie)	1	3	3
	Challenges in BIM Data Management	1	3	3
	Case Studies on Successful BIM Integration	1	3	3
Unit 4	**Legal and Ethical Aspects of Bim**	**08**	4	1,4
	Legal and Ethical Implications of BIM	2	4	1,4
	Contractual Considerations in BIM Projects	1	4	1,4
	Liability Issues in BIM Implementation	1	4	1,4
	Industry Standards and Guidelines for BIM	1	4	1,4
	Best Practices for Legal and Ethical BIM Implementation	1	4	1,4
	Guest Lectures and Discussions with Legal Experts in BIM	2	4	1,4
Total Contact Hours		**30**		

Course Unitization Plan Lab

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	Introduction to BIM Software (e.g., Revit, ArchiCAD, Navisworks)	10	5	4
2	Basic Tools and Features of BIM Software Autodesk Revit	10	5	4
3	Creating and Modifying 3D Models in BIM Software Autodesk Revit	10	5	4
4	Data Management in BIM Software Autodesk Revit	10	5	4
5	Exercises with BIM Tools using Autodesk Revit	20	5	4
Total Contact Hours		**60**		

Learning Assessment Theory

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 15%	CLA-2 10%	CLA-3 15%	
Level 1	Remember	80%	60%	60%	60%	50%
	Understand					
Level 2	Apply	20%	40%	40%	40%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Learning Assessment Lab

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%			End Semester Exam 50%
		Lab Performance 20%	Observation Notes 10%	Model Exam 20%	
Level 1	Remember	30%	50%	40%	50%
	Understand				
Level 2	Apply	70%	50%	60%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		100%	100%	100%	100%

Recommended Resources

1. Mordue, S., Swaddle, P. and Philp, D., 2015. Building information modeling for dummies. John Wiley & Sons.
2. Issa, Raja RA, and Svetlana Olbina, eds. "Building information modeling: applications and practices." American Society of Civil Engineers, 2015.
3. Lu, Weisheng, Chi Cheung Lai, and Tung Tse. BIM and Big Data for Construction Cost Management. Routledge, 2018.
4. Nawari, Nawari O. Building information modeling: Automated code checking and compliance processes. CRC Press, 2018.
5. Kirby, L., Krygiel, E. and Kim, M., 2017. Mastering Autodesk Revit 2018. John Wiley & Sons.

Other Resources

1. Eastman, Charles M. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons, 2011.

Course Designers

1. Dr. GVP Bhagath Singh, Associate Professor, Department of Civil Engineering, SRM University-AP

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

Design of Steel Structures

Course Code	CVE 403	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CVE 203 CVE 209	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To introduce the students about the fundamental concepts of steel design.
2. To encourage the students to solve various problems associated with the design of steel structural members.
3. To encourage the students to solve various problems associated with the design of connections in steel 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	Discuss the concepts of mechanical behavior of steel, design philosophies (WSM, ULM, LSM) and classification of cross-sections.	2	75%	75%
Outcome 2	Illustrate the design of tension members.	3	70%	70%
Outcome 3	Demonstrate the design of compression members.	3	70%	70%
Outcome 4	Complete the design of flexure members, column splices and column bases.	3	70%	70%
Outcome 5	Demonstrate the design of connections.	3	70%	70%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	1	2	-	-	1	1	-	-	-	-	3	1	3
Outcome 2	3	3	2	3	1	-	-	1	-	-	-	-	3	1	3
Outcome 3	3	3	2	3	1	-	-	1	-	-	-	-	3	2	3
Outcome 4	3	3	2	3	1	-	-	1	-	-	-	-	3	2	3
Outcome 5	3	3	2	3	1	-	-	1	-	-	-	-	3	2	3
Average	**3**	**3**	**2**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction and Methods of Structural Design**	**5**	**1**	
	Introduction	1	1	1,3
	Mechanical behavior of steel – Measures of Yielding – Measures of Ductility, Types of Structures – Structural Steel Sections	1	1	1,3
	Design Philosophies-Working Stress method- Ultimate Strength Method-Load and Resistant factor-	1	1	1,3
	Design Philosophies-Limit State Method-Partial safety factor-Load Combinations	1	1	1,3
	Classification of Cross sections- General aspects in the design	1	1	1,2,3
Unit 2	**Design of Steel Fasteners and Tension Members**	**9**	**2,5**	
	Types of fasteners – Riveted connections- Bolted Connections- Assumptions- Failure of bolted joints	1	5	1,2
	Strength of bolted joints – Design examples	2	5	1,2
	Design of Welded connections – Butt weld- fillet weld – Design examples	2	5	1,2
	Design of Tension Members: General-Modes of Failure of Tension member	2	2	1,2
	Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design	2	2	1,2
Unit 3	**Design of Compression Members**	**9**	3	
	General – Strength of Compression members- Design Compressive strength- Example on analysis of Compression members	2	3	1,2
	Design of Angle struts – Design Examples	2	3	1,2
	Built up Columns- Design of Lacing – Design of Battens- Design Examples-	3	3	1,2
	Design of Roof members.	2	3	1,2
Unit 4	**Design of Beam and Column Splices**	**10**	2,3	
	Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams –Plastic Section Modulus - Design Examples	3	4	1,2
	Design of Beam Columns: Behaviour of members under combined loading – Modes of Failures – Design Examples	3	4	1,2
	Design of Column Splices and Column Base: Design of Column Splice-Design Examples	2	4	1,2
	Design of Column Base- Slab Base- Gusseted Base- Design Examples.	2	4	1,2
Unit 5	**Design of Eccentric Connections and Plate Girder**	**12**	4,5	
	Design of Eccentric Connections: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples	4	5	1,2
	Design of Plate Girder: General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength	2	4	1,2
	Design of Plate Girder: Shear Buckling- Simple Post critical method- Tension Field method	3	4	1,2
	Design of Plate Girder: Stiffeners-Bearing- Transverse stiffeners - Design Examples	3	4	1,2
Total Contact Hours		**45**		

Course Unitization Plan Theory

Unit No.	Unit Name	Contact Hours	Non-Contact Hours	CLOs Addressed	References Used
Unit 1	**Project**	5	25	1-5	1-3

Learning Assessment

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

Recommended Resources

1. Limit State Design of Steel Structures – S.K.Duggal, TMH Education Pvt Ltd, 2nd Edition,2014.
2. IS-800-2007, BIS Publication.
3. Design of Steel structures – S.S. Bhavikatti, IK International Pub Pvt Ltd, 4th Edition.

Other Resources

1. Mindess, Sidney., Young, J.F., Darwin, D., "Concrete", Pearson Education, 2003.
2. RCC Designs-B.C.Pummia, A.K.Jain and A.K.Jain, 10th edition Lakshmi Publications Ltd, New Delhi.

Course Designers

1. Dr. GVP Bhagath Singh, Assistant. Professor, Department of Civil Engineering, SRM University – AP.

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Summer Internship

Course Code	CVE 309	Course Category	RDIP	L	T	P	C
				0	0	4	4
Pre-Requisite Course(s)	None	Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Civil Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To enable students to understand the application of academic knowledge to practical social, environmental, industrial, and scientific problems.
2. To develop essential soft skills and relevant technical abilities for managing practical tasks and projects.
3. To help students understand and adhere to standard operating procedures and interpret quality control measures specific to their industry.
4. To build students' capabilities in forming effective professional relationships through networking with supervisors, team members, and other departments.
5. To foster an environment where students can report their progress, engage in critical analysis, evaluate methodologies, and present their findings effectively.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the application of academic knowledge to practical (Social, Environmental, Industrial and Scientific) problems	2	70%	80%
Outcome 2	Demonstrate essential soft skills and relevant technical abilities in managing practical tasks and projects within the internship setting.	3	70%	80%
Outcome 3	Understand and adhere to standard operating procedures and interpret quality control measures specific to the industry or organization.	2	70%	80%
Outcome 4	Build effective professional relationships by networking with supervisors, team members, and other departments.	3	70%	80%

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 ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	1	2	2	2	1	2	1	0	3	-	-	-
Outcome 2	3	3	1	3	2	2	1	1	3	3	2	3	-	-	-
Outcome 3	3	3	2	2	2	1	2	1	2	2	2	2	-	-	-
Outcome 4	1	1	1	1	1	3	1	1	3	3	0	2	-	-	-
Average	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**1**	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Weeks	CLOs Addressed
Unit I	**Definition of Problem** This unit focuses on clearly articulating the problem that the project aims to solve. Interns will describe the current situation, analyze gaps or challenges, and explain why a solution is necessary. Establishing a clear problem statement is essential to set a precise project direction.	2	1
Unit II	**Method** Interns will explore and apply various methods and approaches critical to the successful execution of the project. This unit includes planning, selecting suitable methods, and implementing best practices to achieve project objectives efficiently.	2	1,2
Unit III	**Description of results** This unit requires interns to interpret the results obtained from their project using appropriate software, tools, and analytical techniques. Emphasis is on accuracy, relevance, and coherence in presenting findings that support the project objectives.	1	3
Unit IV	**Strategy Evaluation** Students assess and critique the effectiveness of strategies and methodologies employed that support the project objectives.	1	3
Unit V	**Project Presentation and thesis report** Interns will prepare and deliver a scientific presentation of their results, providing well-supported reasoning. Additionally, they will compile their work into a thesis, manuscript, or report that summarizes the project, including methodology, results, and conclusions, adhering to academic or industry standards.	1	4

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		Diary 10%	Mid Sem 20%	Synopsis 10%	Report 10%	
Level 1	Remember	100%	40%	50%	20%	20%
	Understand					
Level 2	Apply		60%	50%	60%	60%
	Analyse					
Level 3	Evaluate				20%	20%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Major Project

Course Code	CVE 310	**Course Category**		**L**	**T**	**P**	**C**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department		**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1.

Course Outcomes / Course Learning Outcomes (CLOs)

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

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

CLOs	**Program Learning Outcomes (PLO)**														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1															
Outcome 2															
Outcome 3															
Average															

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I				
Unit II				
Unit III				
Unit IV				
Unit V				

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.

Water Resources for Smart and Liveable Cities

Course Code	CE 244	**Course Category**	TE	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To develop a basic understanding about various types of Infrastructure and Smart city.
2. To enable the students to apply the basic need and planning concept to solve various Infrastructure 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	Recognise the need for smart city infrastructure development.	3	80%	75%
Outcome 2	Determine the infrastructure's components and create a smart city infrastructure plan.	2	70%	70%
Outcome 3	Recognise smart city transport systems and how they are used.	4	70%	65%
Outcome 4	Analysis and implementation of water resource systems for smart cities.	4	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2		2	2								2	3	3	3
Outcome 2	2	3	2	2								2	1	3	2
Outcome 3	2	3	2	2								2	3	3	1
Outcome 4	2	3	2	2								2	1	3	2
Average	**2**	**3**	**2**	**2**								**2**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Basics of Smart Cities and Infrastructure: Overview of Smart Cities, The idea behind smart cities, their goals, India's and the world's smart city histories. The creation of smart cities is necessary. Challenges of managing infrastructure in India and global, many types of Infrastructure systems, Infrastructures need assessment	8	1	1-5
Unit 2	Infrastructure planning and development for smart cities includes energy and ecology, solar energy for smart cities, housing, sustainable green buildings, cyber security, economy, safety, and disaster management.	8	1-4	1-5
Unit 3	Transport systems with intelligence Traffic safety management, e-ticketing, GIS, GPS, navigation systems, smart cars and fuels, and mobility services.	10	2,4	1-5
Unit 4	Water resources and associated infrastructure management Water storage and transportation infrastructure, sustainable water and sanitation, sewage systems, flood control and conservation systems.	10	2,4	1-5
Unit 5	Policy and Infrastructure Management System for Smart Cities Applications of infrastructure management systems for already-existing smart cities, as well as integrated infrastructure management systems for smart cities. Global regulations for smart cities The Indian government's smart city policy, mission statement and policies, Indian smart city case studies and smart city initiatives.	9	2,4	1-5
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li.
2. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos.
3. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend.
4. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997
5. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines (1).pdf

Other Resources

Course Designers

1. Dr. Ainal Hoque Gazi, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Availability and Management of Ground Water Resources

Course Code	CE 251	**Course Category**	TE	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the occurrence, distribution, and movement of groundwater resources.
2. To enable students to apply analytical techniques for assessing, planning, and managing groundwater resources.
3. To introduce modern tools and technologies for sustainable groundwater development and 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	Understand the fundamental principles of groundwater occurrence and movement.	3	80%	75%
Outcome 2	Evaluate groundwater availability using analytical and experimental methods.	2	70%	70%
Outcome 3	Analyse groundwater recharge and develop strategies for sustainable utilization.	4	70%	65%
Outcome 4	Apply modern tools like Geographic Information Systems (GIS) and Remote Sensing for groundwater management.	4	70%	65%
Outcome 5	Assess groundwater management policies and case studies for real-world applications.	4	60%	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3		2	2								2	3	1	3
Outcome 2	2	3	2	1								1	2	3	1
Outcome 3	1	3	2	2								3	1	1	2
Outcome 4	2	3	2	3								2	2	3	2
Average	**2**	**3**	**2**	**2**								**2**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Groundwater Resources:** Hydrologic cycle, occurrence of groundwater, aquifers, classification, properties (specific yield, permeability, porosity), Darcy's Law, and groundwater movement.	8	1	1-5
Unit 2	**Groundwater Recharge and Development:** Artificial recharge techniques, groundwater extraction systems, estimation of recharge potential, and sustainable utilization practices.	8	1-3	1-5
Unit 3	**Groundwater Quality and Pollution:** Groundwater contamination sources, transport modeling, and water quality standards. Methods for groundwater remediation and management of salinity intrusion.	10	2,4	1-5
Unit 4	**Tools and Technologies for Groundwater Management:** GIS and Remote Sensing applications, aquifer modeling, advanced well testing techniques, and IoT-enabled groundwater monitoring systems.	10	4-5	1-5
Unit 5	**Groundwater Management Policies and Case Studies:** National and global groundwater policies, success stories, and challenges in implementing groundwater conservation programs.	9	5	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 10%	CLA-2 10%	CLA-3 15%	
Level 1	Remember	70%	60%	60%	60%	65%
	Understand					
Level 2	Apply	30%	40%	40%	40%	35%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Todd, D.K., Groundwater Hydrology, Wiley.
2. K.R. Karanth, Groundwater Assessment, Development, and Management, Tata McGraw-Hill.
3. Raghunath, H.M., Hydrology: Principles, Analysis, and Design, New Age International Publishers.
4. Sophocleous, M., Advances in Groundwater Resources, Elsevier.
5. Ministry of Jal Shakti Reports: Groundwater Yearbooks and National Groundwater Management Framework.

Other Resources

Course Designers

1. Dr. Ainal Hoque Gazi, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Design of hydraulic structure and Irrigation system

Course Code	CE 431	**Course Category**	TE	**L**	**T**	**P**	**C**
				2	0	1	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the basic type of irrigation, irrigation standards and crop water assessment.
2. To provide knowledge on various hydraulic structures such as energy dissipators, head and cross regulators, canal falls and structures involved in cross drainage works.
3. To design different types of dams.

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	Design various irrigation structures like head and cross regulator structure.	3	80%	75%
Outcome 2	Describe the steps involved in constructing an irrigation structure using water resource engineering to address a particular problem.	2	70%	70%
Outcome 3	Analyse the various types of reservoirs and their design aspects, Cross drainage works and Canal design.	4	70%	65%
Outcome 4	Analyse an irrigation structure as a case study and write a brief report.	4	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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2		2	2								3	3	2	3
Outcome 2	2	3	2	2								1	2	2	2
Outcome 3	2	3	2	2								3	1	1	1
Outcome 4	2	3	2	2								1	2	3	2
Average	**2**	**3**	**2**	**2**								**2**	**2**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Measurement of soil moisture by different soil moisture measuring instruments, Importance of irrigation structures, Automatic drip irrigation system, manually operated drip irrigation system, Sprinkler irrigation system.	8	1-2	1,2,3
Unit 2	Loading -Concepts and criteria, Gravity dam analysis design features and stability elementary profile of gravity dam- Concrete for dams – roller compacted concrete gravity dams.	20	1-4	1,2,3
Unit 3	Selection of the suitable site for the diversion headwork components of diversion headwork.	10	2,4	1,2,3
Unit 4	Trapezoidal notch fall, selection of suitable type of CD works- aqueduct and Syphon aqueduct- determination of maximum flood discharge and waterway for drain, fluming of canal- uplift pressure on underside of barrel roof and at the floor of the culvert.	7	3-4	1,2,3
Unit 5	Analyse an irrigation structure as a case study and write a brief report.	15	2,4	1,2,3
	Total Contact Hour	**60**		

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-3 15%	
Level 1	Remember	70%	60%	60%	60%	65%
	Understand					
Level 2	Apply	30%	40%	40%	40%	35%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Water Resources Engineering – Principles and Practice by C. Satyanarayana Murthy,
2. New age International Publishers.
3. S. K. Garg, Irrigation engineering and hydraulic structures (Khanna publishers).
4. Irrigation and waterpower Engineering Punmia, B.C., Pande, B, Lal Lakshmi Publications, New Delhi – 110 002. Edition2016 ISBN 13: 9788131807637

Other Resources

Course Designers

1. Dr. Ainal Hoque Gazi, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Design and Implementation of Rooftop Solar Systems

Course Code		**Course Category**	OE	**L**	**T**	**P**	**C**
				2	0	1	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with the knowledge and skills to assess, design, and implement rooftop solar power systems.
2. Develop a strong understanding of solar technology, its components, and their integration.
3. Enable financial analysis and feasibility assessment for solar 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	Assess site feasibility and energy requirements for rooftop solar installations.	4	80%	70%
Outcome 2	Design and optimize rooftop solar systems for maximum energy generation.	6	80%	70%
Outcome 3	Analyse the financial viability and economic benefits of solar projects.	5	80%	70%
Outcome 4	Develop implementation and maintenance plans for sustainable solar system operation.	6	80%	70%

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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	2	2	1	3	1	2	2	2	3	3	3	2
Outcome 2	2	3	3	3	3	1	2	1	2	2	3	3	3	3	3
Outcome 3	2	2	2	2	1	1	2	2	1	2	3	2	2	3	2
Outcome 4	2	2	3	2	2	2	3	2	3	3	3	3	3	3	3
Average	**2.25**	**2.25**	**2.5**	**2.25**	**2**	**1.25**	**2.5**	**1.5**	**2**	**2.25**	**2.75**	**2.75**	**2.75**	**3**	**2.5**

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit-1	**Introduction to solar energy** Basics of solar energy and photovoltaic technology, Types of solar panels and their characteristics (Monocrystalline, Polycrystalline, Thin-film), Components of a solar power system: PV modules, inverters, mounting structures, batteries, and balance of systems (BoS), Overview of rooftop solar systems: On-grid, off-grid, and hybrid systems, Global and national policies for solar energy development.	5	1	1,2,3
Unit 2	**Site Assessment and Initial Survey** Understanding load requirements: Evaluating energy consumption patterns, Safety considerations for rooftop installations.	4	1	1,2,3
Unit 3	**System Design** Steps in designing a rooftop solar system, Calculating system capacity based on load demand and available area, Selection of components (panels, inverters, batteries, etc.), Designing electrical layouts: Single line diagrams (SLD) and wiring schematics, Software tools for design and simulation (e.g., PVsyst, HelioScope)	6	2,3	1,2,3
Unit 4	**Financial and Economic Analysis** Understanding costs associated with rooftop solar systems: Capital costs, operational costs, and maintenance costs, Solar financing models: CAPEX, RESCO, and third-party financing, Calculating Levelized Cost of Electricity (LCOE). Evaluating payback periods and return on investment (ROI), Overview of government subsidies, incentives, and net metering policies, Financial modelling.	5	2,3	1,2,3
Unit-5	**Installation and Maintenance** Rooftop system installation: Best practices and safety protocol, Testing and commissioning of solar systems, Operation and maintenance (O&M) strategies for long-term performance, troubleshooting common issues in solar power systems, Field visit: Observing the installation of a rooftop solar system.	6	4	1,2,3
Unit-6	**Sustainability and Project Management** Assessing the environmental impact of solar systems, Life cycle analysis of solar panels and components, Project management principles for rooftop solar projects, Group activity: Preparing a detailed project report for a hypothetical rooftop solar installation.	4	4	1,2,3
	Total Contact Hours	**45**		

Course Unitization Plan Practical

S.No	LIST OF PRACTICALS	Required Contact Hours	CLOs Addressed	References Used
1	Solar Potential Assessment Using Solar Pathfinder	3	1	1,2,3
2	Rooftop Dimensions and Usable Area Calculation	3	1	1,2,3
3	Load Profiling and Energy Demand Analysis	3	1	1,2,3
4	Structural and Safety Evaluation for Rooftop Solar Systems	3	2	1,2,3
5	System Sizing for Rooftop Solar Installations	3	2	1,2,3
6	Component Selection and Specification Analysis	3	2	1,2,3
7	Solar PV System Design Using Pvsyst	3	2	1,2,3
8	Creating Single Line Diagrams (SLD) and Wiring Schematics	3	2	1,2,3
9	Hands-on Rooftop Solar Installation Techniques	3	4	1,2,3
10	Troubleshooting Common Solar PV System Issues	3	4	1,2,3
	Total	**30**		

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	25%	25%	25%	25%	25%
	Understand					
Level 2	Apply	25%	25%	25%	25%	25%
	Analyse					
Level 3	Evaluate	50%	50%	50%	50%	50%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Solar Photovoltaics: Fundamentals, Technologies and Applications" by Chetan Singh Solanki, PHI Learning.
2. Photovoltaic Systems" by James P. Dunlop, American Technical Publishers.
3. Handbook of Photovoltaic Science and Engineering" edited by Antonio Luque and Steven Hegedus, Wiley

Other Resources

1. Renewable Energy Systems: The Earthscan Expert Guide to Renewable Energy Technologies for Home and Business" by David Thorpe, Routledge.
2. "Modeling Photovoltaic Systems Using PVSyst" by Gokmen Taylan, Springer.

Course Designers

1. Dr Harish Puppala, Assistant Professor, Department of Civil Engineering, SRM University-AP.

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

Non-Destructive Testing Methods for Concrete and Soil

Course Code		**Course Category**	CC		**L**	**T**	**P**	**C**
					1	0	2	3
Pre-Requisite Course(s)	Civil Engineering Materials	**Co-Requisite Course(s)**	CVE 203 CVE 207	**Progressive Course(s)**				
Course Offering Department	CE	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To familiarize students with the principles, methodologies, and applications of non-destructive testing (NDT) techniques for evaluating concrete structures
2. To enable students to perform standard NDT methods, such as rebound hammer and ultrasonic pulse velocity (UPV), and interpret the results to assess material quality and structural integrity.
3. To encourage the application of NDT techniques in developing sustainable solutions and integrating innovative practices for improved construction quality and durability.

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 fundamental principles, tools, and applications of non-destructive testing (NDT) methods	1	65%	55%
Outcome 2	Explain the operational principles and significance of commonly used NDT techniques, such as rebound hammer and UPV tests.	2	60%	60%
Outcome 3	Apply standard procedures for conducting NDT methods and interpreting results to evaluate material quality	3	55%	50%
Outcome 4	Students will be able to effectively apply electric conductivity testing methods (Wenner and Schlumberger) to analyze soil properties such as moisture, density and interpret the results for use in geotechnical engineering applications.	3	65%	60%
Outcome 5	Students will be able to utilize drone technologies for Non-Destructive Testing applications, including soil analysis, slope monitoring, and infrastructure inspection, and effectively analyze the collected data to assess structural integrity and terrain stability.	2	60%	55%

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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1		1									1	1		1
Outcome 2	2		1									1	1		1
Outcome 3	2	1	1	1								1	2	2	1
Outcome 4	3	3	1	2			1		2			1	3	3	3
Outcome 5	3	2	1	2	3				1			1	3	3	2
Average	**2**	**1**	**1**	**1**	**1**		**1**		**1**			**1**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Non-Destructive Testing**	**7**	1	1,2
	Fundamentals of Non-Destructive Testing (NDT)	2	1	1,2
	Overview of Common NDT Methods	2	1	1,2
	Applications of NDT in Civil Engineering	2	1	1,2
	Standards and Codes Governing NDT	1	1	1,2
Unit 2	**Rebound Hammer Testing**	**15**	**2, 3**	1,2,4
	Principles and Working Mechanism	1	2, 3	1,2,4
	Test Procedure and Setup	3	2, 3	1,2,4
	Factors Influencing Test Results	1	2, 3	1,2,4
	Applications and Standards	1	2, 3	1,2,4,5
	Correlation Between Rebound Number and Compressive Strength	1	2, 3,4	1,2,4,5
	Variability and Statistical Analysis of Results	2	2, 3,4	1,2,4,5
Unit 3	**Ultrasonic Pulse Velocity (UPV) Testing**	**7**	**2,3**	1,3
	Principles and Fundamentals	1	2, 3	1,3
	Equipment and Test Procedure	1	2, 3	1,3,5
	Factors Affecting Results	1	2, 3	1,2,4,5
	Applications and Standards	1	2,3	1,2,4,5
	Correlation Between UPV and Concrete Quality	1	2, 3,4	1,2,3,5
	Advanced Analysis for Structural Integrity	2	2, 3,4	1,2,3,5
Unit-4	**Electric Conductivity Testing of Soil**	**15**		
	Introduction to Soil Electrical Conductivity (EC)	1	4	6
	Principles of Electrical Conductivity Testing	2	4	6
	Wenner Method for Electrical Conductivity	6	4	6
	Schlumberger Method for Electrical Conductivity	6	**4**	6
Unit 5	**Drone Applications in NDT for Soil Slopes**	**15**		
	Drone-Based Soil and Terrain Analysis	5	5	7
	Slope Monitoring with Drones	6	5	7
	Data Processing and Analysis	4	5	7
Total Contact Hours		**75**		

Learning Assessment

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

Recommended Resources

1. V. M. Malhotra and Nicholas J. Carino, "Handbook on Nondestructive Testing of Concrete" 2004 (2nd edition), ISBN: 9780849314854, CRC Press
2. Nevelli, A.M., "Properties Of Concrete", – 5th Ed, Prentice Hall Publishers, 2012.
3. IS 13311 (Part 1): 1992, Non-Destructive Testing of Concrete - Methods of Test: Part 1 Ultrasonic Pulse Velocity.
4. IS 13311 (Part 2): 1992, Non-Destructive Testing of Concrete - Methods of Test: Part 2 Rebound Hammer Test.
5. IS 516: 2018, Method of Tests for Strength of Concrete.
6. Plaster, Edward J.. Soil Science & Management. United States: Delmar, Cengage Learning, 2014.
7. Tal, Daniel., Altschuld, Jon. Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation. United Kingdom: Wiley, 2021.

Course Designers

1. Dr. GVP Bhagath Singh, Associate Professor, Department of Civil Engineering, SRM University-AP
2. Dr. Raviteja KVNS, Assistant Professor, Department of Civil Engineering, SRM University-AP

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

Prestressed Concrete Structures

Course Code		**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CVE 205	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To describe the various types of prestress technology, their advantages and disadvantages, and their applications.
2. To explain the behaviors of prestressed concrete elements under different limit states.
3. To explain fundamentals of prestressed concrete design using advanced construction materials.
4. To understand the applications of precast prestressed components in civil infrastructure.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Understand the requirement of PSC members for present scenario	2	70%	70%
Outcome 2	Analyse the stresses encountered in PSC element during transfer and at working.	3	70%	70%
Outcome 3	Understand the effectiveness of the design of PSC after studying losses	3	70%	70%
Outcome 4	Capable of analyzing the PSC element and finding its efficiency, and design PSC beam for different requirements.	3	65%	60%

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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	3									3	3	3
Outcome 2	3	3	2	3									2	3	3
Outcome 3	2	3	2	3									2	3	2
Outcome 4	2	3	2	3									2	3	1
Average	**2.6**	**2.6**	**2**	**3**									**3**	**3**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction and Analysis of Members**	**10**		
	Concept of Prestressing, Types of Prestressing, Advantages, Limitations, Prestressing systems, Anchoring devices, Materials - Mechanical Properties of high strength concrete, high strength steel - Stress-Strain curve for High strength concrete	5	1	1, 2
	Analysis of members at transfer - Stress concept - Comparison of behavior of reinforced concrete – prestressed concrete, Force concept, Load balancing concept - Kern point, Pressure line	5	1	1, 2
	;	4	1	1, 2
Unit 2	**Losses in Prestress**	**8**		
	Loss of Prestress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel, Total Loss,	4	2	1, 2
	Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force, Total deflection, Limits of deflection, Limits of span-to-effective depth ratio, Calculation of Crack Width - Limits of crack width.	4	2	1, 2
Unit 3	**Design of Sections for Flexure**	**10**		
	Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1members.	10	4	1, 2,3
Unit 4	**Design for Shear**	**8**		
	Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of transverse reinforcement.	8	4	1, 2,3
Unit 5	**Different anchorage system and design of end block by latest IS codes**	**9**		
	Types of anchorage systems and their design specifications	4	2	1, 2
	Design of anchorages with IS latest codes	5	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 20%	CLA-2 10%	CLA-3 10%	
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. Krishna Raju, N. "Prestressed Concrete", Tata McGraw Hill Publishing Company, New Delhi 2006.
2. Krishna Raju. N., "Prestressed Concrete - Problems and Solutions", CBS Publishers and Distributors, Pvt. Ltd., New Delhi.
3. Rajagopalan N, "Prestressed Concrete", Narosa Publishing House, New Delhi.

Other Resources

1. Lin and Burns, Design of Prestressed Concrete Structures, Wiley India
2. Dayaratnam P Prestressed Concrete Structures, Oxford and IBH.

Course Designers

1. Dr. Kona Veera Ganesh, Asst. Professor, Dept. of Civil Engineering, SRM University – AP.

SRM University – AP, Andhra Pradesh

Neerukonda, Mangalagiri Mandal
Guntur District, Mangalagiri, Andhra Pradesh 522240

Industry Readiness Course								
Course Code	SEC-	Course Category	Career skill-II	L-T-P-C	3	0	0	3
Pre-Requisite Course(s)	No pre-requisite	Co-Requisite Course(s)	-NA-	Progressive Course(s)				
Course Offering Department	Department of Civil Engineering	Professional / Licensing Standards						
Board of Studies Approval Date		Academic Council Approval Date						

About the course

The Industry Readiness for Civil Engineers course is designed to equip students with the latest industry advancements, essential skills, and emerging technologies relevant to modern civil engineering practices. The course covers key domains such as structural engineering, geotechnical engineering, transportation, construction management, and sustainable infrastructure development. Special emphasis is given to digital transformation, including Building Information Modeling (BIM), drone applications, AI in construction, and smart materials. By integrating theoretical knowledge with practical exposure, this course enhances students' employability and readiness for professional challenges.

Course Objectives / Course Learning Rationales (CLRs)

Objective 1: To familiarize students with modern industry practices, standards, and emerging technologies in civil engineering.
Objective 2: To enhance students' problem-solving, decision-making, and project management skills relevant to the construction sector.
Objective 3: To bridge the gap between academic learning and industry expectations by incorporating real-world case studies and skill-based training.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the latest industry trends, regulations, and technological advancements in civil engineering.	3	80%	70%
Outcome 2	Apply problem-solving skills and project management techniques to real-world engineering challenges.	3	80%	70%
Outcome 3	Utilize modern tools such as BIM, drones, and AI-based decision-making frameworks in construction projects.	4	80%	70%
Outcome 4	Develop an industry-relevant skillset, including effective communication, teamwork, and leadership abilities.	6	80%	70%

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT 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 Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	0	0	0	0	0	0	0	0	0	0	1	3	3	3
Outcome 2	3	3	2	3	3	0	0	0	0	0	0	2	3	3	3
Outcome 3	3	3	2	3	3	0	0	0	1	0	0	2	3	3	3
Outcome 4	3	3	2	2	3	0	0	0	1	0	1	1	3	3	3
Course Average	3	2	2	2	2	0	0	0	0	0	0	2	3	3	3

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit-1	**Unit 1: Modern Trends in Civil Engineering (8 hours)** • Industry 4.0 and its impact on civil engineering • Building Information Modeling (BIM) and its applications • Sustainable and green building practices • Digital twins for infrastructure management	8	1,2	1,2
Unit 2	**Unit 2: Smart Construction Technologies (8 hours)** • Applications of AI and machine learning in construction • Drones in surveying, mapping, and monitoring • 3D printing in construction • Internet of Things (IoT) for smart infrastructure.	8	1,2	1,2
Unit 3	**Unit 3: Project Management and Industry Standards (8 hours)** • Principles of construction project management • Lean construction and productivity enhancement strategies • Health, safety, and environmental regulations • Contract management and dispute resolution	8	2	1,2
Unit 4	**Unit 4: Career Readiness and Soft Skills Development (6 hours)** • Resume building and interview preparation • Effective communication and teamwork	8	3	1,2

	in civil engineering • Leadership and decision-making in project execution • Entrepreneurial opportunities in the construction sector			
Unit-5	Industry Expert Lectures	8	4	-
Total Contact Hours		**45**		

Recommended Resources

- Re-skilling Human Resources for Construction 4.0: Implications for Industry, Academia and Government [1 ed.]. Omoseni Adepoju, Clinton Aigbavboa, Nnamdi Nwulu, Michael Onyia. Springer., 2021.
- Construction 4.0: Advanced Technology, Tools and Materials for the Digital Transformation of the Construction Industry, Marco Casini, Woodhead Publishing Series in Civil and Structural Engineering, 2021.

Learning Assessment (Theory)

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%)**	
Level 1	Remember	50%	50%	50%	50%	50%
	Understand					
Level 2	Apply	25%	25%	25%	25%	25%
	Analyse					
Level 3	Evaluate	25%	25%	25%	25%	25%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Course Designers

Dr Pranav R T Peddinti, Assistant Professor, Department of Civil Engineering, SRM University-AP.