Department of Civil Engineering

B.Tech. Civil Engineering
Curriculum and Syllabus

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

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

Department Vision

To 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)		5	150
University AEC	1		
School AEC	4		
Value Added Courses (VAC)		4	120
University VAC	4		
School VAC	0		
Skill Enhancement Courses (SEC)		17	510
School SEC	6		
Department SEC	5		
SEC Elective	6		
Foundation / Interdisciplinary courses (FIC)		28	840
School FIC	28		
Department FIC	0		
Core + Core Elective including Specialization (CC)		79	2370
Core	64		
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		**164**	**4920**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semesters**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	3	0	2	0	0	0	0	0	5	3
Value Added Courses - VAC	0	0	0	0	0	4	0	0	4	3
Skill Enhancement Courses - SEC	3	3	3	2	0	3	3	0	17	10
Foundation / Interdisciplinary Courses - FIC	12	16	0	0	0	0	0	0	28	17
CC / ES / SE / CE / TE / DE / HSS	0	4	15	16	18	17	9	0	79	48
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	**18**	**23**	**23**	**21**	**21**	**27**	**19**	**12**	**164**	**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	EGL 101	Communicative English	3	0	0	3
2	SEC	S SEC	ENTR 100	Exploratory Learning and Discovery	1	0	0	1
3	SEC	S SEC	IRH 101	Orientation on Internationalization	1	0	0	1
4	SEC	S SEC	ISES 101	Industry Specific Employability Skills - I	1	0	0	1
5	FIC	S FIC	CHE 103	Chemistry for Engineers	2	0	0	2
6	FIC	S FIC	CHE 103L	Chemistry for Engineers Lab	0	0	1	1
7	FIC	S FIC	CSE 108	Introduction to Computer Science and Programming using C	3	0	0	3
8	FIC	S FIC	CSE 108L	Introduction to Computer Science and Programming using C Lab	0	0	1	1
9	FIC	S FIC	ENV 111	Environmental Sciences	2	0	0	2
10	FIC	S FIC	MAT 113	Calculus	3	0	0	3
				Semester Total	**16**	**0**	**2**	**18**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SEC	S SEC	CSE 131	Industry Standard Coding Practice - I	0	0	2	2
2	SEC	S SEC	ISES 102	Industry Specific Employability Skills - II	1	0	0	1
3	FIC	S FIC	BIO 103	Introductory Biology for Engineers	2	0	0	2
4	FIC	S FIC	CSE 107	Data Structures	3	0	0	3
5	FIC	S FIC	CSE 107L	Data Structures Lab	0	0	1	1
6	FIC	S FIC	EEE 103	Basic Electrical and Electronics Engineering	3	0	0	3
7	FIC	S FIC	EEE 103L	Basic Electrical and Electronics Engineering Lab	0	0	1	1
8	FIC	S FIC	MAT 211	Linear Algebra	3	0	0	3
9	FIC	S FIC	PHY 101	Engineering Physics	2	0	0	2
10	FIC	S FIC	PHY 101L	Engineering Physics Lab	0	0	1	1
11	Core	CC	CE 101	Civil Engineering Drawing	2	0	0	2
12	Core	CC	CE 101L	Civil Engineering Drawing Lab	0	0	1	1
13	Core	CC	ME 103L	Mechanical Engineering Tools	0	0	1	1
				Semester Total	**16**	**0**	**7**	**23**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	AEC 105	Analytical Skills for Engineers	1	0	1	2
2	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
3	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
4	SEC	D SEC	CVE 201	Probability and Statistics	2	0	1	3
5	Core	CC	CVE 202	Fluid Mechanics	2	1	1	4
6	Core	CC	CVE 203	Structural Mechanics	2	1	1	4
7	Core	CC	CVE 204	Spatial Data Acquisition	2	1	1	4
8	Core	CC	CVE 205	Civil Engineering Materials	2	0	1	3
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**14**	**3**	**6**	**23**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	D SEC	CVE 210	Numerical Methods and its Application in Civil Engineering	1	1	0	2
4	Core	CC	CVE 206	Reinforced Concrete Design	3	0	1	4
5	Core	CC	CVE 207	Soil Behaviour and Engineering	2	1	1	4
6	Core	CC	CVE 208	Modern Highway Engineering	2	1	1	4
7	Core	CC	CVE 209	Analysis of Determinate and Indeterminate Structures	2	1	1	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**13**	**4**	**8**	**21**

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	Core	CC	CVE 301	Physico-Chemical Water Treatment: Materials and Processes	2	1	1	4
4	Core	CC	CVE 302	Geotechnical Analysis and Design	2	1	1	4
5	Core	CC	CVE 303	Engineering Hydrology	1	1	1	3
6	Core	CC	CVE 304	Remote Sensing and GIS	1	1	1	3
7	Core	CC	CVE 305	High-Speed Railways, Airways, and Waterways Engineering	2	1	1	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**11**	**5**	**5**	**21**

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 - I	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	SEC	E SEC		Career Skills - II	3	0	0	3
2	Elective	CE		Core Elective	2	0	1	3
3	Elective	CE		Core Elective	2	0	1	3
4	Elective	CE		Core Elective	2	0	1	3
5	Elective	OE		Open Elective / Minor	3	0	0	3
6	RDIP	RDIP	CVE 309	Summer Internship	0	0	4	4
				Semester Total	**12**	**0**	**7**	**19**

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 Elective								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE / SE	CE 423	Introduction to Structural Dynamics	3	0	0	3
2	Elective	CE / SE	CE 424	Environmental Geotechnics	3	0	0	3
3	Elective	CE / SE	CE 430	Introduction to Drone technology and applications	2	1	0	3
4	Elective	CE / SE	CE 431	Design of Hydraulic Structure and Irrigation System	2	1	0	3
5	Elective	CE / SE	CE 433	Sustainable waste management systems	2	0	1	3
6	Elective	CE / SE	CE 436	Water resource planning and management	2	1	0	3
7	Elective	CE / SE	CE 453	Air Quality in Changing Environments	3	0	0	3
8	Elective	CE / SE	CE 454	Introduction to Computational Solid Mechanics	2	0	1	3
9	Elective	CE / SE	CE 456	Finite Element Method for Structural Engineers	3	0	0	3
10	Elective	CE / SE	CE 459	Designing with Geosynthetics	3	0	0	3
11	Elective	CE / SE	CE 460	Sustainable Pavement Materials and Construction	3	0	0	3
12	Elective	CE / SE	CE 461	Advanced Pavement Design and Maintenance	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 247	Remote Sensing and GIS applications in Engineering	3	0	0	3
2	OE	OE	CVE 248	Drones for Asset Management	3	0	0	3
3	OE	OE	CVE 249	Civil Engineering Profession-Developing Nations	3	0	0	3
4	OE	OE	CVE 250	Heritage Structures & Conservation Strategies	3	0	0	3
5	OE	OE	CVE 251	Availability and Management of Groundwater Resources	3	0	0	3
6	OE	OE	CVE 252	Introduction to Reliability Engineering	3	0	0	3
7	OE	OE	CVE 253	Optimization methods for Civil Engineering	3	0	0	3
8	OE	OE	CVE 254	Introduction to Civil Engineering Profession	3	0	0	3

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Communicative English

Course Code	EGL 101	**Course Category**	AEC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	English	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To know the fundamentals of producing a written scripts using the formula for writing.
2. To understand language Production skills while learning its importance in communication using written and spoken form.
3. To gain knowledge of the Persuasive Communication Principles in both academic and non-academic contexts focusing/preparing for the audience at hand.
4. To use Persuasive skills while presenting a Scientific Data in written form with attention to various modes of presentation.

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 critical writing skills	3	75%	75%
Outcome 2	Demonstrate communication skills using writing as a means to communicate	3	75%	75%
Outcome 3	Analyze the role and use of writing for informative and academic practices	4	75%	75%
Outcome 4	Compare and contrast given case studies based on persuasive and writing skills	4	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	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	3	-	3	-	-	-
Outcome 2	-	-	-	-	2	3	-	3	3	3	-	3	-	-	-
Outcome 3	-	-	-	-	2	3	-	3	3	3	-	3	-	-	-
Outcome 4	-	-	-	-	2	3	-	3	3	3	-	3	-	-	-
Average	-	-	-	-	**2**	**3**	-	**3**	**3**	**3**	-	**3**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Horizontal and vertical writing**	**6**		
	Fundamentals of Vertical and Horizontal Writing	2	1,4	1
	Reading and illustrating best writing	2	1,4	1,2
	Expressing Ideas using Critical thought	2	1,4	1
Unit II	**Basic English concepts and introduction to linguistics**	**8**		
	Reading Skills – Introduction, Skill & Process	2	2	1
	Writing Skills – Introduction, Skill & Production	2	2	1,2
	Production Concepts- Reading, Writing Process & production of Language	4	2	1
Unit III	**Creative writing**	**12**		
	Introduction to Persuasive clarity	3	3	1
	Examine Reading: Comprehension and Creative Clarity	3	3	1
	Examine Writing: Expressive clarity using Rhetoric	3	3	1,2,3
	Production of Creative and Expressive clarity	3	3,4	1,2,3
Unit IV	**Research writing**	**12**		
	Fundamentals of Research Paper Writing	4	3,4	2, 3
	Understanding the role of Bibliography and Referencing	4	3,4	3
	Constructing a Write up using Fundamentals of Writing	4	3,4	2, 3
Unit V	**Persuasion, Ideology and Media bias**	**7**		
	Identifying: combining and synthesizing information	2	4	3
	Processing: Clarity to Inform and persuade in written form	2	4	2,3
	Applying the skill within small and large group	3	4	1,3
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. Beebe, Beebe and Ivy (2016). Communication: Principles for a Lifetime. (6th Edition). Pearson Publishing.
2. Taylor and Lindof (2011). Qualitative Communication Research Methods. (3rd Edition). Sage Publication.
3. Myers and Anderson (2008). The Fundamentals of Small Group Communication. Sage Publication.

Other Resources

Course Designers

1. Dr. G. Priyank Varma, Assistant Prof, Department of English, SRM University – AP.
2. Prof. Rajesh Kumar, Professor, Department of H&S, IIT Madras.
3. Dr. Md. Mojibur Rahman, Associate Professor, Department of H&S, IIT Dhanbad

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Orientation on Internationalization

Course Code	IRH 101	**Course Category**	SEC	**L**	**T**	**P**	**C**
				1	0	0	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	IRH	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To Understand the need and Importance of Internationalization as per the New Education Policy and to make student aware about the different pathways of Internationalization, which will help them to achieve their International Goals.

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 Need and importance of internationalization in Indian Higher Education system and Comparison with the global standards			
Outcome 2	Know the guidelines issued by the University grant commission for the internationalization of institutions and the importance in New Education Policy			
Outcome 3	Know the Different Pathways of Internationalization, Efforts of SRM University AP for various Pathways, available opportunities and application process.			

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															
Outcome 2															
Outcome 3															
Outcome 4															
Average															

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**INTERNATIONALISATION OF HIGHER EDUCATION**	**3**		
	Internationalization, Global Trends and Indian Initiatives	1		
	Internationalization and Indian higher education	1		
	Internationalization as the pathway to the Future universities	1		
Unit II	**GUIDELINES FOR INTERNATIONALIZATION OF HIGHER EDUCATION**	**3**		
	NEP and Internationalization	1		
	Strategic Programs and Initiatives - I	1		
	Strategic Programs and Initiatives – II and Role of Institutions	1		
Unit III	**INTENATIONALIZATION PATHWAYS**	**10**		
	International Partnerships, Need and Importance, Key for Internationalization goals, Type, Process and Current status	1		
	Pathway -1: International Internships, its role in internationalization, Need, Scope and Benefits, Comparison with global institutions1	1		
	Opportunities, Process and Policy guidelines	1		
	Languages, Centre of Excellences for Languages, Purpose and Scope	1		
	Pathway -2: Immersion Programs (Inbound and Outbound), its role in internationalization, Need, Scope and Benefits, Comparison with global institutions, how it is different from Internships	1		
	Opportunities, Process and Policy guidelines	1		
	Pathway -3: Semester Abroad and Exchange Program, Its role in Internationalization, Scope and Benefits, Process and Guidelines	1		
	Pathway -4: International Transfer Program Program, Its role in Internationalization, Scope and Benefits, Process and Guidelines, Credit Transfer	1		
	Pathway -5: Higher Studies (India or Abroad), Importance, Need and Scope, Process and Component of Higher Studies abroad, Benefits, Training and Support	1		
	Other Pathways of Internationalizations, SRM University AP Goals and Vision for Internationalizations, Intranet Portal a tool.	1		
	Total contact hours	**16**		

Learning Assessment

Course Nature				**Theory**
Assessment Method – Theory Component 100%				
In-semester	Assessment tool	Mid Term I	Mid Term II	Total
	Weightage	15%	15%	30%
End semester examination Weightage: 70%				70%

Recommended Resources

Other Resources

1. https://drive.google.com/drive/u/1/folders/1uUiQV30enEAuU3Ov6Gx0R0EGSaha4rzl
2. https://drive.google.com/file/d/1yTO36ezB8x2kDIh-RtEfg6J-W3SxEai_/view?usp=sharing
3. https://drive.google.com/file/d/1AYeCeGaGb4pQ4a7VvEAbmooywRJHDZVY/view?usp=sharing

Course Designers

1. Directorate of International Relations and Higher Studies

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

Industry Specific Employability Skills-I

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

Course Objectives / Course Learning Rationales (CLRs)

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

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognize the factors which motivate him in learning.	1	70%	60%
Outcome 2	Apply the knowledge of creativity and originality.	3	80%	70%
Outcome 3	Employ lateral thinking in solving problems.	1	70%	60%
Outcome 4	Identify themselves as team player.	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	-	**3**	-	-	**2**	-	-	**4**	**4**	-	-	**3**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Quants**	**5**		
	Speed calculations, Time, and Distance	1	2,3	2,4
	Problems on Trains, Boats and Streams, Races and Games, Escalator problems	1	2,3	2,4
	Time and work, Chain rule, Pipes and Cistern	1	2,3	2,4
	Simplification, surds and indices,	1	2,3	2,4
	square roots and cube roots, Functions	1	2,3	2,4
Unit II	**Reasoning**	**4**		
	Number Series, Alphabet series, Odd Man Out, Missing number, Wrong number	1	2,3	1,4
	Analogies, Mathematical Operations, Calendars, Clocks	1	2,3	1,4
	Crypt arithmetic's, Identification of cross variable relations	1	2,3	1,4
	SUDOKU	1	2,3	1,4
Unit III	**Verbal**	**3**		
	Basic sentence structure: Nouns, Pronouns, Adjectives, Parts of speech, Degree of comparison	1	1,2	3,7
	Articles, conditionals, and sentences (kinds), Verb Tense, Sentence formation.	1	1,2	3,7
	Paragraph formation, change of voice, Change of speech, Synonyms, Antonyms.	1	1,2	3,7
Unit IV	**Communication Skills**	**3**		
	Self-introduction	1	1,4	5,6
	Presentations	1	1,4	5,6
	E-Mail Etiquettes	1	1,4	5,6
Total Contact Hours		**15**		

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%	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. R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2. How to prepare for Quantitative Aptitude for CAT – Arun Sharma
3. Meenakshi Upadhyay, Arun Sharma -Verbal Ability and Reading Comprehension
4. How to prepare for Logical reasoning and data interpretation for CAT – Arun Sharma.
5. Mastering Soft skills – Julian Vyner.
6. Soft skills – Key to success in workplace and life – Meenakshi Raman, Shalini Upadhyay.
7. English grammar and composition – S. C. Gupta.

Other Resources

Course Designers

1. Mr. Asghar Ahamad, Soft skills trainer, Department of CDC, SRM University AP.

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

Chemistry for Engineers

Course Code	CHE 103	**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	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 III	**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.

Chemistry for Engineers Lab

Course Code	CHE 103L	**Course Category**		**L**	**T**	**P**	**C**
				0	0	1	1
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 gain knowledge on different kinds of quantitative analyses.
2. To apply various analytical titration techniques.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Choose the appropriate indicator for a given acid base titration and may also predict the pH and pOH of the given solutions	3	70%	80%
Outcome 2	Predict the pH and pOH of the given solutions	4	70%	80%
Outcome 3	Explain the principles and working of electrochemistry.	3	70%	80%
Outcome 4	Demonstrate the electro analytical technique in the volumetric titration.	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	-	2	2	2	2	-	2	-	1	-	-	2	-	-	-
Outcome 2	-	2	3	2	1	-	2	-	2	-	-	2	-	-	-
Outcome 3	-	2	1	2	2	-	1	-	2	-	-	2	-	-	-
Outcome 4	-	2	2	2	2	-	1	-	2	-	-	2	-	-	-
Average	-	**2**	**2**	**2**	**2**	-	**2**	-	**2**	-	-	**2**	-	-	-

Course Unitization Plan

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Volumetric titration of HCl vs NaOH	4	2,4	1,2,3
2	Standardization of potassium permanganate by Oxalic acid	4	2,4	1,2,3
3	Conduct metric titration of HCl vs NaOH	4	2,4	1,2,3
4	Determination of strength of given hydrochloric acid using pH meter	4	3,4	1,2,3
5	Determination of hardness of water by EDTA method	4	1,2	1,2,3
6	Estimation of iron content of the given solution using potentiometer	4	3,4	1,2,3
7	Iodometric Determination of Ascorbic Acid (Vitamin C)	6	1,2	1,2,3
Total Contact Hours		**30**		

Learning Assessment

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

Recommended Resources

1. G.H Jeffery, J Bassett, J Mendham, R.C Denny, Vogel's Text Book of Quantitative Chemical Analysis, Longmann Scientific and Technical, John Wiley, New York.
2. J.B Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
3. A.I Vogel, A.R Tatchell, B.S Furnis, A.J Hannaford, P.W.G Smith, Vogel's Text Book of Practical Organic Chemistry, Longman and Scientific Technical, New York, 1989.

Other Resources

Course Designers

1. Dr. S. Mannathan, Associate Professor, Department of Chemistry, SRM University – AP.
2. Dr. Sabyasachi Chakrabortty, Associate 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.

Introduction to Computer Science and Programming Using C

Course Code	CSE 108	**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	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	-	-	-	1	-	-	-	-	-	-
Outcome 2	3	3	2	1	2	-	-	-	2	-	-	-	-	-	-
Outcome 3	3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
Outcome 4	3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
Outcome 5	3	3	2	2	2	-	-	-	-	-	-	2	-	-	-
Average	**3**	**3**	**2**	**2**	**2**	-	-	-	**2**	-	-	**2**	-	-	-

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to Computer Science**	**9**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer: ALU, input-output units, memory, program counter - variables and addresses - instructions: store, arithmetic, input and output	2	1	1,2
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	1	1	1,2
	Computer languages: Machine, symbolic and high-level language 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	2	1	1,2
Unit II	**C Programming Basics**	**9**		
	Structure of a C program, identifiers Basic data types and sizes. Constants, Variables	2	1	1,2
	Arithmetic, relational and logical operators, increment and decrement operator's	2	1	1,2
	Conditional operator, assignment operator, expressions Type conversion 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
Unit II	**Functions and Arrays**	**9**		
	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	2	2,3	1,2
	one dimensional, two dimensional and multidimensional arrays	2	2,3	1,2
	array operations and examples, Character arrays and string manipulations	1	2,3	1,2
Unit IV	**Pointers**	**9**		
	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	3	3,4	1,2
	command line arguments	2	3,4	1,2
Unit V	**Enumerated, Structure and Union Types**	**9**		
	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.	3	5	2, 3, 4
Total Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 40%				End Semester Exam 40%
		CLA-1 10%	Mid-1 10%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	70%	60%	30%	30%	50%
	Understand					
Level 2	Apply	30%	40%	70%	70%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**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, Assistant Professor, SRM University-AP.

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

Introduction to Computer Science and Programming using C Lab

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

Course Objectives / Course Learning Rationales (CLRs)

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

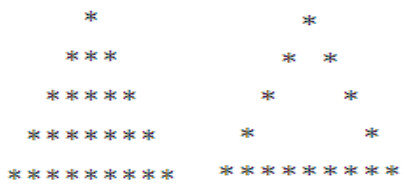
Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe fundamentals in C, enumerators, data types, 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	2	3	3	3	2	-	-	-	2	-	-	-	-	-	-
Outcome 2	2	2	3	3	2	-	-	-	2	-	-	-	-	-	-
Outcome 3	2	3	3	2	2	-	-	-	2	-	-	-	-	-	-
Outcome 4	3	3	3	3	2	-	-	-	3	-	-	-	-	-	-
Outcome 5	2	3	3	3	3	-	-	-	3	-	-	-	-	-	-
Average	**2**	**3**	**3**	**3**	**2**	-	-	-	**2**	-	-	-	-	-	-

Course Utilization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction To Computer Science**	**4**		
	GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
	Calculation of the area of the triangle. Swap two numbers without using a temporary variable. Find the roots of a quadratic equation	2	1	1,2
Unit II	**C Programming Basics**	**6**		
	Find the sum of individual digits of a positive integer and find the reverse of the given number. Generate the first n terms of Fibonacci sequence. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	2	1,2	1,2
	Print the multiplication table of a given number n up to a given value, where n is entered by the user. Decimal number to binary conversion. Check whether a given number is the Armstrong number or not.	2	1,2	1,2
	Triangle star patterns  I II	2	1,2	1,2
Unit III	**Functions And Arrays**	**9**		
	(nCr) and (nPr) of the given numbers $1+x+x^2\backslash 2+x^3\backslash 3!+x^4\backslash 4!+\ldots\ldots\ldots X^n\backslash n!$	2	2,3	1,2
	Interchange the largest and smallest numbers in the array. Searching an element in an array Sorting array elements.	2	2,3	1,2
	Transpose of a matrix. Addition and multiplication of 2 matrices.	2	2,3	1,2
	Function to find both the largest and smallest number of an array of integers. Liner search. Replace a character of string either from beginning or ending or at a specified location.	2	2,3	1,2
	Pre-processor directives If Def, Undef and Pragma	1	2,3	1,2
Unit IV	**POINTERS**	**6**		
	Illustrate call by value and call by reference. Reverse a string using pointers Compare two arrays using pointers	2	3, 4	1,2,3
	Array of Int and Char Pointers. Array with Malloc, calloc and realloc.	2	3, 4	1,2,3
	To find the factorial of a given integer. To find the GCD (greatest common divisor) of two given integers. Towers of Hanoi	2	3, 4	1,2,3
Unit V	**Enumerated, Structure And Union Types**	**5**		
	Reading a complex number Writing a complex number. Addition of two complex numbers Multiplication of two complex numbers	2	5	2, 3, 4
	File copy Word, line and character count in a file.	3	5	2, 3, 4
Total Hours		**30**		

Learning Assessment

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

Recommended Resources

1. 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, Assistant Professor, SRM University-AP.

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

Environmental Science

Course Code	ENV 111	**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	Environmental Science	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Aims to provide a comprehensive introduction to wide-ranging environmental issues and their drivers.
2. To understand numerous approaches to reduce a variety of contemporary environmental problems for a sustainable future.

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 sustainable solutions for various environmental issues.	3	80%	70%
Outcome 2	Interpret the functioning of ecosystems, matter cycling, and diversity of species around us.	3	80%	70%
Outcome 3	Investigate natural resources and impact of their overexploitation on our environment.	4	80%	70%
Outcome 4	Inspect the extent of environmental pollution and diverse regulations, policies and efforts to reduce the environmental burden.	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	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	-	-	-	-	-	3	1	-	-	-	1	-	-	-
Outcome 2	1	1	-	-	-	-	3	-	-	-	-	1	-	-	-
Outcome 3	1	-	-	-	-	-	3	-	-	-	-	1	-	-	-
Outcome 4	1	1	-	-	-	-	3	-	-	-	-	1	-	-	-
Average	**1**	**1**	-	-	-	-	**3**	**1**	-	-	-	**1**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Environmental Crisis and Sustainable Development**	**3**	1	1, 2
	Need for environmental science studies, Fundamentals of ENV – Atmosphere, lithosphere, hydrosphere, biosphere. Global environmental crisis and its causes, Man-Environment relationship & interaction	2		
	Ecological footprint, Sustainable development	1		
Unit II	**Ecosystems**	**5**	2, 3	1, 3
	Ecosystem - Structure and functions of an ecosystem	1		
	Energy flow in an ecosystem, biomass flow in an ecosystem, food chain and web, Ecological Succession	1		
	Ecological pyramid, Water cycle, Carbon cycle, Sulphur cycle, Nitrogen cycle	1		
	Forest ecosystems: tropical rain forest, coniferous forests, tundra forests, temperate forests, Grasslands and desert ecosystems	2		
	Aquatic ecosystems: Freshwater zones, streams, rivers, state of rivers in India, wetlands, Zones in ocean, ocean activities, coastal zones, Estuaries, Mangroves	1		
Unit III	**Renewable and Non-Renewable Resources**	**5**	3, 4	1, 2
	Energy resources: Global energy crisis, energy sources, energy needs, global energy consumption, Renewable and Non-renewable energy sources: Hydropower, Solar, tidal, wind, energy, Bioenergy, coal, natural gas	2		
	Energy resources: fossil fuel vs renewable fuels, peak oil Conventional and unconventional oil, oil price determination	1		
	Environmental implications of Energy use: India and world, Energy use pattern – national and global	1		
	Water availability, Water for irrigation, water situation in India	1		
Unit IV	**Biodiversity**	**6**	2, 3	1, 2, 3
	Significance of biodiversity, Current state of biodiversity: National and global, Causes of biodiversity loss	2		
	Biological hotspots, aquatic biodiversity	1		
	Endangered species and endemic species of India	1		
	Biodiversity conservation: Seed banks, botanical gardens, marine biodiversity protection, national and international efforts	2		
Unit V	**Environmental Pollution and Control**	**11**	1, 4	1, 2, 4
	Types of Environmental Pollution Air pollution: Sources, effects, and control Air standards, Air pollution in India and the world Sources of air pollution, Outdoor & Indoor air pollution Point source, mobile, area source, Effects of air pollution: Smog, urban heat island, ozone layer depletion, acid rain, Controlling air pollution: Emission regulation, e-cars	2		
	Water pollution: Sources & effects, Water Quality standards, Water pollutants, eutrophication, thermal pollution, bio-magnification, Wastewater treatment, Methods of water purification	2		
	Soil pollution: Sources, causes and effects Control of soil pollution: Air purging, phytoremediation, and bio-remediation	2		
	Solid waste management, Types and sources of solid wastes, Hazardous waste, and electronic wastes, Recycling, and management of solid wastes (4Rs), Sanitary landfills and leachate management	2		
	Noise pollution: Sources, effects, and control Air quality standards with respect to noise	1		
	Introduction to Climate change: Impact of climate change, IPCC assessment, Carbon footprint, carbon sequestration, carbon trade, carbon credits, Kyoto protocol, Montreal protocol, Paris agreement	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 15%	CLA-2 10%	Mid-2 15%	
Level 1	Remember	60%	50%	40%	50%	40%
	Understand					
Level 2	Apply	40%	50%	60%	50%	60%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. R. Rajagopalan (2016). Environmental Studies (3rd edition), Oxford University Press.
2. Deeksha Dave, S.S. Katewa (2012). Textbook of Environmental Studies (2nd edition), Cengage.
3. W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill.
4. APHA and AWWA (1999): Standard Methods for the Examination of Water and Wastewater. American Public Health Association (APHA), 20th Ed, Washington, D.C., USA.

Other Resources

1. KL Rao (1979). India's water wealth. Orient Black Swan.
2. Saadat, S., Rawtani, D., & Hussain, C. M. (2020). Environmental perspective of COVID-19. Science of The Total Environment, 138870.

Course Designers

1. Dr. Pankaj Pathak, Assistant Professor, Department of Environmental Science, SRM University AP
2. Dr. Shoji, Assistant Professor, Department of Environmental Science, SRM University AP

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Calculus

Course Code	MAT 113	**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	Describe functions and their graphs to identify key characteristics such as domain, range, and behaviour.	2	75%	80%
Outcome 2	Compute derivatives of single-variable functions at specific points and apply various differentiation rules.	3	70%	75%
Outcome 3	Determine definite and indefinite integrals of functions and their applications.	3	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.	4	72%	75%
Outcome 5	Analyse double and triple integrals over various regions and apply calculus to real-world problems such as finding volumes, masses, and areas.	4	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	-	-	-	-	3	-	-	-	-	-	-
Outcome 2	3	2	-	1	-	-	-	-	3	-	-	-	-	-	-
Outcome 3	2	3	-	1	-	-	-	-	2	-	-	-	-	-	-
Outcome 4	3	3	-	2	-	-	-	-	3	-	-	-	-	-	-
Outcome 5	3	2	-	2	-	-	-	-	3	-	-	-	-	-	-
Average	3	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	50%	40%	55%	40%	50%
	Understand					
Level 2	Apply	50%	60%	45%	60%	50%
	Analyse					
Level 3	Evaluate					
	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

1. Introduction to Real Analysis, 4th Edition, (2014) – R. Bartle, D. Sherbert, John Wiley and Son
2. Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney. 2017

Course Designers

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

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Industry Standard Coding Practice - I

Course Code	CSE 131	**Course Category**	SEC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop foundational programming skills.
2. Enhance problem-solving abilities with a focus on efficiency.
3. Master advanced programming concepts related to memory.
4. Explore advanced problem-solving techniques and programming constructs.
5. Introduce Python programming for problem-solving.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Students will have a strong foundation in basic coding practices and be able to apply them to solve programming problems.	3	75%	70%
Outcome 2	Students will develop efficient problem-solving skills, especially in dealing with linear list data, arrays, and matrix-related challenges.	4	70%	60%
Outcome 3	Proficiency in advanced programming concepts like pointers, memory handling, and string manipulation will be achieved.	4	75%	70%
Outcome 4	Students will gain expertise in advanced problem-solving techniques, including parameter passing, recursion, and working with structures and unions.	5	70%	60%

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

CLOs	Program Learning Outcomes (PLO)														
	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	1	1	3	-	-	-	-	-	-	1	3	2	-
Outcome 2	2	3	1	1	3	-	-	-	-	-	-	1	3	2	-
Outcome 3	2	3	1	1	3	-	-	-	-	-	-	1	3	2	-
Outcome 4	2	3	1	1	3	-	-	-	-	-	-	1	3	2	-
Average	2	3	1	1	3	-	-	-	-	-	-	1	3	2	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Problem Solving with - Basic coding practices	10		
	Expression Evaluation	2	1	1,2
	Operators Usage	2	1	1,2
	Expressions	2	1	1,2
	Control Structures	2	1	1,2
	Loop & Iterations for all test case scenarios	2	1	1,2
Unit II	Problem Solving using time efficient logics	12		
	Linear list data	4	2	1,2
	Array problems	4	2	1,2
	2D Arrays and Matrix Data for all test case scenarios	4	2	1,2
Unit III	Problem Solving	8		
	Pointers & Memory referencing,	4	3	1,2
	String Handling functions for all test case scenarios	4	3	1,2
Unit IV	Problem Solving	8		
	Parameter passing	2	4	1,2
	Recursion	2	4	1,2
	Recursion Analysis	2	4	1,2
	Structures and unions	2	4	1,2
	Enumerations & Memory allocation for all test case scenarios	1	4	1,2
Unit V	Problem Solving using Python	12		
	String manipulations	2	3	3
	Lists	2	2	3
	Display patterns	1	2	3
	Matrix	2	2	3
	Tuples	1	2	3
	Dictionaries	1	2	3
	Modules	1	4	3
	Packages	1	4	3
	Exception handling	1	4	3
Total Hours		**50**		

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%		Theory 30%	Practical 20%
Level 1	Remember							
	Understand							
Level 2	Apply	80%	70%	80%	70%	40%	70%	
	Analyse							
Level 3	Evaluate	20%	30%	20%	30%	40%	30%	100%
	Create							
Total		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Problem solving with C++ -9e- Walter Savitch – Pearson.
2. The complete Reference C, Fourth REdition – Herbert Schildt – MC Graw Hill.
3. Programming in Python 3, A complete introduction to Python language - 2e - Mark Summerfield – Addison-Wiley.

Other Resources

Course Designers

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

Introductory Biology for Engineers

Course Code	BIO 103	**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	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the importance of Biological Sciences
2. To understand the biomolecules and their importance in biological systems.
3. To understand the structure and function of prokaryotic and eukaryotic cells, as whole entities and in terms of their subcellular processes including the molecular biology of cells.
4. To understand the importance of bioinformatics in biological sciences research

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the importance of biology in everyday life.	2	80%	75%
Outcome 2	Describe the evolution of life forms and the importance of biomolecules in living systems	2	80%	65%
Outcome 3	Explain the structure of different types of cells and cellular respiration, photosynthesis.	2	70%	65%
Outcome 4	Describe the molecular biology of cells and the process of cell division	2	70%	65%
Outcome 5	Discuss the use of bioinformatics tools for analysis of DNA and proteins.	2	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	-	2	3	3	1	-	3	3	3	3	-	2	-	-	-
Outcome 2	-	2	3	3	2	-	3	-	1	-	-	2	-	-	-
Outcome 3	-	2	3	3	3	-	3	-	1	-	-	2	-	-	-
Outcome 4	-	2	3	3	3	-	3	-	1	-	-	2	-	-	-
Outcome 5	-	2	3	3	3	-	2	-	2	-	-	3	-	-	-
Average	-	**2**	**3**	**3**	**2**	-	**3**	**3**	**2**	**3**	-	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Biomolecules**	**6**		
	Why study Biology?	1	1	1, 2, 3
	Evolution of complex biomolecules	1	1, 2	1, 2, 3
	Life on earth	1	1, 2	1, 2, 3
	Biomolecules - carbohydrates	1	1, 2	1, 2, 3
	Biomolecules – lipids and fats	1	1, 2	1, 2, 3
	Biomolecules – nucleic acids and proteins	1	1, 2	1, 2, 3
Unit II	**Cell Biology**	**6**		
	Prokaryotic cell structure	2	1, 2, 3	1, 2, 3
	Eukaryotic cell (Animal and Plant) - structure and functions of organelles	2	1, 2, 3	1, 2, 3
	Diversity of life: virus, bacteria, archaea and eukarya	2	1,2,3	1, 2, 3
Unit III	**Cell Physiology**	**6**		
	Membrane transport	1	2,3,4	1, 2, 3
	Cellular respiration and energy generation	2	2,3,4	1, 2, 3
	Brief account of Photosynthesis	1	2,3,4	1, 2, 3
	Enzymes and their kinetics	1	2,3,4	1, 2, 3
	Vitamins, Hormones	1	2,3,4	1, 2, 3
Unit IV	**Molecular Biology**	**6**		
	DNA and Chromosomes: structure and organization	1	2,3	1, 2, 3
	Central Dogma- DNA replication, transcription and translation	2	2,3	1, 2, 3
	Cell division – mitosis and meiosis	1	2,3	1, 2, 3
	Mutations, Cancer, and genetic diseases.	2	2,3	1, 2, 3
Unit V	**Biological Sequences and Databases**	**6**		
	Concept of genomics, transcriptomics, proteomics, and metabolomics	1	2,3,5	4
	FASTA file format	1	2,3,5	4
	Biological databases – NCBI	1	2,3,5	4
	Applications of BLAST and protein/Gene ID conversion	1	2,3,5	4
	Hands on experience in analyzing biological data using above mentioned tools	2	2,3,5	4
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 15%	CLA-2 10%	CLA-3 10%	
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. Thrives in Biochemistry and Molecular Biology, Edition 1, 2014, Cox, Harris, Pears, Oxford University Press.
2. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Chris Smith and Davis, Oxford University Press.
3. iGenetics: A Molecular Approach by Peter J Russell, 3rd edition, Pearson International Edition.
4. Bioinformatics Introduction – Mark Gerstein.

Other Resources

1. The Physiological Society (https://www.youtube.com/user/PhysocTV)

Course Designers

1. Dr. Writonban Basu Ball, Assistant Professor, Department of Biological Sciences, SRM University – AP.

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Data Structures

Course Code	CSE 107	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)	CSE 105	**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 I	**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
Unit II	**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 III	**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
Unit IV	**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
	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
Unit V	**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
Total Contact Hours		**45**		

Learning Assessment

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

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.

Data Structures Lab

Course Code	CSE 107L	**Course Category**	FIC	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)	CSE 105L	**Co-Requisite Course(s)**	CSE 107	**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

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

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Compare and contrast the algorithms for linked list, stack and queue operations.	4	77%	70%
Outcome 2	Illustrate algorithms for Binary Search Trees and AVL Trees.	4	75%	70%
Outcome 3	Analyze Graph traversal and minimum cost spanning tree algorithms.	4	72%	70%
Outcome 4	Distinguish searching and sorting techniques.	3	78%	80%

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

CLOs	Program Learning Outcomes (PLO)													
	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	2	2	2
Outcome 2	3	3	2	-	-	-	-	-	-	-	-	1	3	3	3
Outcome 3	3	3	2	1	-	-	-	-	-	-	-	1	3	3	3
Outcome 4	3	3	2	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
Week 1 & 2	Simulate the following operations: • Conversion of infix expression to postfix expression • Evaluation of expressions	4	1	1,6
Week 3 & 4	Simulate the following tasks: • Implementation the following operations: enqueue, dequeue and finding an element: • Linear Queue using arrays • Circular queue arrays • Priority queue singly linked list.	4	1	1,6
Week 5 & 6	Demonstrate the following though simulation: • Create a singly linked list and perform the following operations: • Add an element at the end of the list • Delete an element from the beginning of the list • Find the middle element of the list • Search the given key form the list • Polynomial addition using linked list • Sparse matrix operations using linked list	4	1	1,6
Week 7 & 8	Write code to perform the following operations: • Develop a code to test whether the given tree is binary tree or not. • Implementation of Binary tree traversals techniques – pre-order, in-order, and post-order. • Implementation of AVL tree and its operations	4	2	5
Week 9	Write a C program for implementation of Graph traversals techniques (BFS and DFS).	2	3	1,6
Week 10	The Dijkstra's algorithm is an algorithm that gives the shortest path between two given vertices of a graph. In this problem we are given a directed graph with each edge having a non-negative weight. Thus, a solution requires a path of many other that costs least. We can think of the problem as like this: think graph G as a map of the airline routes, each node of the graph as the cities and the weights on each edge as the cost of flying from one city to another city. The solution we have to find a routing from a city v to city w such that the total cost is minimum. Write a C program to simulate the given problem. That is find the shortest path between node A and node F in the given graph.	1	3	1,6
Week 11	Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?	2	4	2
Week 12	Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?	2	4	2
Week 13	Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?	1	4	2
Week 14	Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?	1	4	3
Week 15	Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?	1	4	3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%		End Semester Exam 50%
		Observation Note 20%	Project Presentation 30%	
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. "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.

Other Resources

Course Designers

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

SRM University *AP*, Andhra Pradesh
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Basic Electrical and Electronics Engineering

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

Course Objectives / Course Learning Rationales (CLRs)

1. To provide the basic idea on electrical and electronic circuits.
2. Describe the laws and concepts on electrical circuits.
3. Discuss the network theorems under DC Excitation
4. Conduct Steady State Analysis on Pure R, L, C Circuits, RL, RC and RLC circuits under single-phase AC Excitation.
5. Illustrate the basic semiconductor devices, analog circuits and applications.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the application on electrical engineering in daily life	2	70%	70%
Outcome 2	Discuss the laws and concepts for electrical circuits.	2	70%	70%
Outcome 3	Apply the network theorems under DC Excitation	3	70%	70%
Outcome 4	Conduct Steady State Analysis on Pure R, L, C Circuits, RL, RC and RLC circuits under single-phase AC Excitation.	2	70%	70%
Outcome 5	Describe the basic semiconductor devices and applications.	2	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	-	1	-	2	-	-	-	1	1	-	2	-	-	-
Outcome 2	3	3	1	-	2	-	-	-	1	1	-	2	-	-	-
Outcome 3	3	3	1	-	2	-	-	-	1	1	-	2	-	-	-
Outcome 4	3	3	1	-	2	-	-	-	1	1	-	2	-	-	-
Outcome 5	3	3	1	-	2	-	-	-	1	1	-	2	-	-	-
Average	**3**	**2**	**1**	-	**2**	-	-	-	**1**	**1**	-	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Basic Circuit Analysis**	**8**		
	Ohm's law, Kirchhoff's laws, Concept of Node, Path, Loop, Branch, Mesh	2	1, 2	1, 2
	Voltage and Current Division, Ideal and Practical Voltage and Current Source, Source transformations	2	1, 2	1, 2
	Nodal Analysis and Supernode - Presence of independent voltage and current sources.	2	1, 2	1, 2
	Mesh Analysis and Super mesh - Presence of independent voltage and current sources. Illustrative examples.	2	1, 2	1, 3
Unit II	**Network Theorems with DC Source**	**6**		
	Introduction to Network Theorems and Techniques, Superposition Theorem	1	1, 3	2, 3
	Thevenin's Theorem	2	1, 3	1, 2
	Norton's Theorem	1	1, 3	1, 2
	Maximum Power Transfer Theorem, Illustrative examples.	2	1, 3	1, 2
Unit III	**Single-Phase AC Circuits**	**11**		
	Basic Concepts Related to Generation of Sinusoidal AC Voltage. Definition and Numerical values of Average Value, Root Mean Square Value, Form Factor and Peak Factor for sinusoidal varying quantities	2	1, 4	1, 2
	Steady State Analysis of Pure R, L, C Circuits.	2	1, 4	1, 2
	Steady State Analysis of RL, RC and RLC Series Circuits with Phasor Diagrams	5	1, 4	1, 2
	Definitions of Real Power, Reactive Power, Apparent Power, and Power Factor. Concepts of Resonance Illustrative examples.	2	1, 4	1, 2
Unit IV	**Semiconductor Devices and Circuits**	**12**		
	PN junction diode structure	1	1, 5	1, 2
	Forward and reverse bias operation and characteristics of PN junction diode	1	1, 5	1, 2
	Half-wave, full wave, bridge rectifiers, clipping circuits using PN junction diode	2	1, 5	2, 3
	Bipolar junction transistors (BJTs) structure and operation	2	1, 5	1, 2
	common-base, common-collector, and common-emitter configurations using BJTs	6	1, 5	1,2
Unit V	**Basic Analog Circuits and Applications**	**8**		
	Characteristics of an operational amplifier and Definitions of characteristics	3	1, 5	1, 2
	Inverting and non-inverting op-amps, summing amplifier, Difference amplifier, Integrator and differentiator design using op-amp	3	1, 5	4,5
	Op Amp Applications as Voltage to Current Converter and Current to Voltage converters, filters	2	1, 5	1, 2
Total Contact Hours		**45**		

Learning Assessment

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

Recommended Resources

1. William H Hayt, J E Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2011.
2. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co. 7th Edition, 2017.
3. Online Sources

Other Resources

1. Electrical Engineering Fundamentals, Vincent Del Toro, Second Edition, PHI
2. Fundamentals of Electrical Engineering, Second edition, Leonard S. Bobrow, Oxford University press, 2011

Course Designers

1. Dr. Tarkeshwar, Asst Professor, Department of EEE, SRM University - AP
2. Dr. Somesh Vinayak Tewari, Asst Professor, Department of EEE, SRM University – AP

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Basic Electrical and Electronics Engineering Lab

Course Code	EEE 103L	**Course Category**	FIC		**L**	**T**	**P**	**C**
					0	0	1	1
Pre-Requisite Course(s)	Physics	**Co-Requisite Course(s)**		**Progressive Course(s)**	Circuit Theory			
Course Offering Department	EEE	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To provide the basic idea for electrical and electronic circuits.
2. Describe the laws and concepts on electrical circuits.
3. Discuss the network theorems under DC Excitation
4. Conduct Steady State Analysis on Pure R, L, C Circuits, RL, RC and RLC circuits under single-phase AC Excitation.
5. Summarize the basic semiconductor devices, analog circuits and applications.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the electrical engineering application in daily life	2	70%	70%
Outcome 2	Discuss the electrical circuits laws and concepts	2	70%	70%
Outcome 3	Apply the network theorems under DC Excitation	3	70%	70%
Outcome 4	Conduct Steady State Analysis on Pure R, L, C Circuits, RL, RC and RLC circuits under single-phase AC Excitation.	2	70%	70%
Outcome 5	Describe the basic semiconductor devices and applications.	2	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	-	-	1	-	2	-	-	-	-	-	-	2	-	-	-
Outcome 2	-	3	1	1	2	-	-	-	-	-	-	2	-	-	-
Outcome 3	3	3	1	1	2	-	-	-	1	1	-	2	-	-	-
Outcome 4	2	3	1	-	2	-	-	-	1	1	-	2	-	-	-
Outcome 5	1	3	1	1	2	-	-	-	1	1	-	2	-	-	-
Average	**2**	**2**	**1**	**1**	**2**	-	-	-	**1**	**1**	-	**2**	-	-	-

Course Unitization Plan

Exp. No.	Name of Experiment	Required Contact Hours	CLOs Addressed	References Used
1	Verification of Ohm's Law	3	1,2	1, 2
2	Verification of Kirchoff's Law	3	1,2	1, 2
3	Verification of Superposition theorem	3	1,3	1, 2
4	Verification of Thevenin's and Norton's theorem	3	1,3	1, 3
5	Verification of Maximum Power transfer theorem.	3	3,4	1, 2
6	P-N junction diode I-V characteristics	3	1,5	4, 5
7	Application of P-N junction diode	3	1,5	1, 3
8	BJT I-V characteristics (I/P and O/P)	3	4,5	1, 2
9	Op-Amp Inverting and Non-inverting mode - Gain verification	3	1,5	2, 4
10	Verification of truth tables of basic logic gates	3	3,5	1, 2
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%			End Semester Exam 50%
		Experiments 20%	Record/ Observation Note 10%	Viva Voce + Model examination 20%	
Level 1	Remember	30%	60%	30%	30%
	Understand				
Level 2	Apply	70%	40%	70%	70%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. William H Hayt, J E Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2011.
2. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co. 7th Edition, 2017.
3. Online Sources

Other Resources

1. Electrical Engineering Fundamentals, Vincent Del Toro, Second Edition, PHI
2. Fundamentals of Electrical Engineering, Second edition, Leonard S. Bobrow, Oxford University press, 2011

Course Designers

1. Dr. Tarkeshwar, Asst Professor, Department of EEE, SRM University - AP
2. Dr. Somesh Vinayak Tewari, Asst Professor, Department of EEE, SRM University – AP

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

Linear Algebra

Course Code	MAT 211	**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. 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

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

Engineering Physics

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

Course Objectives / Course Learning Rationales (CLRs)

1. To understand fundamental concepts of classical mechanics and elastic properties of solids.
2. To understand laws of Geometrical and Wave Optics and waves properties of light.
3. To learn fundamentals of Electromagnetism and Maxwell's equation as the foundation of Maxwell's Equation.
4. To familiarize about particle properties of waves and related fundamentals.

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 classical mechanics	2	70%	65%
Outcome 2	Explain Electromagnetic Equations and its applications	2	70%	65%
Outcome 3	Illustrate Laws of Optics and waves properties of light	3	70%	65%
Outcome 4	Demonstrate particle properties of waves and related fundamentals	3	70%	65%

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

CLOs	Program Learning Outcomes (PLO)														
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and 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	-	-	-
Outcome 2	-	-	-	-	2	-	-	-	2	-	-	2	-	-	-
Outcome 3	-	2	-	-	2	-	-	-	2	-	-	2	-	-	-
Outcome 4	-	2	-	-	2	-	-	-	3	-	-	2	-	-	-
Average	-	**2**	-	-	**3**	-	-	-	**2**	-	-	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Classical Physics**	**8**		
	Introduction	1	1	1, 2
	Newton's laws of mechanics, Free body force diagram	1	1	1, 2
	Momentum and Impulse, Conservation of linear momentum	1	1	1, 2
	Work-Kinetic Energy Theorem and related problems	1	1	1,2
	Conservation of mechanical energy: Worked out problems	1	1	1, 2
	Elastic properties of solids, Stress-strain relationship, elastic constants, and their significance	1	1	1, 2
	Lab experiment: Hooke's law and determine spring constant for a given spring	2	1	4
Unit II	**Optics**	**12**		
	Concept of Electromagnetic waves & EMW Spectra	1	3	1,2
	Geometrical & Wave Optics: Laws of reflection and refraction	1	3	1,2
	Concept of Interference	1	3	1,2
	Phase Difference and Path Difference	1	3	1,2
	Double-Slit Interference	1	3	1,2
	Diffraction: types and single slit	1	3	1,2
Unit III	**Modern Physics**	**8**		
	Black Body Radiation; Wien's displacement law	1	4	1,2,3
	Discussion on failure of classical laws to explain Black Body Radiation, and concept of Planck's Hypothesis	1	4	1,2,3
	What is Light? Photon and Overview on Planck Constant	1	4	1,2,3
	Photoelectric effect – Concept and Experimental Setup	1	4	1,2,3
	Photoelectric effect – Intensity vs Current, Frequency vs Kinetic Energy, the drawback of Wave theory to explain Photoelectric effect	1	4	1,2,3
	Wave properties of particle: De Broglie wave	1	4	1,2,3
Unit IV	**Electro-Magnetism – I**	**8**		
	Focus on Maxwell's Equation I: Discuss lines of force and Electrostatic flux, Introduce Gauss's law (differential and integral form)	1	2	1, 2, 5
	Application of Gauss Law: ES field due to infinite wire and sheet.	1	2	1, 2, 5
	Electrostatic field due to conducting and insulating sphere.	1	2	1, 2, 5
	Concept of Electrostatic Potential and Potential Energy Inter-relation with electrostatic field.	1	2	1, 2, 5
	Capacitor and Capacitance:	1	2	1, 2, 5
	Capacitance of a parallel plate capacitor.	1	2	1, 2, 5
Unit V	**Electro-Magnetism - Ii**	**10**		
	Introduce Biot-Savart Law as an alternative approach to calculate magnetic field.	1	2	1, 2, 5
	Calculate Magnetic field due to finite current element using Biot Savart Law.	1	2	1, 2, 5
	Focus on Maxwell's Equation IV: Discuss Ampere's circuital law.	1	2	1, 2, 5
	Calculate Magnetic field due to Infinite wire and Solenoid using Ampere's Law.	1	2	1, 2, 5
	Focus on Maxwell's Equation III: Lenz's Law and Faraday's law: Induced EMF and Current	1	2	1, 2, 5
	Describe Maxwell Equations as the foundation of electro-magnetism. Derive differential forms starting from Integral forms. Discuss Physical Significance.	1	2	1, 2, 5

Learning Assessment

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

Recommended Resources

1. Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett, XIX Edition (2017), Publisher - Cengage India Private Limited
2. University Physics with Modern Physics with Mastering Physics - D Young, Roger A Freedman And Lewis Ford, XII Edition (2018), Publisher – PEARSON
3. Concept of Modern Physics - Arthur Beiser, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill
4. Laboratory manuals, SRM University-AP

Other Resources

1. Introduction to Electrodynamics – David J. Griffiths. 4th Edition (2012), Publisher - PHI Eastern Economy Editions
2. Electricity and Magnetism - A S Mahajan and A A Rangwala, Revised of 1 Edition (2001), Publisher - McGraw-Hill

Course Designers

1. Dr. Jatis Kumar Dash, Associate Professor. Dept. Of Physics. SRM University – AP
2. Dr. Pranab Mandal, Professor & Head. Dept. Of Physics. SRM University – AP
3. Prof. M. S. Ramachandra Rao, Professor, Department of Physics, Indian Institute of Technology, Madras
4. Prof. D. Narayana Rao, Raja Ramanna Fellow, University of Hyderabad

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

Engineering Physics Lab

Course Code	PHY 101L	**Course Category**	FIC		**L**	**T**	**P**	**C**
					0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	PHY 101	**Progressive Course(s)**				
Course Offering Department	Physics	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. Operate physics equipment and measurement tools experience.
2. Determine physical parameters of mechanics, thermodynamics, electromagnetism, and optics.
3. To collect experimental data, analyse and graph plot.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Illustrate equipment operation and analysis	2	70%	65%
Outcome 2	Compute time period, acceleration due to gravity, viscosity and spring constant	3	70%	65%
Outcome 3	Explain working principle of compound pendulum, spring and thermodynamic laws	2	70%	65%
Outcome 4	Verify the laws of electromagnetism and optics using experimental results	5	70%	65%
Outcome 5	Plot graphs and analyse the experimental results	5	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	3	3	-	-	-	3	-	-	-	-	-	-
Outcome 2	-	3	2	3	3	-	-	-	3	-	-	-	-	-	-
Outcome 3	2	3	3	3	3	-	-	-	2	-	-	1	-	-	-
Outcome 4	2	3	2	3	3	-	-	-	3	-	-	-	-	-	-
Outcome 5	-	3	2	3	3	-	-	-	3	-	-	2	-	-	-
Average	**2**	**3**	**2**	**3**	**3**	-	-	-	**3**	-	-	**2**	-	-	-

Course Unitization Plan

S.N.	Experiment Description	Required Contact Hours	CLOs Addressed	References Used
1	Moment of inertia of a flywheel	2	1,2,5	1,2
2	Hooke's law and determine spring constant for a given spring	2	1,2,5	1,2
3	Compound Pendulum: Acceleration due to gravity and radius of gyration of the given pendulum	4	1,2,5	1,2
	To determine the rigidity modulus of steel wire by torsional Pendulum **[Optional]**			
	To calculate Young's modulus of a given material by deflection method **[Optional]**			
4	Faraday law & Induced E.M.F: Measurement of the induced voltage and calculation of the magnetic flux induced by a falling magnet	2	1,4,5	1,2
	To study the B-H curve of the given material and the permeability curve of the given material. [**Optional**]			
5	Biot-savart law: To study the dependence of magnetic field on the current and magnetic field along the axis of a current carrying circular loop	4		
	Hall Effect: Determination of type of semiconductor and carrier concentration in a given semiconductor **[optional]**		1,4,5	1,2
	Magnetic field in Helmholtz coil [**Optional**] To investigate the spatial distribution of magnetic field between coils and determine the spacing for uniform magnetic field. To demonstrate the superposition of the magnetic fields of the two individual coils.		1,4,5	1,2
6	To determine the dielectric constant of air using dielectric constant kit.	4	1,4,5	1,2
	Measurement of Resistivity of a semiconductor using Four probes [**Optional**]		1,4,5	1,2
7	Michelson interferometer kit with diode laser	4	1,4,5	1,2
	Resolving power of A Telescope **[Optional]**			
	Balmer Series and Rydberg constant **[Optional]**			
8	He-Ne laser kit: Optical Interference and Diffraction	2	1,4,5	1,2
	Solar cell characteristics**[Optional]**			
	Frank Hertz Experiment **[Optional]**			
9	Particle size measurement	4	1,4,5	1,2
10	Verification of Stefan's Law	2	1,3,5	1,2
	Measurement of specific heat capacity of any given material **[optional]**		1,3,5	1,2
Total contact hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%			End Semester Exam 50%
		Experiments 20%	Record/ Observation Note 10%	Viva Voce + Model examination 20%	
Level 1	Remember		40%	30%	
	Understand				
Level 2	Apply	40%	60%	30%	50%
	Analyse				
Level 3	Evaluate	60%		40%	50%
	Create				
Total		100%	100%	100%	100%

Recommended Resources

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

Other Resources

Course Designers

1. Dr. Jatis Kumar Dash, Assistant Professor, Dept. of Physics. SRM University – AP
2. Dr. Pranab Mandal, Assistant Professor, Dept. of Physics. SRM University – AP
3. Prof. M. S. Ramachandra Rao, Professor, Department of Physics, Indian Institute of Technology, Madras
4. Prof. D. Narayana Rao, Raja Ramanna Fellow, University of Hyderabad

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

Civil Engineering Drawing

Course Code	CE 101	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	0	0	2
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 to the principles of building planning, site selection criteria, byelaws, regulations, and specifications for the planning of residential and public buildings.
2. To enable students to understand different rules and regulations through Building Byelaws and the National Building Code.
3. To understand the fundamental design principles involves in various components of building and their functions.

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 objectives and underlying principles of building bylaws and regulations	2	75%	75%
Outcome 2	Formulate the dimensions of the different parts of residential and public buildings as per Indian standards	3	70%	70%
Outcome 3	Prepare the plan, elevation and section of building	4	70%	70%
Outcome 4	Demonstrate various types of staircases and design philosophy	4	70%	70%
Outcome 5	Demonstrate various types of foundation and design philosophy	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	1	1	1	-	-	-	-	1	-	-	-	-	2	1	2
Outcome 2	2	2	1	1	-	-	-	1	-	-	-	-	2	1	2
Outcome 3	2	3	1	-	1	-	-	1	-	-	-	-	2	1	2
Outcome 4	2	1	-	-	3	-	-	1	-	-	-	-	3	3	2
Outcome 5	2	3	1	1	1	-	-	1	-	-	-	-	3	3	2
Average	**2**	**2**	**2**	**1**	**1**	-	-	**1**	-	-	-	-	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Building Byelaws and Regulations**	**10**		
	Introduction	1	1	1
	Building planning approval procedure, key plan, site plan and layout plan.	2	1	1
	Approval procedure of multi-storied building	1	1	1
	Introduction, terminology, objectives of building byelaws, floor area ratio, floor space index	2	1	1, 2
	Principles under laying building bye laws, classification of buildings, open space requirements	2	1	1, 2
	built up area limitations, height of buildings, wall thickness, lightening and ventilation requirements	2	1	1, 2
Unit II	**Residential and Public Buildings**	**10**		
	Minimum standards for various parts of buildings requirements of different rooms and their grouping	1	2	1, 2
	Characteristics of various types of residential buildings and relationship between plan, elevation and forms and functions	1	2	1, 2
	Site selection criteria	1	2	1, 2
	Principles of planning of buildings and governing factors	2	2	1
	Public buildings: Planning of educational institutions	1	3	1, 3
	Public buildings: Planning of hospitals and dispensaries	1	3	1, 3
	Public buildings: Planning of office buildings and banks	1	3	1, 3
	Public buildings: Planning of industrial buildings	1	3	1, 2
	Public buildings: Planning of hotels, motels and buildings for recreation	1	3	1, 2
Unit III	**Doors, Windows, Ventilators and Roofs**	**7**		
	Panelled-door, panelled and glazed door, glazed windows, panelled windows, swing ventilators, fixed ventilators, coupled roof, collar roofs	2	3	1
	King post truss, Queen post truss, sloped and flat roof and buildings	2	3	1
	Drawing plans, elevations and cross sections of given sloped and flat roof buildings	3	3	1
Unit IV	**Staircase and Foundation**	**3**		
	Introduction to the staircase, types, and design	1.5	4	3
	Introduction to foundation, types, and design	1.5	5	3
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 10%	CLA-2 15%	CLA-3 15%	
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. Building Planning and Drawing, N. Kumara Swamy, A. Kameswara Rao,
2. Planning, designing and Scheduling, Gurucharan Singh and Jagadish Singh
3. Building planning and drawing by M. Chakravarthi.

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.

Civil Engineering Drawing Lab

Course Code	CE 101L	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	0	1	1
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 to computer-aided drafting with the help of a professional software package.
2. To provide hands-on training on basic engineering drawing with the help of computer-aided drafting.
3. To encourage the students to use computer-aided drafting for drawing the plan, elevation, and sectional views of residential and public 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	Demonstrate different tools of computer-aided drafting	1	85%	85%
Outcome 2	Demonstrate the use of computer-aided drafting and prepare orthographic projections	4	70%	70%
Outcome 3	Demonstrate the use of computer-aided drafting and prepare isometric projections	4	70%	70%
Outcome 4	Prepare the plan, elevation, and sectional views of residential and public buildings	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	3	2	2	-	-	-	-	2	-	-	-	3	2	1
Outcome 2	3	3	2	2	-	-	-	-	2	-	-	-	3	2	1
Outcome 3	3	3	2	2	-	-	-	-	2	-	-	-	3	2	1
Outcome 4	3	2	1		-	-	-	-	2	-	-	-	2	2	1
Average	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**	**1**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**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 II	**Orthographic Projection**	**7**		
	Introduction	1	2	2
	Selection of scale, Principle of projection, method and plane of projection	2	2	2
	Four quadrants, first and third angle projections using CAD	4	2	2
Unit III	**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 IV	**Planning of Different Types of Buildings**	**10**		
	Introduction to line diagram	1	4	1
	Residential building: Planning of low, middle and high-income group housing	2	4	1
	Public buildings: Planning of educational institutions	1	4	1
	Public buildings: Planning of hospitals and dispensaries	1	4	1
	Public buildings: Planning of office buildings and banks	1	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**		

Learning Assessment

Bloom's Level of Cognitive Task		Lab Performance 25%	Observation Notes 25%	End Semester Exam 50%
Level 1	Remember	30%	50%	50%
	Understand			
Level 2	Apply	70%	50%	50%
	Analyse			
Level 3	Evaluate			
	Create			
Total		**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.

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.

Mechanical Engineering Tools Lab

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

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the use of fitting tools to perform fitting operations.
2. To learn different machine tools, accessories, and attachments
3. To gain knowledge of fitting and machining operations to enrich their practical skills.
4. To inculcate team qualities and expose students to shop floor activities.

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	Read working drawings based on operational symbols and execute machining operations	2	70%	75%
Outcome 2	Illustrate integral parts of lathe, shaping & milling machines, and their accessories & attachments	3	70%	75%
Outcome 3	Select cutting parameters such as cutting speed, feed, depth of cut, and tooling for machining operations	3	70%	75%
Outcome 4	Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time	3	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	3	3	3	2	1	-	-	-	3	1	-	2	-	-	-
Outcome 2	1	2	2	3	2	-	-	-	2	1	-	3	-	-	-
Outcome 3	1	2	2	1	1	-	-	-	2	1	-	2	-	-	-
Outcome 4	1	3	3	2	3	-	-	-	2	1	-	2	-	-	-
Average	**2**	**3**	**3**	**2**	**2**	-	-	-	**2**	**1**	-	**2**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	Preparation of at least two fitting joint models by proficient handling and application of hand tools- Vblock, marking gauge, files, hack saw drills etc.	6	**1,2,3,4**	**1**
Unit II	Preparation of three models on lathe involving - Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning. Exercises should include selection of cutting parameters and cutting time estimation	8	**1,2,3,4**	**1**
Unit III	Cutting of V Groove/ dovetail / Rectangular groove using a shaper. Cutting of Gear Teeth using a Milling Machine. Exercises should include selection of cutting parameters and cutting time estimation.	8	**1,2,3,4**	**1**
Unit IV	Study & Demonstration of power tools like power drill, power hacksaw, portable hand grinding, cordless screwdrivers, production air tools, wood cutter, etc., used in Mechanical Engineering	8	**1,2,3,4**	**1**
	Total Contact Hours	**30**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments 50%**			**End Semester Exam 50%**
		Experiments 30%	**Record / Observation Note 10%**	**Viva + Model 10%**	
Level 1	Remember	40%	30%	40%	40%
	Understand				
Level 2	Apply	60%	70%	60%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Workshop manual, SRM University AP

Other Resources

Course Designers

1. Dr G S Vinod Kumar, Professor, Department of Mechanical Engineering, SRM university - AP

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

Analytical Skills for Engineers

Course Code	AEC 105	**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	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To categorize, apply and use thought process to distinguish between concepts of quantitative methods.
2. To prepare and explain the fundamentals related to various possibilities.
3. To critically evaluate numerous possibilities related to puzzles.
4. Explore and apply key concepts in logical thinking to business problems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Use logical thinking and analytical abilities to solve quantitative aptitude questions from company specific and other competitive tests.	1	70%	60%
Outcome 2	Solve questions related to Aptitude from company specific and other competitive tests.	3	80%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	70%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	90%	80%

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

CLOs	Program Learning Outcomes (PLO)														
	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	-	**3**	-	-	**2**	-	-	**3**	**3**	-	-	**3**	-	-	-

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Quantitative Aptitude**			
	Data interpretation – Introduction and basics to solve data interpretation	4	1,4	1,4
	Data interpretation line graphs, Data interpretation bar graph.	6	1,4	1,4
Unit II	**Quants**			
	Data interpretation – Pie charts,	2	1,4	1,4
	Data interpretation – Tabular, Data interpretation – case lets.	2	1,4	1,4
Unit III	Statistics	6	1,2	2,3
Unit IV	Functions and graphs	3	1,2	1,2
	graph theory with respect to coding	2	1,2	1,2
	math graph theory and coding problems	2	2,3	2,3
	discrete planar theory and coding problems.	3	1,2	2,4
Total Contact Hours		**30**		

Learning Assessment

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

Recommended Resources

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

Other Resources

Course Designers

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

Probability and Statistics for Engineers

Course Code	CVE 201	**Course Category**	SEC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

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

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the basic knowledge on fundamental probability concepts, including random variable, probability of an event, additive rules and conditional probability Bayes' theorem S understand the basic statistical concepts and measures	2	70%	75%
Outcome 2	Demonstrate the concept of the central limit theorem understand several well-known distributions, including, Geometrical, Negative Binomial, Pascal, Normal and Exponential Distribution	4	70%	73%
Outcome 3	Apply the central limit theorem to sampling distribution use estimation technique to determine point estimates confidence interval and sample size.	3	75%	80%
Outcome 4	Interpret and Analyses in SAS, S-PLUS, R or MATLAB	4	70%	70%
Outcome 5	Apply central limit theorem and hypothesis testing	3	70%	72%

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

CLOs	Program Learning Outcomes (PLO)														
	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	3	2	-	1	-	-	-	-	2	-	-	-	-	-	-
Outcome 3	2	3	-	1	-	-	-	-	2	-	-	-	-	-	-
Outcome 4	2	3	-	2	-	-	-	-	3	-	-	-	-	-	-
Outcome 5	3	2	-	2	-	-	-	-	3	-	-	-	-	-	-
Average	**2**	**3**	-	**2**	-	-	-	-	**3**	-	-	-	-	-	-

Course Unitization Plan

Unit No.	Description of Topic	Contact hours	CLOs Addressed	Reference
Unit I	**Introduction to Probability**	**7**		
	Basic principle of counting, multinomial coefficients	1	1	1
	Axioms of probability, computing probabilities - unions, intersections, and Inclusion-exclusion principle	2	1	1
	Conditional probability, Independent events	2	1	1
	In Bayes' theorem, law of total probability	2	1	1
Unit II	**Random variables and distributions**	**12**		
	Random variables, cumulative distribution function	1	1	1
	Discrete random variables	1	1	1
	Cumulative distribution function and its properties	1	1	1
	Expectation, variance and standard deviation of discrete random variables, conditional expectation	1	1	1
	Bernoulli and binomial distributions, their expectations and variances	1	1	1
	Poisson, geometric and negative binomial distributions, their expectations and variances	1	1	1
	Continuous random variables	1	1	1
	Expectation and variance, Conditional expectation	2	1	1
	Uniform and exponential distributions	1	1	1
	Normal distribution ,	2	1	1
	Student's t-distribution			
Unit III	**Joint probability distributions and CLT**	**8**		
	Joint distribution of two random variables - discrete and continuous	2	2	1
	Change of variables under integration (Determinant of Jacobian), Independent random variables and their sum,	3	2	1
	Central limit theorem	1	2	1
	Covariance and correlation between random variables	2	2	1
Unit IV	**Descriptive statistics and linear regression**	**8**		
	Graphical representation of data -Histograms, scatter plots & time plots	1	3,4	1
	Descriptive statistics	2	1	2,3
	Correlation – Pearson's correlation coefficient	2	3	2,3
	Linear regression, Goodness of fit,	3	3,5	2,3
	Normal equations for least-squares regression,			
Unit V	**Introduction to statistical inference**	**10**		
	Population, sample and statistics	2	3	2,3
	Point estimation of population parameters	1	3	2,3
	Confidence intervals for population mean, and population proportion	2	3	2,3
	P-values, Significance level,	3	3,4	2,3
	Tests of significance for population mean, population proportion.			
	Types of errors, contingency table, sensitivity, specificity, power of a test.	2	3	2,3

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	25	10	20	25%
	Understand	30	30	30	30	30%
Level 2	Apply	20	25	30	30	25%
	Analyse	20	20	30	20	20%
Level 3	Evaluate	30	25	10	20	25%
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. S. Ross, A First course in probability, Pearson Education; Ninth edition (2018)
2. M. Baron, Probability and Statistics for computer scientists, Chapman and Hall/CRC; First edition (2006)
3. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Wiley; Sixth edition (2016)

Other Resources

Course Designers

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

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Fluid Mechanics

Course Code	CVE 202	**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 about the fundamental concepts of fluid flow.
2. To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyze and appreciate the complexities involved in solving the fluid flow problems.
3. To enable student to understand the concept of buoyancy, stability of floating bodies and the forces acting on immersed bodies by employing the concept of pressure.

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	Calculate gauge and differential pressures in fluids for given problem	3	70%	70%
Outcome 3	Use 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	3	70%	70%
Outcome 5	Analyze fluid flow with the mass and energy equations for determining analytical solutions of given fluid flow problem	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 I	**Introduction to the basic concepts**	**2**		
	Basic principles relating to features including surface tension, capillarity, vapour pressure,	1	1	1,3
	kinds of fluids, mass density, weight density, specific gravity, specific volume, viscosity, compressibility, and elasticity.	1	1	1,3
Unit II	**Kinematics and dynamics of fluid flow**	**9**		
	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.	2	2	1,2
	Different types of fluid flows, descriptions of flow patterns, Lagrangian and Eulerian methods, continuity equation,	1	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,	1	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
Unit III	**Flow Measurement Devices**	**6**		
	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.	3	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.	3	5	1,2,4
Unit IV	**Flow through notches and weirs**	**6**		
	Flow through rectangular channels, Flow through triangular and trapezoidal notches and weirs, Cippoletti Weir; End contractions, Velocity of approach; Broad crested weir, practical to be conducted in lab.	6	6	2,3,6
Unit V	**Flow through pipes**	**8**		
	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.	8	6	1,4,6
Unit VI	**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	6	2,4,6,7
Unit VII	**Hydraulic machine**	**8**		
	Turbines: Kaplan, Francis, Pelton, Practical to be conducted in lab	8	5	2,5,7
Unit VIII	**Project base learning**	**0**	6	
Total Contact Hours		**45**		

Guided study

Sl. No	Component	Contact Hours	Non-contact Hours	CLOs Addressed	References Used
1	Project	0	15	1-5	1-3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	CLA-2 10%	CLA-3 10%	Mid-1 20%	
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. 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

Other Resources

1. Fluid Mechanics, by Frank White; Tata McGraw Hill Education Pvt. Ltd.; 2011.
2. Fluid Mechanics and Machinery by C.S.P.Ojha et.al, Oxford University Press, 2010, ISBN: 0-19-569963-7.
3. Fluid Mechanics by R. C. Hibbeler, Pearson Press, 2017, ISBN: 978-93-325-4701-8.
4. Fluid Mechanics by Streeter, V.L. and Benjamin, W.E., McGraw-Hill.
5. F. M White, Fluid Mechanics, Tata McGraw Hill Education.

Course Designers

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

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Structural Mechanics

Course Code	CVE 203	**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 I	**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 II	**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 III	**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 IV	**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 V	**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	2	2	1,3
2	Compression test of Concrete cubes and cylinders	2	2	3
3	Test on open coil and closed coil Helical springs	2	2	3
4	Izod & Charpy impact test	2	2	3
5	Torsion test on Graded steels	2	6	1,3
6	Deflection test on beams of different materials using Maxwell reciprocal theorem	2	3,4	3
7	Double shear test on metallic materials	2	2,5	3
8	Comparison of mechanical properties of Unhardened, Quenched and tempered specimen	2	2	3
9	Strain measurement on rods and beams	2	2	1,3
10	Buckling analysis	2	6	1
Total Contact Hours		**20**		

Guided study

Sl. No	Component	Contact Hours	Non-contact Hours	CLOs Addressed	References Used
1	Project	5	5	1-6	1-3

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

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Spatial Data Acquisition

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 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

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit I	**Introduction to mapping and spatial data acquisition**	**9**		
	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.	3	1,2	1,2
	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.	6	1,2	1,2
	Mini project-1/ Field tour			
Unit II	**Distance Measurements**	**13**		
	Distance measurement conventions and methods; use of chain and tape	4	2,3	1,2
	electronic distance measurements (EDM)- principles of electro optical EDM-errors and corrections to linear measurements. Hands-on sessions	4	2,3	1,2
	Mini project-2/ Field tour	5	3,4	1,2
Unit III	**Angular Measurements**	**10**		
	Compass survey – Meridians, Azimuths and Bearings, declination, computation of angle. Traversing – Purpose-types of traverse-traverse computation – traverse adjustments	6	1,2,3	1,2
	Mini project-4/ Field tour	4	1,2,3	1,2
Unit IV	**Levelling and Contouring**	**10**		
	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	3,4	1,2
	Mini project-4/ Field tour	4	3,4	1,2
Unit V	**Total Station**	**8**		
	Description to Total station, Comparison of total station with conventional equipment, principles-uses and adjustments – temporary and permanent, measurement of horizontal and vertical angles, areas, height of buildings.	5		
	Mini project-4/ Field tour	3	3,4	1,2,3
Unit VI	**Sensors for Geospatial Data Acquisition**	**6**		
	Introduction to Sensors, types of sensors, calibration, accuracy, precision, resolution, sensitivity, range, and response time. Data loggers and data acquisition systems, Data acquisition using sensors, Data Visualization, photospheres.	2	3,4	1,2 ,3
	Mini project + Field tour	3	3,4	1,2,3
Unit VII	**Remote data acquisition using open-source tools and UAVs**	**9**		
	Introduction to google earth, measurement of distance and area, creating web maps, Introduction to drones, types and classification of drones,	2	3,4	1,2,3
	drone deployment, data processing and visualization, linear measurements using drone, aerial measurements using drone, measuring height of buildings.	2	1,2	1,2,3
	Introduction to GPS and Differential GPS, waypoint collection using GPS, length and aerial computations using GPS, preparation of maps.	2	1,2	1,2,3
	Mini project/Field tour	3	3,4	1,2,3
Total Contact Hours		**65**		

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.

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Civil Engineering Materials

Course Code	CVE 205	**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 I	**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 II	**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 III	**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 IV	**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 V	**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**		

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%**

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

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Numerical Methods and its application in Civil Engineering

Course Code	CVE 210	**Course Category**	SEC	**L**	**T**	**P**	**C**
				1	1	0	2
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 I		**03**		
	Introduction, Kinds of errors in numerical procedures, measurement of efficiency of numerical procedures, order of accuracy, and Interface of MATLAB	1	1,2	1
Unit II		**06**		
	Bisection, secant, method of false – position, Newton's method, Fixed point iteration method, Order of convergence, multiple roots.	1	1,2	1
Unit III		**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	1
Unit IV		**04**		
	Least square regression, Existence and Uniqueness of interpolating polynomial, Lagrange polynomials, divided differences, evenly space points, error of interpolation		2,3	1
Unit V		**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	1
Unit VI		**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	1
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

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Reinforced Concrete Design

Course Code	CE 206	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	CE 205	**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 I	**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 II	**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 III	**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 IV	**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 V	**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**		

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

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Soil Behaviour and 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**	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	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 I	**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 II	**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 III	**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 IV	**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 V	**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**		

Course Unitization Plan

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Determination of liquid limit	2	1, 2	2,3
2	Determination of plastic limit	1	1, 2	2,3
3	Determination of shrinkage limit	2	1, 2	2,3
4	Soil gradation using sieve analysis	1	1	2,3
5	Soil gradation using hydrometer analysis	3	1, 2	2,3
6	Determination of specific gravity using density bottle method	2	1, 2	2,3
7	Determination of specific gravity using pycnometer bottle method	2	1, 3	2,3
8	Determination of unit weight by core cutter method	2	1, 3	2,3
9	Determination of unit weight by sand replacement method	2	1, 3	2,3
10	Determination of relative density by vibration table test	2	1, 3	2,3
11	Determination of maximum dry density of soil using standard proctor compaction	2	2, 3	2,3
12	Determination of maximum dry density of soil using standard proctor compaction	3	2, 3	2,3
13	Determine the coefficient of permeability of soil using constant head permeability test	3	2, 3	2,3
14	Determine the coefficient of permeability of soil using falling head permeability test	3	2, 3	2,3
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%	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.

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Modern Highway Engineering

Course Code	CVE 208	**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 learn highway geometric design and analysis.
3. To explore highway traffic analysis and design.
4. To gain knowledge of pavement materials, design, construction, and maintenance.

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

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

Guided Study

Unit No.	Unit Name	Non-Contact Hours	CLO Addressed	Reference
1	Project	30	1-4	1-5

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 70%				End Semester Exam 30%
		CLA-1 15%	Mid-1 20%	CLA-2 15%	Project 20%	
Level 1	Remember	60%	65%	40%	40%	50%
	Understand					
Level 2	Apply	40%	45%	60%	60%	50%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Highway Engineering, by Martin Rogers and Bernard Enright, Wiley Publishers, 3rd edition.
2. Highway Engineering, by S. K. Khanna., C. E. G. Justo and A. Veeraragavan, Nem Chand Bros, India.
3. Traffic Engineering, by Roger P. Roess, Elena S. Prassas, and William R. McShane, Pearson Publishers, 5th edition.
4. Principles of Transportation Engineering, by Partha Chakraborty and Animesh Das, Prentice Hall India.
5. Pavement Analysis and Design, by Yang H. Huang, 2nd edition.

Other Resources

1. Specifications for Roads and Bridge Works, by Ministry of Road Transport and Highways-, Fifth Revision, IRC, New Delhi, India-2013
2. Guidelines for the Design of Flexible Pavements- IRC 37:2018.
3. Guidelines for the Design of Plain Jointed Rigid Pavements for Highways- IRC 58:2015.
4. Highway Material Testing, by S. K. Khanna., C. E. G. Justo and A. Veeraragavan, Nem Chand Bros, India.

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.

Analysis of Determinate and Indeterminate Structures

Course Code	CVE 209	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	1	4
Pre-Requisite Course(s)	CVE 203	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Civil Engineering	**Professional / Licensing Standards**	**STAADPro, SAP2000**				

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.

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%
Outcome 6	Analyse structures experimentally	3	75%	75%
Outcome 7	Analyze and interpret experimental data	4	70%	70%
Outcome 8	Document and report findings	3	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	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
Outcome 6	3	3	1	2	1	-	-	1	-	-	-	-	3	3	2
Outcome 7	2	3	1	2	-	-	-	1	-	-	-	-	2	3	2
Outcome 8	1	3	-	2	-	-	-	1	-	-	-	-	2	3	2
Average	**2**	**3**	**2**	**2**	**2**	-	-	**1**	-	-	-	-	**2**	**3**	**2**

Course Unitization Plan

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

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	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

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Physico-Chemical Water Treatment: Materials and Processes

Course Code	CVE 301	**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	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 Theory

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

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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 207	**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 I	**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 II	**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 III	**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 IV	**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 V	**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**		

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.

Engineering Hydrology

Course Code	CVE 303	**Course Category**	CC	**L**	**T**	**P**	**C**
				1	1	1	3
Pre-Requisite Course(s)	CVE 202	**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	-	-	-	-	-	-	-	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	References Used
Unit I	**Introduction**	**10**		
	Hydrologic cycle, Water-budget equation, Applications in engineering, Sources of data, Precipitation: Forms of precipitation, characteristics of precipitation in India,	2	1-3	1, 2
	Measurement of precipitation, rain gauge network Mean precipitation over an area;	4	1-3	1, 4
	Depth-Area-Duration relationships Depth-Duration-Frequency relationships	2	1	1, 2
	Probable maximum precipitation and rainfall data in India	2	1-3	2, 3
Unit II	**Abstractions from precipitation**	**16**		
	Evaporation process, Evaporimeters, analytical methods of evaporation estimation	4	2	1, 2
	Reservoir evaporation and methods for its reduction, Evapotranspiration, measurement of evapotranspiration	4	2	2, 5
	Evapotranspiration equations, Potential evapotranspiration over India and actual evapotranspiration, Interception, depression storage;	4	2	1, 2
	Infiltration, infiltration capacity, measurement of infiltration;	4	2	2, 5
Unit III	**Runoff**	**10**		
	Runoff volume, SCS-CN method of estimating runoff volume,	2	3	1, 3
	Flow duration curve, flow-mass curve, Hydrograph, factors affecting runoff hydrograph, Components of hydrograph,	2	3	1, 4
	Base flow separation, Effective rainfall, Unit hydrograph – applications and limitations,	3	3	1, 3
	Unit hydrograph from direct runoff hydrograph S-Hydrograph Surface water resources of India, environmental flows.	3	3	1, 3
Unit IV	**Ground water and well hydraulics**	9		
	Ground water hydrology, Occurrence, movement and distribution of ground water	2	4	1, 3
	Aquifers – Types, specific yield, permeability, Darcy's law	3	4	1, 3
	Well hydraulics: Steady state flow in wells, Equilibrium equations for confined and unconfined aquifers, aquifer tests, Well constants	4	4	1, 3
Total Contact Hours		**45**		

Guided Study

Unit No.	Unit Name	Required Contact Hours	CLO Addressed	Reference Used
1	Project	30	1-4	1-5

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

Course Designers

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

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

Remote Sensing and GIS

Course Code	CE 304	**Course Category**	Technical Elective (TE)	**L**	**T**	**P**	**C**
				3	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. 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 I	**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 II	**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 III	**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 IV	**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 V	**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

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High-Speed Railways, Airways, and Waterways Engineering

Course Code	CVE 305	**Course Category**	Core Course (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	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	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

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Course Introduction	2		
	Railway Engineering-1	**7**		
	Introduction – Railway Infrastructure, Rolling Stock, and Railway Operations	1	1	1,2
	Modern railway systems – Hi speed rails, Suburban, Metro, Tramway, Monorail, cable-propelled	1	1	1,2
	Permanent Way and its Components	1	1	1,2
	Components of Permanent Way	2	1	1,2
	Track Gauge, Alignment, Engineering Surveys	1	1	1,2
	Track Stresses and Creep of Rails	1	1	1,2
Unit 2	**Railway Engineering-2**	**12**		
	Track Geometric Design – Curves and Superelevation	2	2,3	1,2
	Points and Crossings	1	2	1,2
	Train Resistance and Tractive Power	2	2	1,2
	Level Crossing, Signalling and Interlocking	1	2	1,2
	Modern Welded Railway Track	1	1	1,2
	Track Maintenance and Track drainage	2	1	1,2
	Railway Tunnelling	1	1	1,2
Unit 3	**Airport Engineering-1**	**8**		
	Introduction – ICAO, FAA, Demand Forecast	1	1	3,4
	Aircraft characteristics and Airport System Planning	1	1	3,4
	Airport Master Plan and Site Selection	1	1	3,4
	Airport Capacity	1	1	3,4
	Airside Configuration and Geometric Design – Runway Orientation, Runway Length	2	2,3	3,4
	Taxiway Design and Aprons	1	1,3	3,4
	Airport Safety, Passenger Terminal, Air Cargo Facilities	1	1	3,4
Unit 4	**Airport Engineering-2**	**8**		
	Airport Drainage	1	1,2	3,4
	Airport Flexible Pavement Design	2	2,3	3,4
	Airport Rigid Pavement Design	2	2,3	3,4
	Aircraft & Pavement Classification Numbers	1	1	3,4
	Airport Access; Heliports and Vertiports	1	1	3,4
	Environmental Impacts of Airports	1	1	3,4
Unit 5	**Waterways Engineering**	**8**		
	Introduction - Layout of Port components	2	1, 4	5
	Functions - Classification of Ports	1	4	5
	Site selection	1	4	5
	Natural Phenomenon – Tides, Winds, Waves, Currents – Drift	1	4	5
	Navigational aids	1	4	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**		30	1-4	1-5

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

Recommended Resources

1. Railway Transportation Systems Design, Construction and Operation, by Christos N. Pyrgidis, CRC Press, 2nd edition
2. Railway Engineering, by Satish Chandra and M.M. Agarwal, Oxford Publishing, 2nd edition
3. Airport Engineering – Planning, Design and Development of 21st Century Airports, by Norman J Ashford, Wiley Publishers
4. Airport Planning and Design by S.K.Khanna and Arora; Nem Chand Bros.
5. Transportation Engineering: Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels by C Venkatramaiah; Orient Blackswan Private Limited.

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

Course Designers

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

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
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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 306	**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 I	**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 II	**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 III	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 IV	**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 V	**Disinfection**	**3**		
	Disinfection theory	1	3	1, 2
	Kinetics of Disinfection	1	3	1, 2
	Disinfection methods	1	3	1, 2
Unit VI	**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 VII	**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

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Building Information Modelling and Management

Course Code	CVE 307	**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. IM 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	-	-	-	-	-	-	-	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 I	**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 II	**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 III	**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 IV	**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

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%

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

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Design of Steel Structures

Course Code	CVE 308	**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 Life Long 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 I	**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 II	**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 III	**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 IV	**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 V	**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

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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%**