



# ST. JOSEPH'S

COLLEGE OF ENGINEERING  
AND TECHNOLOGY,  
- PALAI -

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## Cycle 1 - NAAC Accreditation 2023

### Criterion - 2

## 2.6 Student Performance and Learning Outcome

2.6.1 Programme Outcomes (POs) and Course Outcomes (COs) for all Programmes offered by the institution are stated and displayed on website and attainment of POs and COs are evaluated

*Submitted to:*



**National Assessment and Accreditation Council**

2.6.1 Programme Outcomes (POs) and Course Outcomes (COs) for all Programmes offered by the institution are stated and displayed on website and attainment of POs and COs are evaluated

**DEPARTMENT OF CIVIL ENGINEERING**

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## 1. CO–PO–PSO Mapping And Justification - Semester 1& 2

B. Tech Semester I & II (Civil)	
EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING: Part 1
<i>Student able to :</i>	
CO1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits.
CO2	Develop and solve models of magnetic circuits.
CO3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state.
<b><u>Department of Civil Engineering: PSO</u></b>	
PSO1	To practice civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
PSO2	To grow professionally in their careers through continued development of technical, management, communication skills and to achieve their professional aims ethically and with cultural competency.

B. Tech Semester I															
EST 130		BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING: Part 1													
COs/POs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K1	3	1	-	-	-	-	-	-	-	-	-	2	1	-
CO2	K2	3	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	K2	3	1	-	-	-	-	-	-	-	-	-	2	2	-
Average		3	1	-	-	-	-	-	-	-	-	-	2	2	-

### JUSTIFICATION FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO1	3	Completely compatible with CO1, so that complex engineering problems can be solved.
	PO2	1	Used the principles of basic electric circuits.
	PO12	2	Prepare the student to solve electrical based problems in their carrier.
	PSO1	1	Application in industries.
CO2	PO1	3	Completely compatible with CO2, so that complex engineering problems can be solved.
	PO2	1	Used the principles of magnetic circuits.
	PO12	2	Prepare the student to solve magnetism based problems in their carrier.
CO3	PO1	3	Completely compatible with CO3, so that electrical engineering problems in construction sites can be mitigated.
	PO2	1	Used the principles of ac circuits.
	PO12	2	Knowledge of single phase & three phase electrical systems help in industries.
	PSO1	2	Knowledge of single phase & three phase electrical systems help in industries.

<b>COURSE CODE: EST 100</b>	<b>COURSE NAME: ENGINEERING MECHANICS</b>	<b>SEMESTER: 2</b>
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**Prerequisite:** Nil

**Course Outcomes:** After completion of the course the student will be able to:

EST100.1	Recall principles and theorems related to rigid body mechanics
EST100.2	Identify and describe the components of system of forces acting on the rigid body.
EST100.3	Apply the conditions of equilibrium to various practical problems involving different force system
EST100.4	Choose appropriate theorems, principles or formulae to solve problems of mechanics
EST100.5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

	<b>PO</b> <b>1</b>	<b>PO</b> <b>2</b>	<b>PO</b> <b>3</b>	<b>PO</b> <b>4</b>	<b>PO</b> <b>5</b>	<b>PO</b> <b>6</b>	<b>PO</b> <b>7</b>	<b>PO</b> <b>8</b>	<b>PO</b> <b>9</b>	<b>PO</b> <b>10</b>	<b>PO</b> <b>11</b>	<b>PO</b> <b>12</b>	<b>PSO</b> <b>1</b>	<b>PSO</b> <b>2</b>
EST100.1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
EST100.2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
EST100.3	3	3	-	-	-	-	-	-	-	-	-	-	3	2
EST100.4	3	3	-	-	-	-	-	-	-	-	-	-	3	2
EST100.5	3	3	-	-	-	-	-	-	-	-	-	-	3	2
<b>EST100</b>	2.80	2.80	-	-	-	-	-	-	-	-	-	-	2.80	2.00

CO	PO	LEVEL	REMARKS
EST100.1	PO 1	2	The student will be able to solve complex engineering problems.
	PO 2	2	The student will be able to solve complex engineering problems.
	PSO 1	2	Students will be able to gain knowledge on basic problems and to work in the field of civil engineering.
	PSO 2	2	Students will be able to gain knowledge on analyzing problems which help them to grow professionally in their career.
EST100.2	PO 1	3	The knowledge of representing and solving problems in three dimensions.
	PO 2	3	The knowledge of representing and solving problems in three dimensions.
	PSO 1	3	Students will be able to gain knowledge on basic design methods.
	PSO 2	2	Students will be able to gain knowledge on structural members which enable them to work in their career.
EST100.3	PO 1	3	The idea of properties of different cross sections that an engineer has to encounter in professional life is an important engineering knowledge.
	PO 2	3	The idea of properties of different cross sections that an engineer has to encounter in professional life is an important engineering knowledge.
	PSO 1	3	Students will be able to gain knowledge which help them to work in civil engineering.
	PSO 2	2	Students will be able to gain knowledge which help in their career.

EST100.4	PO 1	3	Students will be able to apply appropriate theorems to solve the problems.
	PO 2	3	Students will be able to apply the principles or formulae for solving the problems
	PSO 1	3	Students will be able to gain knowledge which help in their career.
	PSO 2	2	Students will be able to gain knowledge in design methods.
EST100.5	PO 1	3	Students will be able to solve problems on rigid bodies.
	PO 2	3	Students will be able to solve problems by applying the properties of distributed areas and masses.
	PSO 1	3	Students will be able to gain knowledge which help in their career.
	PSO 2	2	Students will be able to gain knowledge in design methods.

<b>B. Tech Semester I &amp; II (Civil)</b>	
<b>ESL 130</b>	<b>ELECTRICAL &amp; ELECTRONICS WORKSHOP: PART 1</b>
<i>Student able to :</i>	
<b>CO1</b>	<b>Demonstrate safety measures against electric shocks</b>
<b>CO2</b>	<b>Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols</b>
<b>CO3</b>	<b>Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings</b>
<b><u>Department of Civil Engineering: PSO</u></b>	
<b>PSO1</b>	<b>To practice civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.</b>
<b>PSO2</b>	<b>To grow professionally in their careers through continued development of technical, management, communication skills and to achieve their professional aims ethically and with cultural competency.</b>

<b>B. Tech Semester I</b>															
<b>ESL 130</b>		<b>ELECTRICAL &amp; ELECTRONICS WORKSHOP:PART 1</b>													
<b>COs/POs</b>		<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	<b>K2</b>	-	-	-	-	-	3	-	-	-	-	-	1	1	2
<b>CO2</b>	<b>K2</b>	2	-	-	-	-	-	-	-	-	1	-	-	1	2
<b>CO3</b>	<b>K2</b>	2	-	-	1	-	1	-	1	2	2	-	2	1	2
<b>Average</b>		<b>1.33</b>	-	-	<b>.33</b>	-	<b>1.33</b>	-	<b>.33</b>	<b>.67</b>	<b>1</b>	-	<b>1</b>	<b>1</b>	<b>2</b>



### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO6	3	Completely compatible with CO1,because students are using contextual knowledge to safeguard one's life.
	PO12	1	It leads to lifelong learning for students
	PSO1	1	It prepares student in constructional knowledge for practicing engineering.
	PSO2	2	Students are growing professionally by practicing this.
CO2	PO1	2	Applying practical knowledge in engineering, so that complex engineering problems can be solved.
	PO10	1	Communicate effectively on complex engineering activities
	PSO1	1	It prepares student in constructional knowledge for practicing engineering.
	PSO2	2	Students are growing professionally by practicing this.
CO3	PO1	2	Applying practical knowledge in engineering, so that complex engineering problems can be solved.
	PO4	1	Helps students to conduct investigations of complex problems by practicing it by themselves.
	PO6	1	Students are getting responsibilities relevant to the professional engineering practice
	PO8	1	Appling ethical principles
	PO9	2	Functioning effectively as an individual, and as a member, leader in diverse teams etc.
	PO10	2	Communicate effectively on complex engineering activities
	PO12	2	It leads to lifelong learning for students
	PSO1	1	It prepares student in constructional knowledge for practicing engineering.
	PSO2	2	Students are growing professionally by practicing this.

<b>COURSE CODE: EST 110</b>	<b>COURSE NAME: ENGINEERING GRAPHICS</b>	<b>SEMESTER: 1/2</b>
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### Course Outcomes (CO)

After the successful completion of this course, students will able to:

No.	Course outcomes	Knowledge Level
<b>EST 110.1</b>	CO1: Draw the projection of points and lines located in different quadrants	<b>K3</b>
<b>EST 110.2</b>	CO2: Prepare Multiview orthographic projections of objects by visualizing them in different positions	<b>K3</b>
<b>EST 110.3</b>	CO3: Draw sectional views and develop surfaces of a given object	<b>K3</b>
<b>EST 110.4</b>	CO4: Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.	<b>K3</b>
<b>EST 110.5</b>	CO5: Convert 3D views to orthographic views	<b>K3</b>
<b>EST 110.6</b>	CO6: Obtain Multiview projections and solid models of objects using CAD tools	<b>K3</b>

### **CO – PO Matrix**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>EST 110.1</b>	3	-	-	-	-	-	-	-	-	-	-	-	2	-
<b>EST 110.2</b>	3	-	-	-	-	-	-	-	-	-	-	-	3	-
<b>EST 110.3</b>	3	1	-	-	-	-	-	-	-	-	-	-	3	-
<b>EST 110.4</b>	3	-	-	-	-	-	-	-	-	1	-	-	2	-
<b>EST 110.5</b>	3	-	-	-	-	-	-	-	-	2	-	-	3	-
<b>EST 110.6</b>	3	-	-	-	3	-	-	-	-	3	-	-	3	3
<b>EST 110</b>	3	1	-	-	3	-	-	-	-	2	-	-	2.66	3

## JUSTIFICATIONS FOR CO-PO MAPPING

Mapping	Mapping Level (3/2/1)	Justifications
CO1 - PO1	3	Graduates are able to apply Engineering fundamentals related to 2D orthographic projection of lines to develop Engineering drawings related to complex design problems.
CO2-PO1	3	Graduates are able to apply Engineering fundamentals related to 2D orthographic projection of solids to develop Engineering drawings related to complex design problems.
CO3- PO1	3	Graduates will be able to apply the concept of section to describe the concealed features of parts designed as a part of solution to Engineering problems.
CO3 –PO2	1	To an extent graduates will be able to analysis and infer 3 Dimensional Models related to complex problems.
CO4 – PO1	3	Graduates will be able to apply knowledge related to isometric projection to develop 3 Dimensional models as a part of solution related to design problems.
CO4 – PO10	1	To an extent graduates will be able to convey solutions for complex engineering problems in a better way using 3 dimensional models developed using the concept of perspective projection and isometric projection.
CO5 – PO1	3	Graduates will be able to convert 3 Dimensional models to 2 dimensional orthographic views for simplified solutions for design problems
CO5 – PO10	2	Graduates will be able to use simplified orthogonal views to describe delicate and complex features of a 3-Dimensional models.
CO6 - PO1	3	Usage of CAD software package will help graduates apply the Engineering knowledge related to orthographic projection to 2 Dimensional drawing sand 3 Dimensional models as a part of solutions to complex problems.
CO6-PO5	3	Use of Cad Software helps graduate to become familiar with the usage of modern IT tools for modeling solutions of complex Engineering Problems.
CO6-PO10	3	The exploded views of 3D models developed using a Cad software helps graduate to effectively convey order of assembly of different parts.
CO1-PSO1	2	concept of projection of points and lines are the foundation for developing 3D models as a part of solutions for problems in the different areas of Mechanical engineering.
CO2-PSO1	3	The concept of 2D orthographic projection of solids help in developing engineering drawings related to complex design problems
CO3-PSO1	3	concept of section helps to describe the concealed features of designed components.
CO4-PSO1	2	The concept of isometric projection will help graduates to develop 3 Dimensional models as a part of solution related to design problems.
CO5-PSO1	3	Graduates will be able to convert 3 Dimensional models to 2 dimensional orthographic views for simplified solutions for design problems.
CO6-PSO1	3	Usage of CAD software package will help graduates develop optimum solutions for design problems.
CO6-PSO2	3	Use of Cad Software helps graduate to become familiar with the usage of modern IT tools for modeling solutions of complex Engineering Problems

<b>COURSE CODE: EST 120</b>	<b>COURSE NAME: BASICS OF CIVIL &amp; MECHANICAL ENGINEERING</b>	<b>SEMESTER: 1</b>
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**Pre-requisite:** NIL

**Course Outcome:** After the successful completion of this course, the student will be able to:

EST120.1	Recall the role of civil engineer in society and to relate the various disciplines of civil engineering
EST 120.2	Explain different types of buildings, building components, building materials and building construction
EST 120.3	Describe the importance, objectives and principles of surveying
EST 120.4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
EST 120.5	Discuss the materials, energy systems, water management and environment for green buildings

<b>COURSE CODE: EST 120</b>		<b>COURSE NAME: BASICS OF CIVIL &amp; MECHANICAL ENGINEERING</b>										<b>SEMESTER: 1</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
EST120.1	3	-	-	-	-	3	2	2	-	-	-	-	1	1
EST120.2	3	2	-	1	3	-	-	3	-	-	-	-	1	1
EST120.3	3	2	-	-	3	-	-	-	2	-	-	-	1	1
EST120.4	3	2	-	-	3	-	-	-	2	-	-	-	2	1
EST120.5	3	2	-	-	3	2	3	-	2	-	-	-	2	1
<b>EST120</b>	<b>3</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>3</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1.4</b>	<b>1</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
EST120. 1	PO1	3	Students will be able to know the role of a civil engineer in a society and understand the various fields of civil engineering such as structural, transportation, water resources, environmental engineering
	PO6	3	Students will be able to apply their knowledge to the society with respect to certain standards
	PO7	2	Students will be able to consider environmental impacts for a sustainable development
	PO8	2	Students can apply professional ethics and standards in the field of civil engineering
	PSO1	1	Students will be able to create a sustainable environment in all sectors of civil engineering which is fruitful to our society within industry, government and private practice
	PSO2	1	Students will be able to grow professionally with good technical skills, communication skills by keeping the professional ethics
EST120. 2	PO1	3	Students will be able to know the various types of buildings, components, materials and construction methods
	PO2	2	Students will be able to analyse engineering problems related to buildings, components, materials and construction methods
	PO4	1	Students will be able to carry research/ field studies, experimental analysis on various types of buildings and its components
	PO5	3	Students will be able to apply appropriate techniques, modern technologies with the support of IT in designing, planning and implementation of a building project
	PO8	3	Students can apply professional ethics and mandatory standards in all phases of a civil engineering project to ensure the compliance on quality
	PSO1	1	Students will be able to create a sustainable environment in all sectors of civil engineering by selecting the suitable building materials, nature friendly designs etc.
	PSO2	1	Students will be able to think in a professional manner while implementing a building project

EST120. 3	PO1	3	Students will be able to know the various importance and objectives of surveying for a civil engineering project
	PO2	2	Students will be able to do preliminary survey in prior to the implementation of a civil engineering project
	PO5	3	Students will be able to apply appropriate techniques (Total station, Dumpy level), modern technologies with the support of IT, GIS, GPS platforms for surveying
	PO9	2	Students can adopt a participatory approach with good teamwork for effective surveying to minimize the errors
	PSO1	1	Students will be able to do surveying for civil engineering projects within industry, government and private practice, working towards a sustainable solution
	PSO2	1	Students will be able to think in a professional manner while doing surveying
EST120. 4	PO1	3	Students will be able to apply the basic engineering knowledge to select infrastructure services, HVAC, elevators, escalators and ramps
	PO2	2	Students will be able to analyse the need, location and implementation of infrastructure services, HVAC, elevators, escalators and ramps in a building
	PO5	3	Students will be able to apply appropriate techniques, modern technologies with the support of IT for all indoor and outdoor infrastructure services
	PO9	2	Students can adopt a participatory approach for the planning and selection of basic infrastructure services
	PSO1	2	Students will be able to practice civil engineering within industry, government and private practice with various types of infrastructure services
	PSO2	1	Students will be able to grow professionally with good knowledge in implementing all types of indoor and outdoor infrastructure services
EST120. 5	PO1	3	Students will be able to apply the basic engineering knowledge to design a green building by considering social, environmental aspects
	PO2	2	Students will be able to analyse the importance of green building concept to conserve energy, water etc.
	PO5	3	Students will be able to apply appropriate techniques, modern technologies with the support of IT for energy and water management aspects of green building

	PO6	2	Students will be able to contribute the concept of green building, energy conservation, water conservation and apply their knowledge to the society with respect to certain standards
	PO7	3	Students will be able to consider environmental benefits for a sustainable development with respect to green building concept
	PO9	2	Students can adopt a participatory approach to give awareness on green buildings, energy conservation and water management practices
	PSO1	2	Students will be able to practice civil engineering within industry, government and private practice by applying green building concept
	PSO2	1	Students will be able to grow professionally with good knowledge in the field of green buildings

<b>COURSE CODE:</b> CYL 120	<b>COURSE NAME: ENGINEERING CHEMISTRY</b> LAB	<b>SEMESTER: 1/2</b>
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Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

**Course outcomes:** After the completion of the course the students will be able to:

<b>CO 1</b>	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses.
<b>CO 2</b>	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
<b>CO 3</b>	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds.
<b>CO 4</b>	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis.
<b>CO 5</b>	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
<b>CO 6</b>	Function as a member of team, communicate effectively and engage in future learning. Also understand how chemistry addresses social, economical, and environmental problems and why it is an integral part of curriculum.

#### Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO2
<b>CO 1</b>	3	-	-	-	2	-	-	-	-	-	-	3	1	-
<b>CO 2</b>	3	-	-	-	3	-	-	-	-	-	-	3	1	1
<b>CO 3</b>	3	-	-	-	3	-	-	-	-	-	-	3	1	-
<b>CO 4</b>	3	-	-	-	3	-	-	-	-	-	-	3	1	1
<b>CO 5</b>	3	-	-	-	1	-	-	-	-	-	-	3	-	1
<b>CO 6</b>	3	-	-	-	1	-	-	-	-	-	-	3	1	1
<b>Avg.</b>	3	-	-	-	2	-	-	-	-	-	-	3	1	1



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO 1	PO 1	3	Basic knowledge on quantitative chemical analysis is very useful for the successful conduct of technical works related to engineering chemistry
	PO 5	2	A deep understanding of quantitative chemistry will help the engineering graduate to address the quantification of chemical errors in diverse engineering fields
	PO 12	3	Student will be able to apply the basic quantitative chemical analysis techniques in various studies.
	PSO1	1	For the immediate identification and calculation of chemical errors elementary understanding in quantitative chemical analysis is very needful
CO 2	PO 1	3	Understanding the basic principle of chromatography techniques can be used to solve problems related to these fields in engineering stream
	PO 2	3	Basic knowledge on chromatography and organic polymers help to design and select resources for various engineering activities
	PO 12	3	Research based on chromatography and synthesis of organic polymers helps to design and reinforce the properties of engineering polymers
	PSO1	1	The chromatographic techniques can be used as a device for the forecast, design and enactment of modern engineering materials
	PSO2	1	To grow professionally in their careers via the use of spectroscopic techniques for the prediction and design of modern instruments
CO 3	PO 1	3	Knowledge on spectrochemical techniques such as IR and NMR help to find solutions to engineering problems like structure analysis of materials
	PO 2	3	Understanding the basic concepts of spectroscopic techniques can be utilized for the analysis of the structural identification of the materials of importance.
	PO 12	3	Information acquired on the structural identification of compounds can be used to perform studies to solve complex problems
	PSO1	1	The spectroscopic techniques can be used as a tool for the prediction, structural elucidation, designing and synthesizing of modern engineering materials
CO 4	PO 1	3	To study the basic ideas of instrumental techniques for chemical analysis help to bridge the concept of theory of chemistry to practical applications in engineering fields
	PO 2	3	Students will be able to solve engineering problems related to instrumentational chemistry
	PO12	3	Gathered Information on the instrumental analysis in chemistry can be utilized to conduct studies to solve problems in modern engineering materials
	PSO1	1	Gathered information on the instrumental analysis in chemistry can be utilized to conduct studies to solve problems in modern engineering materials
	PSO2	1	Characterization methods via instruments based on chemical knowledge is needful for resolving issues in modern materials analysis
CO 5	PO 1	3	With the basic information in chemical reactions, reaction conditions and safety of chemicals students can successfully design and conduct a chemical reaction of specific importance
	PO 2	1	By using the knowledge on chemical reagents and solvents efficacious design of an object or process in engineering field if possible.
	PO 12	3	Can Solve chemical engineering problems by the acquaintance of theories of basic chemical reactions
	PSO2	1	Deep understanding in experimental procedures in chemistry helps to bridge the basic science knowledge with practical applications

CO6	PO1	3	Doing lab experiments as a member of team help the students to communicate effectively and engage actively in future learning
	PO2	1	Team works during lab experiments facilitates students sharing attitude and helping mentality
	PO 12	3	With the help of basic knowledge in experiments on water chemistry can effectively use to solve problems related to waste water management and environmental pollution
	PSO1	1	By utilizing the principles of chemical experiments and safety students will be able to design novel plants of specific importance
	PSO2	1	Knowledge on various chemical reactions and methods students can effectively solve issues of societal, health and environmental significance

<b>COURSE CODE:</b> ESL 120	<b>COURSE NAME:</b> CIVIL WORKSHOP	<b>SEMESTER: 1/2</b>
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**Pre-requisite:**

**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>ESL120.1</b>	Name different devices and tools used for civil engineering measurements
<b>ESL120.2</b>	Explain the use of various tools and devices for various field measurements
<b>ESL120.3</b>	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
<b>ESL120.4</b>	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
<b>ESL120.5</b>	Compare different techniques and devices used in civil engineering measurements

<b>COURSE CODE:</b> ESL120			<b>COURSE NAME:</b> CIVIL WORKSHOP									<b>SEMESTER: 1/2</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>ESL120.1</b>	1	-	-	-	1	1	-	-	2	2	-	-	2	1
<b>ESL120.2</b>	1	-	-	-	1	1	-	-	2	2	-	-	2	1
<b>ESL120.3</b>	1	-	-	-	1	1	-	2	2	2	-	-	2	2
<b>ESL120.4</b>	1	-	-	-	1	1	-	2	2	2	-	-	2	2
<b>ESL120.5</b>	1	-	-	-	1	1	-	-	2	2	-	-	2	2
<b>ESL120</b>	<b>1</b>				<b>1</b>	<b>1</b>		<b>2</b>	<b>2</b>	<b>2</b>			<b>2</b>	<b>1.6</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
ESL120.1	PO1	1	Enumerate the various tools and devices used in Civil Engineering measurements
	PO5	1	Understand the advanced surveying equipment used in Civil Engineering
	PO6	1	Define the various civil engineering tools and equipment used in real-life construction practices.
	PO9	2	Work effectively as individual or team while handling the different Civil Engineering tools and measuring devices
	PO10	2	Illustrate the measurements and readings obtained from the Civil Engineering equipment for the study of construction site and for further site plan.
	PSO1	2	Use the acquired knowledge on the various civil engineering equipment in Civil engineering practices.
	PSO2	1	Apply the knowledge in Civil Engineering Field practices to grow in profession.
ESL120.2	PO1	1	Enumerate the various tools and devices used in Civil Engineering measurements
	PO5	1	Understand the advanced surveying equipment used in Civil Engineering
	PO6	1	Apply the comprehension of civil engineering tools and equipment in real-life construction practices.
	PO9	2	Work effectively as individual or team while handling the different Civil Engineering tools and measuring devices
	PO10	2	Illustrate the measurements and readings obtained from the Civil Engineering equipment for the study of construction site and for further site plan.
	PSO1	2	Use the acquired knowledge on the various civil engineering equipment in Civil engineering practices.
	PSO2	1	Apply the knowledge in Civil Engineering Field practices to grow in profession.
ESL120.3	PO1	1	Understand the steps involved in various Civil Engineering practices
	PO5	1	Operate various civil engineering tools used in basic civil engineering activities like setting out.

	PO6	1	Apply the knowledge of basic civil engineering in real-life construction practices
	PO8	2	Apply ethical principles in the Construction field activities by following the building construction norms and regulations.
	PO9	2	Work effectively as individual or team while carrying out basic civil engineering experiments
	PO10	2	Illustrate the measurements and readings obtained from the Civil Engineering equipment for the study of construction site and for further site plan.
	PSO1	2	Use the acquired knowledge on the various civil engineering activities carried out in the field in Construction practices.
	PSO2	2	Apply the knowledge in Civil Engineering Field practices to grow in profession.
ESL120.4	PO1	1	Understand the various materials and methods used in Construction practices
	PO5	1	Apply the most appropriate construction practices and desired tools for basic civil engineering activities.
	PO6	1	Apply the comprehension of civil engineering tools and methods in real-life construction practices.
	PO8	2	Apply ethical principles in the Construction field activities by following the building construction norms and regulations.
	PO9	2	Work effectively as individual or team while handling the different Civil Engineering tools and measuring devices
	PO10	2	Illustrate the measurements and readings obtained from the Civil Engineering equipment for the study of construction site and for further site plan.
	PSO1	2	Use the acquired knowledge on the various civil engineering equipment in Civil engineering practices.
	PSO2	2	Apply the knowledge in Civil Engineering Field practices to grow in profession.
ESL 120.5	PO1	1	Understand the various materials and methods used in Construction practices

	PO5	1	Compare the various construction practices and tools used in basic civil engineering activities.
	PO6	1	Apply the best civil engineering tools and methods in real-life construction practices.
	PO9	2	Work effectively as individual or team while handling the different Civil Engineering tools and measuring devices
	PO10	2	Illustrate the measurements and readings obtained from the Civil Engineering equipment for the study of construction site and for further site plan.
	PSO1	2	Use the acquired knowledge on the various civil engineering equipment in Civil engineering practices.
	PSO2	2	Apply the knowledge in Civil Engineering Field practices to grow in profession.

<b>COURSE CODE:</b> EST102	<b>COURSE NAME:</b> PROGRAMMING IN C	<b>SEMESTER: 2</b>
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**Pre-requisite:**

**Course Outcome:** After the successful completion of this course, the student will be able to:

EST102.1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
EST102.2	Develop readable C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators
EST102.3	Write readable C programs with arrays, structure or union for storing the data to be processed
EST102.4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
EST102.5	Write readable C programs which use pointers for array processing and parameter passing
EST102.6	Develop readable C programs with files for reading input and storing output

<b>COURSE CODE:</b> EST102		<b>COURSE NAME:</b> PROGRAMMING IN C										<b>SEMESTER: 2</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
EST102.1	3	3	3	2	-	1	-	-	-	1	1	2	2	1
EST102.2	2	2	2	1	1	-	-	-	-	1	-	2	2	1
EST102.3	2	2	2	1	2	-	-	-	-	1	-	2	2	1
EST102.4	3	3	3	2	3	-	-	-	-	1	1	2	2	1
EST102.5	3	2	-	-	2	-	-	-	-	1	-	2	2	1
EST102.6	3	3	-	-	3	-	-	-	-	3	-	3	2	1
<b>EST102</b>	<b>2.67</b>	<b>2.5</b>	<b>2.5</b>	<b>1.5</b>	<b>2.2</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1.33</b>	<b>1</b>	<b>2.17</b>	<b>2</b>	<b>1</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
EST102.1	PO1	3	Students will study the fundamental of programming by analyzing a problem and develop an algorithm/ flowchart to find its solution
	PO2	3	The students will be able to analyze a given complex problem since they have to understand the problem in depth to write an algorithm/ flowchart
	PO3	3	The students will be able to develop and design solution to complex problems and express the solution they have designed using flowchart/ algorithm/ pseudocode.
	PO4	2	The students will be able to use the skills of algorithm design in design of experiments and interpretation of data
	PO6	1	The students will be able to write algorithm / draw flowchart for a solution catering to the needs of the society
	PO10	1	The students will be able to communicate the idea of their solution effectively in a step by step manner using algorithm or pictorially by using a flowchart
	PO11	1	The students will be able to write algorithm / draw flowchart for a solution catering to the needs of the society
	PO12	2	The students will be able to use their algorithm writing / flowchart drawing skills whenever they need to design solutions to complex real life problems
	PSO1	2	Students will be able to master the CS specific skill of algorithm development.
	PSO2	1	Any solution is first solved by writing a step by step procedure of algorithm. The effectiveness of the algorithm directly affects the programs written from them. So this enhances the programming skills.
EST102.2	PO1	2	The concepts of branching, looping and operators are fundamental to our engineering specialization of problem solving
	PO2	2	The concepts of branching, looping and operators are needed in analyzing complex engineering problems.
	PO3	2	The concepts of branching, looping and operators are inevitable when designing solutions to complex problems.
	PO4	1	The concepts of branching, looping and operators are used in the design of experiments and data interpretation.



	PO5	1	The concepts of branching, looping and operators are useful in usage of different tools since every tool makes use of these fundamentals.
	PO10	1	The concepts of branching, looping and operators are used in the design of solutions which is efficient for communicating the design to others
	PO12	2	The concepts of branching, looping and operators are used in all areas of research as well as industry
	PSO1	2	The concepts of branching, looping and operators are part of the knowledge acquired as part of CS specific skill of programming
	PSO2	1	The concepts of branching, looping and operators are used for enhancing the programming efficiency
EST102.3	PO1	2	The concepts of arrays and structure for data storage are fundamental to our engineering specialization of problem solving
	PO2	2	The concepts of arrays and structure for data storage are needed in analyzing complex engineering problems
	PO3	2	The concepts of arrays and structure for data storage are inevitable when designing solutions to complex problems
	PO4	1	The concepts of arrays and structure for data storage are used in the design of experiments and data interpretation
	PO5	2	The concepts of arrays and structure for data storage are useful in usage of different tools since every tool makes use of these fundamentals.
	PO10	1	The concepts of arrays and structure for data storage are used in the design of solutions which is efficient for communicating the design to others.
	PO12	2	The concepts of arrays and structure for data storage are used in all areas of research as well as industry.
	PSO1	2	The concepts of arrays and structure for data storage are part of the knowledge acquired as part of CS specific skill of programming
PSO2	1	The concepts of arrays and structure for data storage are used for enhancing the programming efficiency by using suitable data structure depending on the applications.	
EST102.4	PO1	3	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are fundamental to our engineering specialization of problem solving.

	PO2	3	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are needed in analyzing complex engineering problems.
	PO3	3	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are inevitable when designing solutions to complex problems
	PO4	2	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are used in the design of experiments and data interpretation
	PO5	3	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are useful in usage of different tools since every tool makes use of these fundamentals
	PO10	1	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are used in the design of solutions which is efficient for communicating the design to others.
	PO11	1	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are fundamental to any application related to engineering
	PO12	2	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are used in all areas of research as well as industry.
	PSO1	2	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are part of the knowledge acquired as part of CS specific skill of programming
	PSO2	1	The concepts of dividing the complex problem into modules forming multi function programs and the concept of recursive functions are fundamental to our engineering specialization of problem solving.
EST102.5	PO1	3	The concepts of pointers for array processing and parameter passing are fundamental to our engineering specialization
	PO2	2	The concepts of pointers for array processing and parameter passing are needed in analyzing complex engineering problems

	PO5	2	The concepts of pointers for array processing and parameter passing are useful in modern tool usage and helps in modeling and predicting complex engineering problems
	PO10	1	The concepts of pointers for array processing and parameter passing are useful in giving more clear instructions to the user and thereby enabling effective communication
	PO12	2	The concepts of pointers for array processing and parameter passing are important in all areas of research and also help in adapting to technological changes
	PSO1	2	The concepts of pointers for array processing and parameter passing are fundamental to CS and belong to the fundamental programming skill.
	PSO2	1	The concepts of pointers for array processing and parameter passing helps to write readable programs in an efficient manner and thereby sharpening the programming and software development skills by doing projects in C
EST102.6	PO1	3	The concept of files for data input and output are fundamental to CS and are very helpful in manipulating large amount of data input and output of complex problems.
	PO2	3	The concept of files for data input and output are helpful in analyzing problems and reviewing the output obtained after doing complex programs in C.
	PO5	3	The concept of files for data input and output will be very useful when we use modern tools for data analysis and prediction
	PO10	3	The concept of files for data input and output helps to store the results in an organized manner so that it can be effectively communicated to outside world
	PO12	3	The concept of files for data input and output is an inevitable concept that can be used with almost every real life engineering problem and this helps to manipulate data effectively
	PSO1	2	The concept of files for data input and output are fundamental to CS specific skills.
	PSO2	1	The concept of files for data input and output helps in programming and software development skills as they help to organize different types of data in an effective manner.

<b>COURSE CODE:</b> <b>EST 100</b>	<b>COURSE NAME: ENGINEERING CHEMISTRY</b>	<b>SEMESTER: 1/2</b>
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Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

**Course outcomes:** After the completion of the course the students will be able to:

<b>CO 1</b>	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
<b>CO 2</b>	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
<b>CO 3</b>	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterization of nanomaterials.
<b>CO 4</b>	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
<b>CO 5</b>	Study various types of water treatment methods to develop skills for treating wastewater.

#### Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO 1</b>	1	2	1	-	-	-	-	-	-	-	-	-	-	-
<b>CO 2</b>	1	1	-	1	2	-	-	-	-	-	-	-	1	-
<b>CO 3</b>	1	1	-	1	2	-	-	-	-	-	-	-	1	1
<b>CO 4</b>	2	1	-	-	-	-	-	-	-	-	-	-	1	1
<b>CO 5</b>	1	-	-	1	-	-	3	-	-	-	-	-	1	-
<b>Avg</b>	1.2	1.25	1	1	2	-	3	-	-	-	-	-	1	1

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO 1	PO 1	1	Information gathered on electrochemistry and corrosion can be used to elucidate various Engineering problems
	PO 2	2	Understanding the basic principles of electrochemistry and corrosion helps to assess recent research literature and also to scrutinize the issues related to the area of electrochemical engineering.
	PO 3	1	Knowledge on Electrochemical basis of corrosion and its prevention method can be utilized in solving problems related to material corrosion and also help to design various energy storage systems.
CO 2	PO 1	1	Knowledge on spectrochemical techniques helps to find solution to engineering problems like structure analysis of materials
	PO 2	1	Understanding the basic concepts of spectroscopic techniques can be utilized for the analysis of the structural identification of the materials of importance
	PO 4	1	Information acquired on structural identification of compounds can be used to perform studies to solve complex problems
	PO 5	2	Spectroscopy can use as a modern tool to for the prediction and design of materials having applications in the field of modern engineering materials
	PSO1	1	The spectroscopic techniques can be used as a method for the prediction, structural elucidation, designing and synthesizing of modern engineering materials
CO 3	PO 1	1	Understanding the basic principle of chromatography and thermal characterization techniques can be used to solve problems related to these fields in engineering stream
	PO 2	1	Analytical techniques help to design and select resources for various engineering activities.
	PO 4	1	Research based on thermo analytical technique such as TGA, DTA and SEM etc. helps to design and reinforce the properties of engineering polymers
	PO 5	2	Knowledge on update analytical techniques provide an effective route for the prediction and implementation of complex engineering accomplishments
	PSO1	1	The analytical techniques can be used as device for the forecast, design and enactment of modern engineering materials
	PSO2	1	Information on basic theories of chromatography and thermal analysis utilized for determining material properties, transformations, characterizations and finally designing of them

CO 4	PO 1	2	Solve engineering problems by apply knowledge on engineering materials like polymers and its stereochemistry.
	PO 2	1	Study of engineering materials used to identify materials for engineering constructions and modeling.
	PSO1	1	By learning stereochemistry and polymers the students will be able to get practice to work in medicinal industry
	PSO2	1	In construction field knowledge on advanced polymers are useful
CO 5	PO 1	1	Knowledge on water treatment methods can be used to solve environmental related problems
	PO 4	1	By utilizing the principles of water treatment methods students will be able to design novel water treatment plants.
	PO 7	3	Knowledge on various water treatment methods can be utilized for the sustainable development based on societal, health and environmental context.
	PSO1	1	Knowledge on various water treatment methods can be used for waste water treatment as a sustainable solution for environmental protection.

<b>COURSE CODE: HUN 102</b>	<b>COURSE NAME: PROFESSIONAL COMMUNICATION</b>	<b>SEMESTER: 1/2</b>
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CO1	Develop vocabulary and language skills relevant to engineering as a profession(k3)
CO2	Analyze, interpret and effectively summarize a variety of textual content(k3)
CO3	Create effective technical presentations(k2)
CO4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus(k5)
CO5	Identify drawbacks in listening patterns and apply listening techniques for specific needs(k3)
CO6	Create professional and technical documents that are clear and adhering to all the necessary conventions(k6)

### **CO-PO-PSO Mapping**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO1 0</b>	<b>PO1 1</b>	<b>PO1 2</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO 1</b>	-	-	-	-	-	2	-	-	2	2	1	3		
<b>CO 2</b>	1	1	-	-	-	-	-	-	3	-	-	3		
<b>CO 3</b>	-	-	-	-	-	1	-	-	1	3	1	-		
<b>CO 4</b>	1	2	-	-	-	-	-	-	-	2	1	1		
<b>CO 5</b>	-	3	2	1	-	-	-	-	-	1	-	1		
<b>CO 6</b>	-	-	-	-	-	1	-	-	2	3	-	1		

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO6	2	Graduate should be able to understand the textual content given to assess societal, health and legal issues
	PO9	2	Graduate need to effectively communicate as a member or leader of a team to constructively work towards providing solution for engineering problems
	PO10	2	Graduate need to effectively communicate using language effectively to comprehend and write effective report
	PO11	1	Graduate needs to communicate effectively knowledge and understanding of engineering principles in order to manage projects
	PO12	3	Graduate need to develop vocabulary and language skills relevant to engineering as a professional to engage in life long learning
CO2	PO1	1	Graduate will be able to apply different reading styles to analyze , interpret & effectively summarize a variety of textual content
	PO2	1	Graduate need to develop reading skills in order to develop sustained conclusions to complex engineering problems
	PO9	3	Graduate need to effectively summarize ,analyses and interpret the textual content in order to function effectively in a team
	PO11		Graduate should able to utilize various reading skills to demonstrate knowledge and understanding of engineering principles
	PO12	3	Graduate need to analyze , interpret & effectively summarize a variety of textual content to effectively engage in life long learning
CO3	PO6	1	Graduate should be able to create technical presentation based on contextual knowledge to convey societal, health and legal issues
	PO9	1	Graduate need to effectively create technical presentation to convey ideas and solutions in a team
	PO10	3	Graduate need to effectively create technical presentation to convey ideas
	PO11	1	Graduate need to effectively create technical presentation to demonstrate their acquired knowledge through effective presentation
CO4	PO1	1	Graduate need to effectively conduct healthy group discussion to analyses ,understand and learn various methodologies towards efficient electrical system design
	PO2	2	Graduate need to actively involve in group discussions to able to arrive at optimal conclusion towards development of electrical system



	PO10	2	Graduate need to discuss technical solution related to complex engineering topics in a group setting and arrive at generalization /consensus
	PO11	1	Graduates need to be able to communicate in a group for effective project management
	PO12	1	Graduate need to discuss technical solution related to complex engineering problems to advance in research and development
CO5	PO2	3	Graduate need to apply proper listening skills and analyze them to constructively contribute to sustained conclusions to complex engineering problems
	PO3	2	Graduate need to implement appropriate listening skills to understand the specified needs to find solution for complex engineering problems
	PO4	1	Graduate need to apply listening skills for synthesis of information to provide valid conclusion
	PO10	1	Graduates need to listen effectively to arrive at proper reports on activities being conducted
	PO12	1	Graduates need to listen effectively to pursue life long learning
CO6	PO6	1	Graduate need to create technical document that convey the textual knowledge associated to an engineering system
	PO9	2	Graduates need to create professional & technical document that will help the team or individual work effectively
	PO10	3	Graduates need to create professional & technical document to communicate ideas and projects effectively
	PO12	1	Graduates need to create professional documents to pursue life long learning

<b>COURSE CODE:</b> MAT 102	<b>COURSE NAME: VECTOR CALCULUS, DIFFERENTIAL EQUATION AND TRANSFORMS</b>	<b>SEMESTER: 1/2</b>
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**Prerequisite: Calculus of single and multi variable functions**

**Course Outcomes:** After completion of the course the student will be able to:

<b>CO 1</b>	Compute the derivatives and line integrals of vector functions and learn their applications
<b>CO 2</b>	Evaluate surface and volume integrals and learn their inter relations and application
<b>CO 3</b>	Solve homogeneous and non homogeneous linear differential equation with constant coefficient
<b>CO 4</b>	Compute Laplace transform and apply them to solve ODEs arising in engineering
<b>CO 5</b>	Determine the Fourier transform of functions and apply them to solve problems arising in engineering

**Mapping of course outcomes with program outcomes (Minimum requirement)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-
<b>CO 2</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-
<b>CO 3</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-
<b>CO 4</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-
<b>CO 5</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO 1	PO 1	3	By understanding the modern theory of vector calculus students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding the vector calculus students will be able to identify, formulate and analyse simple engineering problems.
	PO 3	3	By understanding the differential equation students will be able to design solutions for very simple engineering problems.
	PO4	3	By understanding the vector calculus students will be able to use research knowledge for the analysis and interpretation of data.
	PO5	2	By understanding the vector calculus students will be able to use modern tools
	PO6	1	By understanding derivatives students will be able to communicate on complex engineering activities with the engineering community.
	PO9	1	By understanding derivatives students will be able to engage in continuous learning.
	PO10	2	By understanding vector calculus and derivatives the student will be able to communicate effectively on complex engineering activities with the engineering community.
	PO12	2	By understanding derivatives the student will be able to engage in continuous learning.
	PSO 1		Vector Calculus helps students to deal with practical problems involving flux and work done by a vector field.
CO 2	PO 1	3	By understanding surface and volume integrals the students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding the surface and volume integrals the students will be able to apply identify, formulate and analyze simple engineering problems.
	PO3	3	By understanding the surface and volume integrals students will be able to design solutions for very simple engineering problems.

	PO4	3	By understanding the volume and surface integrals students will be able to use research knowledge for the analysis and interpretation of data.
	PO5	2	By understanding the volume and surface integrals students will be able to use modern tools
	PO6	1	By understanding the volume and surface integrals students will be able to communicate on complex engineering activities with the engineering community and with the society.
	PO9	1	By understanding the volume and surface integrals students will be able to engage in continuous learning.
	PO10	2	By understanding the surface and volume integrals and learn their inter relations and application the student will be able to communicate effectively on complex engineering activities with the engineering community.
	PO12	2	By understanding the surface and volume integrals the students will be able to engage in continuous learning
	PSO 1		Multiple integrals and evaluation helps to solve day to day life problems involving area and mass .
CO 3	PO 1	3	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to apply the knowledge to find solution of complex engineering problems.
	PO 2	3	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to identify, analyze and make conclusions of simple engineering problems.
	PO 3	3	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to design solutions for simple engineering problems.
	PO 4	3	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to conduct investigations of complex problems and provide valid conclusions.
	PO 5	2	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to use modern tools like R for the implementation of concepts.

PO 6	1	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to communicate effectively on complex engineering activities with the engineering community.
PO9	1	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to engage in continuous learning.
PO10	2	By understanding homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to communicate effectively about the numerical methods to the engineering community.
PO12	2	By understanding the homogeneous and non homogeneous linear differential equation with constant coefficient the student will be able to engage in continuous learning.
PSO 1		Differential equations are useful to deal with problems involving deflection of beams, propagation of signals.

CO 4	PO 1	3	By understanding the Laplace transform the student will be able to apply the knowledge on complex engineering problems.
	PO 2	3	By understanding the Laplace transform the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	3	By understanding the Laplace transform the student will be able to design solutions for simple engineering problems.
	PO4	3	By understanding the Laplace transform the student will be able to use research knowledge for the analysis and interpretation of data.
	PO 5	2	By understanding the Laplace transform, the student will be able to use modern tools like Matlab, Mathematica, Maple etc. for the implementation of concepts.
	PO 6	1	By understanding the Laplace transform the student will be able to communicate effectively about the numerical methods to the engineering community.
	PO 9	1	By understanding the Laplace transform the student will be able to engagae in continuous learning.
	PO10	2	By understanding the Laplace transform the students will be able to communicate effectively on complex engineering activities with the engineering community.
	PO12	2	By understanding the Laplace transform the students will be able to the student will be able to engagae in continuous learning.
	PSO 1		Laplace transform helps to solve complicated differential equation involving special functions like dirac delta.
CO 5	PO 1	3	By understanding the Fourier transform and functions the students will be able to apply the knowledge on complex engineering problems..
	PO 2	3	By understanding the Fourier transform and functions the students will be able to the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	3	By understanding the Fourier transform and functions the students will be able to the student will be able to design solutions for simple engineering problems.
	PO 4	3	By understanding the Fourier transform and functions the students will be able to the student will be able to use research knowledge for the analysis and interpretation of data.

PO 5	2	By understanding the Fourier transform and functions the students will be able to the student will be able to use modern tools for the implementation of concepts.
PO 6	1	By understanding the Fourier transform and functions the students will be able to the student will be able to communicate effectively on complex engineering activities with the engineering community.
PO 9	1	By understanding the Fourier transform and functions the students will be able to the student will be able to engagae in continuous learning.
PO10	2	By understanding the Fourier transform and functions the students will be able tocommunicate effectively on complex engineering activities with the engineering community.
PO12	2	By understanding the Fourier transform and functions the student will be able to engagae in continuous learning.
PSO 1		Fourier transforms helps the students to solve complex problems in random process, especially in connection with power spectral density.

<b>COURSE CODE: HUN 101</b>	<b>COURSE NAME: LIFE SKILLS</b>	<b>SEMESTER: 1</b>
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After the completion of the course the student will be able to:

CO1	Define and Identify different life skills required in personal and professional life
CO2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO4	Take part in group discussions
CO5	Use appropriate thinking and problem solving techniques to solve new problems
CO6	Understand the basics of teamwork and leadership

**CO-PO-PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	2	-	1	2	2	1	3	-	-	-
2	-	-	-	-	-	-	-	-	3	-	-	2	-	-	-
3	-	-	-	-	-	1	-	-	1	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-
5	-	3	2	1	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO6	2	Graduate Need to apply the contextual knowledge to assess different life skills required in personal and professional life
	PO8	1	Graduates Need to apply professional ethics and responsibilities in life skills adopted in their personal and professional life
	PO9	2	Graduate Need to act effectively as an individual, or as a member or leader in a group for adopting different life skills.
	PO10	2	Graduates Need to communicate effectively with others to identify different life skills required in their personal and professional life
	PO11	1	Graduates Need to manage projects in multi-disciplinary environments using their life skills.
	PO12	3	Graduate Need to identify the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change using different life skills.
CO2	PO9	3	Graduate Need to act effectively as an individual, or as a member or leader in a group for awareness of the self and apply well-defined techniques to cope with emotions and stress.
	PO12	2	Graduate Need to identify the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of well-defined techniques to cope with emotions and stress.
CO3	PO6	1	Graduate Need to apply the contextual knowledge to assess effective communication and demonstrate these through presentations.
	PO9	1	Graduate Need to act effectively as an individual, or as a member or leader in a group for adopting effective communication through presentations
	PO10	3	Graduates Need to communicate effectively with others and demonstrate these through different presentations
CO4	PO10	3	Graduates Need to communicate effectively with others to improve their skills during group discussions and debates
	PO12	1	Graduate Need to identify the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of well-defined techniques for excelling in group discussions and debates.
CO5	PO2	3	Graduate Need to Identify and formulate appropriate thinking and problem solving techniques to resolve new problems.

	PO3	2	Graduate Need to design solutions for complex engineering problems and design system components or processes for the public with the cultural, societal and environmental considerations.
	PO4	1	Graduate Need to conduct investigations, analysis, interpretation of data, and synthesis of the information for formulating different problem solving techniques
CO6	PO6	1	Graduate Need to apply the contextual knowledge to assess different techniques for effective teamwork and leadership
	PO9	3	Graduate Need to act effectively as an individual, or as a member or leader in a team for a better display of leadership qualities.

<b>COURSE CODE: MAT 101</b>	<b>COURSE NAME: LINEAR ALGEBRA AND CALCULUS</b>	<b>SEMESTER: 1/2</b>
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**Prerequisite:** A basic course in one-variable calculus and matrix theory.

**Course Outcomes:** After completion of the course the student will be able to:

<b>CO 1</b>	Solve systems of linear equations, diagonalize matrices and characterize quadratic forms.
<b>CO2</b>	Compute the partial and total derivatives and maxima and minima of multivariable functions.
<b>CO3</b>	Compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.
<b>CO4</b>	Perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.
<b>CO5</b>	Determine the Taylor and Fourier series expansion of functions and learn their applications.

**Mapping of course outcomes with program outcomes (Minimum requirement):**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO1</b>	3	3	3	3	2	1	-	-	1	2	-	2	1	-	-
<b>CO2</b>	3	3	3	3	2	1	-	-	1	2	-	2	2	-	-
<b>CO3</b>	3	3	3	3	2	1	-	-	1	2	-	2	2	-	-
<b>CO4</b>	3	2	3	2	1	1	-	-	1	2	-	2	-	-	-
<b>CO5</b>	3	3	3	3	2	1	-	-	1	2	-	2	2	-	-
<b>Average</b>	3	2.8	3	2.8	1.8	1	-	-	1	2	-	2	1.75	-	-

**JUSTIFICATIONS FOR CO-PO MAPPING:**

<b>CO</b>	<b>PO</b>	<b>LEVEL</b>	<b>REMARKS</b>
CO1	PO 1	3	By understanding the concept of matrix theory the students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding the fundamental concept of matrix the students will be able to identify, formulate and analyze simple engineering problems.
	PO 3	3	By understanding the fundamental concept of diagonalization of matrices and quadratic forms the help the student in lifelong learning in the context of technology change.
	PO4	3	By understanding the fundamental concept of matrix theory, the students will be able to do analysis and interpretation of data
	PO5	2	By understanding the fundamental concept of linear equations and matrix theory the students will be able to apply appropriate techniques in complex engineering activities.
	PO6	1	The knowledge of fundamental concept of matrix theory help to communicate effectively on complex engineering activities with the engineering community and with society at large.
	PO9	1	By understanding the concept of matrix theory the students will be able to engage in continuous learning.
	PO10	2	Understanding matrices helps students for writing effective reports.

	PO12	2	The matrix theory concepts helps students to adapt emerging Information and Communication Technologies by providing innovative ideas and solutions to novel problems that is identified.
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	PSO1	1	The matrix theory concepts helps students to provide Civil Engineering with industry government and provide practice working towards substantial solution in a wide array of specialties including constructions environmental geothermal structural transportation and greater resource.
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CO2	PO 1	3	By understanding the fundamental concept of differential calculus of functions the students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding the fundamental concept of differential calculus of functions the students will be able to apply the knowledge for analysis and interpretation of data.
	PO3	3	By understanding multivariable calculus the students will be able to model and study high dimensional systems.
	PO4	3	By understanding the multivariable calculus and differential equations the students will be able to explain natural phenomenon in good manner.
	PO5	2	By understanding the modern multivariable calculus the students will be able to apply appropriate techniques in complex engineering activities.
	PO6	1	By understanding the concept of differential equations the students will be able to engage in continuous learning.
	PO9	1	The knowledge of fundamental concept of differential equation help to communicate effectively on complex engineering activities
	PO10	2	The concept of multivariable calculus helps students to adapt emerging Information and Communication Technologies by providing innovative ideas and solutions to novel problems that is identified.
	PO12	2	The knowledge of multi variable calculus and differential equations help in designing solutions to complex problems

	PSO1	2	The knowledge of multi variable calculus and differentialequations help students to provide Civil Engineering withindustry government and provide practice working towards substantial solution in a wide array of specialtiesincluding constructions environmental geothermal
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			structural transportation and greater resource.
	PO 1	3	By understanding the fundamental concept of multiple integrals can be used to create mathematical models in order to arrive into an optimal solution.
CO3	PO 2	3	By understanding the fundamental concept of multiple integrals the students will be able to apply the knowledge for analysis and interpretation of data.
	PO 3	3	By understanding the concept of the double integrals helps in designing solutions for engineering problems
	PO 4	3	The knowledge of double integrals concepts helps the student in lifelong learning in the context of technology change.
	PO 5	2	By understanding the concept of integration can be used to create and apply appropriate techniques in solving engineering problems.
	PO 6	1	By understanding the concept of integration the students will be able to engage in continuous learning
	PO9	1	The knowledge of fundamental concept of integration helps to communicate effectively on complex engineering activities.
	PO10	2	Understanding integration helps students for writing effective reports.
	PO12	2	The concept of double integration helps students to adapt emerging Information and Communication Technologies by providing innovative ideas and solutions to novel problems that is identified.
	PSO1	2	The concept of double integration helps students to provide Civil Engineering with industry government and provide practice working towards substantial solution in a wide array of specialties including constructions environmental geothermal structural transportation and greater resource



CO4	PO 1	3	By understanding the infinite series the student will be able to apply the knowledge on complex engineering problems.
	PO 2	2	By understanding infinite series, the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	3	By understanding the evaluation of definite integrals and interpolation on given numerical data using standard numerical techniques, the student will be able to design solutions for simple engineering problems.
	PO4	2	The knowledge of infinite series provides technique for solving simple engineering problems.
	PO 5	1	The knowledge of fundamental concept of infinite series helps to communicate effectively on complex engineering activities
	PO 6	1	By understanding various tests can be applied to assess societal, legal and cultural issues.
	PO 9	1	By understanding infinite series the student will be able to engage in continuous learning.
	PO10	2	Understanding infinite series helps students for writing effective reports
	PO12	2	By understanding the concept of infinite series will enable students to engage in lifelong learning.
CO5	PO 1	3	By understanding the concept of Taylor series provides different techniques in solving engineering problems.
	PO 2	3	By understanding the fundamental concept of Taylor series the students will be able to apply the knowledge for analysis and interpretation of data.
	PO 3	3	By understanding the concept of Fourier series the students will be able to design system components.

PO 4	3	By understanding the concept of series helps the students to draw valid conclusions from the data
PO 5	2	Understanding the concept of series can be used to create and apply appropriate techniques in solving engineering problems.
PO 6	1	By understanding the concept of series make students to prepare effective reports and to make effective presentation
PO 9	1	By understanding the concept of Fourier series, the students will be able to engage in continuous learning
PO10	2	Modern techniques are used in understanding the problems in the society
PO12	2	By understanding the concept of Fourier series, the students will be able to cop- up with the technology change
PSO1	2	By understanding the concept of infinite series will be able students to provide Civil Engineering with industry government and provide practice working towards substantial solution in a wide array of specialties including constructions environmental geothermal structural transportation and greater resource.

<b>COURSE CODE: PHT 110</b>	<b>COURSE NAME: ENGINEERING PHYSICS</b>	<b>SEMESTER: 1/2</b>
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After the successful completion of this course, students will able to:

No.	Course outcomes	Knowledge Level
CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.	<b>K3</b>
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.	<b>K3</b>
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.	<b>K2</b>
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment	<b>K3</b>
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications.	<b>K2</b>
<b>B. Tech Semester I&amp;II</b>		
<b>PHT 110</b>	<b>ENGINEERING PHYSICS</b>	
The graduates of the program will be able to		Knowledge Level
<b>PSO1</b>	To practice Civil Engineering with industry, government and private practice, working towards sustainable solutions in a wide array of technical specialities, including construction environmental, geothermal, structural, transportation and water resources.	<b>K<sub>3</sub></b>
<b>PSO2</b>	To grow professionally in the career through continued development of technical, management communication skills and to achieve professional aims ethically and with cultural competency.	<b>K<sub>3</sub></b>

### Mapping of course outcomes with program outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	1	2	-	-	1	1	-	-
CO 2	3	2	-	-	-	-	-	1	2	-	-	1	-	-	-
CO 3	3	2	-	-	-	-	-	1	2	-	-	1	-	-	-
CO 4	3	-	-	-	-	-	-	1	2	-	-	1	1	-	-
CO 5	3	2	-	-	-	-	-	1	2	-	-	1	1	-	-
<b>Average</b>	3	2	-	-	-	-	-	1	2	-	-	1	1	-	-

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	Level	Remarks
CO1-PO1	3	Compute the qualitative aspects of waves and oscillations in engineering systems like natural frequency, damped frequency, forced frequency, resonant frequency, Q-factor, frequency etc.
CO1-PO2	2	To identify the physics behind the flow of current and relevant innovations in the respective branches.
CO1-PO8	1	Apply the principles of professional ethics by understanding the norms of engineering practice.
CO1-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO1-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO1-PSO1	1	To compute the qualitative aspects of waves and oscillations to practice Civil Engineering with industry, government and private practice, working towards sustainable solutions.
CO2-PO1	3	Apply the interaction of light with matter through interference and diffraction and to identify these phenomena in different natural optical processes and optical instruments. E.g.: Measurement of refractive index of materials, path difference and phase difference between waves, dispersive power and resolving power of plane transmission grating.
CO2-PO2	2	Use the first principles of interaction of light with matter and apply this to different optical processes and optical devices.
CO2-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO2-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO2-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO3 -PO1	3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices. E.g.: Wave-function and it's physical significance, Schrodinger equations and application to particle in a one-dimensional box, tunnelling, Quantum confinement, properties of nanomaterials.
CO3-PO2	2	Use the principles of behaviour of matter in the atomic and sub atomic level and analyse the various microscopic processes in scientific devices and Nano structures.
CO3-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO3-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO3-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO4-PO1	3	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of Acoustics to explain the nature and characterisation of acoustic design for solving various engineering problems.
CO4-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO4-PO9	2	To practice team work by combining individual responsibilities in various class room activities.

CO4-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO4-PSO1	1	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to working towards sustainable solutions of various engineering problems.
CO5-PO1	3	Apply the knowledge about the properties of laser and fibre optic communication systems in various engineering applications.
CO5-PO2	2	Identify the various areas of engineering applications and formulate solutions of engineering problems in specific areas.
CO5-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO5-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO5-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO5-PSO1	1	Apply the knowledge about laser and fibre optic communication systems in management of communication skills.

<b>COURSE CODE: PHL 120</b>	<b>COURSE NAME: ENGINEERING PHYSICS LAB</b>	<b>SEMESTER: 1/2</b>
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After the successful completion of this course, students will be able to:

No.	Course outcomes	Knowledge Level
<b>CO 1</b>	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories	<b>K3</b>
<b>CO 2</b>	Understand the need for precise measurement practices for data recording	<b>K3</b>
<b>CO 3</b>	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations	<b>K3</b>
<b>CO 4</b>	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics	<b>K3</b>
<b>CO 5</b>	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results	<b>K2</b>

<b>PHL 120</b>	<b>ENGINEERING PHYSICS LAB</b>	
	The graduates of the program will be able to:	Knowledge Level
<b>PSO1</b>	To practice Civil Engineering with industry, government and private practice, working towards sustainable solutions in a wide array of technical specialities, including construction environmental, geothermal, structural, transportation and water resources.	<b>K<sub>3</sub></b>
<b>PSO2</b>	To grow professionally in the career through continued development of technical, management communication skills and to achieve professional aims ethically and with cultural competency.	<b>K<sub>3</sub></b>

#### Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	1	2	-	-	1	1	-	-
CO 2	3	-	-	-	3	-	-	1	2	-	-	1	1	-	-
CO 3	3	-	-	-	3	-	-	1	2	-	-	1	-	-	-
CO 4	3	-	-	-	3	-	-	1	2	-	-	1	1	1	-
CO 5	3	-	-	-	3	-	-	1	2	-	-	1	1	1	-
<b>Average</b>	3	-	-	-	3	-	-	1	2	-	-	1	1	1	-

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	Level	Remarks
CO1-PO1	3	Designing of instruments, structures and analysis using tools requires fundamentals of oscillations, resonance and waves.
CO1-PO5	3	Applying the theoretical knowledge of resonance and waves to design and conduct experiments for data interpretation.
CO1-PO8	1	Apply the principles of professional ethics by understanding the norms of engineering practice.
CO1-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO1-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO1-PSO1	1	To develop experimental skills for analysing the fundamental concepts.
CO2-PO1	3	Designing of instruments, structures and analysis tools require fundamentals of interference and diffraction engineering problems.
CO2-PO5	3	Applying the theoretical knowledge of interference and diffraction to design and conduct experiments for data interpretation.
CO2-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO2-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO2-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO2-PSO1	1	To Understand the need for precise measurement practices for data recording in various engineering problems.
CO3 -PO1	3	Analyse the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices. E.g.: Wave-function and its physical significance, Schrodinger equations and application to particle in a one-dimensional box, tunnelling, Quantum confinement, properties of nanomaterials.
CO3-PO5	3	Use the principles of behaviour of matter in the atomic and sub atomic level and analyse the various microscopic processes in scientific devices and Nano structures.
CO3-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO3-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO3-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO4-PO1	3	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of Acoustics to explain the nature and characterisation of acoustic design for solving various engineering problems.
CO4-PO5	3	To practice effective communication by various presentations in class and laboratory sessions.
CO4-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.

CO4-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO4-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO4-PSO1	1	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics.
CO4-PSO2	1	To understand the principle, concept, working and applications in theoretical calculations.
CO5-PO1	3	Application of laser, photonics and fiber optics in various branches of engineering.
CO5-PO5	3	Applying the theoretical knowledge of laser, photonics and fiber optics for data interpretation.
CO5-PO8	1	Apply the principles of professional ethics to various fields of engineering practice.
CO5-PO9	2	To practice team work by combining individual responsibilities in various class room activities.
CO5-PO12	1	To understand the use of new technologies and relevant innovations in the respective branches.
CO5-PSO1	1	Develop basic communication skills through working in groups in performing the laboratory experiments in finding the results.
CO5-PSO2	1	To understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations by applying fundamental concepts.



## 2. CO–PO–PSO Mapping and Justification - Semester 3

B. Tech Semester III	
HS200	Business Economics
<i>Student able to:</i>	
CO1	Understand the basic concepts of Economics and their relevance in managerial decision making
CO2	Describe meaning and components of microeconomics
CO3	Discuss various cost concepts and market situations
CO4	Illustrate macroeconomic issues related to inflation and monetary policies
CO5	Apply investment analysis and various indices of measurement
CO6	Prepare and interpret a balance sheet

HS200	Introduction to Sustainable Engineering													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C200.1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
C200.2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C200.3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C200.4	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C200.5	-	-	-	-	-	-	-	-	-	-	1	-	-	-
C200.6	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Average	-	1	-	-	-	-	-	-	-	-	1	-	-	-

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO11	1	By understanding the basic concepts of Economics, the student will be able to manage projects in multi-disciplinary environment.
CO2	PO2	1	By using components of microeconomics the student will be efficient to do teamwork in project management.
CO3	PO2	1	By analyzing cost concepts, the student will be able to analyse complex engineering problems.
CO4	PO2	1	By illustrating macroeconomics concepts the student will be able to identify and formulate research literature,
CO5	PO11	1	By preparing and interpreting a balance sheet, the student will be able to manage projects as a team leader.
CO6	PO11	1	By applying investment analysis, the student will demonstrate management skills in project work.

<b>B. Tech Semester III</b>	
<b>CET203</b>	<b>FLUID MECHANICS AND HYDRAULICS</b>
<i>Student able to :</i>	
<b>C203.1</b>	Recall the relevant principles of hydrostatics and hydraulics of pipes and open channels
<b>C203.2</b>	Identify or describe the type, characteristics or properties of fluid flow
<b>C203.3</b>	Estimate the fluid pressure, perform the stability check of bodies under hydrostatic condition
<b>C203.4</b>	Compute discharge through pipes or estimate the forces on pipe bends by applying hydraulic principles of continuity, energy and/or momentum
<b>C203.5</b>	Analyze or compute the flow through open channels, perform the design of prismatic channels

<b>CET203</b>	<b>FLUID MECHANICS AND HYDRAULICS</b>													
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>C203.1</b>	2	2	-	-	-	-	-	-	-	-	-	-	3	3
<b>C203.2</b>	2	2	-	-	-	-	-	-	-	-	-	-	3	3
<b>C203.3</b>	3	3	-	-	-	1	-	-	-	-	-	-	3	3
<b>C203.4</b>	3	3	-	-	-	1	-	-	-	-	-	-	3	3
<b>C203.5</b>	3	3	2	-	-	-	-	-	-	-	-	-	3	3
<b>Average</b>	<b>2.6</b>	<b>2.6</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>3</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO1	2	The relevant principles of hydrostatics and hydraulics can be applied to solve problems of pipes and open channels.
	PO2	2	The student develops the ability to solve the problems on the topics related to fluid statics.
	PSO1	3	The student will be able to apply knowledge in fluid statics in various areas of civil engineering like water resources engineering, geotechnical engineering etc. throughout their career.
	PSO2	3	The student will obtain knowledge in fluid mechanics to grow professionally in their careers
CO2	PO1	2	The student can apply knowledge related to types of flow and characteristics like velocity and acceleration.
	PO2	2	The student develops the ability to solve the problems on the topics related to fluid flow.
	PSO1	3	The student will be able to apply knowledge of fluid flow characteristics in various areas of civil engineering like water resources engineering, irrigation engineering, design of hydraulic structures etc. throughout their career.
	PSO2	3	The student will obtain knowledge in fluid flow characteristics to grow professionally in their careers.
CO3	PO1	3	The student can apply knowledge on measurement of pressure and buoyancy.
	PO2	3	The student develops the ability to solve the problems on measurement of pressure and buoyancy.
	PO6	1	The student acquires the knowledge on engineering applications like pressure measurement and buoyancy which is needed in different fields of society.
	PSO1	3	The student will be able to apply knowledge of measurement of pressure and buoyancy in various areas of civil engineering like water resources engineering, geotechnical engineering etc. throughout their career.
	PSO2	3	The student will obtain knowledge in pressure measurement and buoyancy to grow professionally in specific areas throughout their careers.
CO4	PO1	3	The student will be able to calculate the discharge through pipes by applying hydraulic principles of continuity, energy and/or momentum.
	PO2	3	The student develops the ability to solve the problems on discharge through pipes and various applications on Bernoulli's equation.

	PO6	1	The student acquires knowledge on discharge measurement which is applied in various technical specialties like environmental engineering, water resources engineering etc.
	PSO1	3	The student will be able to calculate the discharge through pipes by applying hydraulic principles of continuity, energy and/or momentum in various areas of civil engineering like water resources engineering, environmental engineering etc. throughout their career.
	PSO2	3	The student will obtain knowledge in discharge through pipes by applying hydraulic principles to grow professionally in specific areas throughout their careers.
CO5	PO1	3	Knowledge is obtained by the student for computing the flow through open channels and perform the design of prismatic channels.
	PO2	3	The student will be able to solve problems on flow through open channels and perform the design of prismatic channels.
	PO3	2	The student will be able to solve problems on open channels, perform the design of prismatic channels which is necessary for irrigation, water conveyance, design of water channels etc.
	PSO1	3	The student will be able to apply knowledge of open channel flow characteristics like specific energy and hydraulic jump in areas of civil engineering like water resources engineering, irrigation engineering etc.
	PSO2	3	The student will obtain knowledge in channel design and it's various related characteristics necessary for professional growth.

<b>COURSE CODE:</b> <b>EST 200</b>	<b>COURSE NAME:</b> <b>DESIGN AND ENGINEERING</b>	<b>SEMESTER: 4</b>
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**Pre-requisite:**

**Course Outcome:** After the successful completion of this course, the student will be able to:

EST200.1	Explain the different concepts and principles involved in design engineering.
EST200.2	Apply design thinking while learning and practicing engineering.
EST200.3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

<b>COURSE CODE:</b> <b>EST 200</b>		<b>COURSE NAME:</b> <b>DESIGN AND ENGINEERING</b>										<b>SEMESTER: 4</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
EST200.1	2	1	-	-	-	-	1	-	-	1	-	-	3	2
EST200.2	-	2	-	-	-	1	-	1	-	-	-	2	3	2
EST200.3	-	-	2	-	-	1	1	-	2	2	-	1	3	2
<b>EST200</b>	<b>2</b>	<b>1.5</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1.5</b>		<b>1.5</b>	<b>2.67</b>	<b>2</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEV EL	REMARKS
EST200.1	PO1	2	Illustrate the different concept and principles in Design Engineering.
	PO2	1	Analyze the different concepts in Design Engineering, in order to choose best design solution.
	PO7	1	Apply the different concepts and principles in Design Engineering to develop a sustainable design solution.
	PO10	1	Communicating the numerous design solutions developed by the designer effectively to the client through proper documentation.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Use the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth
EST200.2	PO2	2	Analyze the different design thinking approaches, inorder to reach a sustainable design solution.
	PO6	1	Apply the design thinking approach to develop design solution in context with societal needs and aspects.
	PO8	1	Apply ethical principles while proposing design solution to the client, by following norms of engineering practices.
	PO12	2	Use the knowledge in design engineering through out the phase of career development and provide effectual problem solution to the habitué.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Apply the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth
EST200.3	PO3	2	Evaluate the various adaptive and development level design to formulate a new design solution.
	PO6	1	Apply the design thinking approach to develop design solution in context with societal needs and aspects.
	PO7	1	Apply the proficiency in Design Engineering to develop a sustainable design solution.
	PO9	2	Construct design solution efficaciously in team environment or as an individual.

	PO10	2	Communicating the numerous design solutions developed by the designer effectively to the client through proper documentation.
	PO12	1	Use the knowledge in design engineering through out the phase of career development and provide effectual problem solution to the habitu��.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Apply the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth



<b>COURSE CODE:</b> <b>CET205</b>	<b>COURSE NAME:</b> <b>SURVEYING &amp; GEOMATICS</b>	<b>SEMESTER: 3</b>
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**Pre-requisite:** CET 205 SURVEYING & GEOMATICS

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET205.1	To apply surveying techniques and principles of levelling for the preparation of contour maps
CET205.2	To apply principles of levelling with its various types of levelling to calculate the level difference between two points
CET205.3	To calculate the area and volume, illustrate theodolite, its components and sketching mass diagram and to explain the triangulation principles to analyze the inter-visibility of stations
CET205.4	To identify the possible errors in surveying and apply different methods of traverse surveying and traverse balancing
CET205.5	Apply the basic knowledge of setting out different types of curves and to understand modern methods and equipments of surveying
CET205.6	Employ surveying techniques using advanced surveying equipments and understand the concepts of GPS, GIS and Remote Sensing

<b>COURSE CODE:</b> <b>CET205</b>			<b>COURSE NAME:</b> <b>SURVEYING &amp; GEOMATICS</b>									<b>SEMESTER: 3</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CE205.1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CE205.2	2	2	-	-	2	-	-	-	-	-	-	-	3	2
CE205.3	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CE205.4	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CE205.5	2	2	-	-	-	-	-	-	-	-	-	-	1	1
CE205.6	1	1	-	-	2	-	-	-	-	-	-	-	3	3
<b>AVG.</b>	<b>2.00</b>	<b>2.00</b>	<b>1.00</b>	<b>-</b>	<b>2.00</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2.33</b>	<b>2.16</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET205.1	PO1	2	Apply the principles used in survey form the basis of the knowledge of a Civil Engineer to encounter any problem in the field of Surveying
	PO2	2	Identification of local attraction, compass surveying is a promising practical problem solving area in the field of civil engineering.
	PSO 1	2	Basic knowledge on surveying principles helps to work in the field of civil engineering.
	PSO 2	2	Basic knowledge on surveying concepts including local attraction and compass surveying helps them to grow professionally in the civil engineering career.
CET205.2	PO1	2	Apply the concept rankine's theory for active and passive lateral earth pressure with the geotechnical engineering fundamentals for solving the retaining wall related engineering problems
	PO2	2	Study of levelling principles and contouring is a promising practical problem solving area in Civil Engineering.
	PO5	2	Modern tools are introduced day by day. So we need to have knowledge on different instruments used for surveying, especially contouring and how it will useful when new updates comes
	PSO 1	3	Basic knowledge on the concept levelling and contouring methods helps to work in the field of civil engineering
	PSO 2	2	Basic knowledge on the levelling principles along with advanced contouring methods helps to work in the field of civil engineering
CET205.3	PO1	3	Apply the basic knowledge of how area and volume can be calculated on a given plot or between the given points on ground
	PO2	3	By different methods of calculation of area and volume any complex problems can be solved in surveying.
	PO3	1	Basic concept of analysis helps design and develop solutions of any kind of surveys
	PSO 1	3	Knowledge on basic calculations of area and volume and mass haul diagram construction helps to work in the field of civil engineering.
	PSO 2	3	Knowledge on area and volume calculation along with mass haul diagram construction helps them to grow professionally in their career.

CET205.4	PO1	2	Apply the basic theory of errors and balancing the traverse for solving the engineering problems
	PO2	2	Identify or analyse any kind of surveying problem which comes under balancing the traverse is a promising practical problem solving area in Civil Engineering.
	PSO 1	2	Knowledge on concepts of traverse surveying and balancing the traverse helps to work in the field of civil engineering.
	PSO 2	2	Knowledge on analyzing traverse surveying and balancing the traverse helps them to grow professionally in their career.
CET205.5	PO1	2	Apply the knowledge of curves and surveying using the modern surveying equipments
	PO2	2	Setting out curves and surveying using modern instruments is a practical problem arising area in Civil Engineering.
	PSO 1	1	Setting out curves and surveying using modern instruments to work in the field of civil engineering.
	PSO 2	1	Setting out curves and surveying using modern instruments helps them to grow professionally in their career.
CET205.6	PO1	1	With the help of sophisticated different instruments and technologies one can one can find solution for any complex problems related to surveying
	PO2	1	Basic knowledge on the modern technologies in the field of surveying and its functionality which is similar to the real life civil engineering problem.
	PO5	2	With the help of sophisticated different instruments one can one can find solution for any complex problems related to surveying
	PSO 1	3	Knowledge on basic operations of modern instruments helps to work in the field of surveying and civil engineering.
	PSO 2	3	Knowledge on modern equipments and its operations helps them to grow professionally in their career.

<b>COURSE CODE:</b> <b>HUT 200</b>	<b>COURSE NAME: PROFESSIONAL ETHICS</b>	<b>SEMESTER: 3</b>
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**Pre-requisite:** nil

**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>HUT200.1</b>	Understand the core values that shape the ethical behaviour of a professional.
<b>HUT200.2</b>	Adopt a good character and follow an ethical life
<b>HUT200.3</b>	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics
<b>HUT200.4</b>	Solve moral and ethical problems through exploration and assessment by established experiments.
<b>HUT200.5</b>	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

<b>COURSE CODE:</b> <b>HUT200</b>		<b>COURSE NAME:</b> <b>PROFESSIONAL ETHICS</b>										<b>SEMESTER: 3</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
HUT200.1	-	-		-	-	-	-	2	-	-	2	-	2	3
HUT200.2	-	-	-	-	-	-	-	2	-	-	2	-	2	3
HUT200.3	-	-	-	-	-	-	-	3	-	-	2	-	2	3
HUT200.4	-	-	-	-	-	-	-	3	-	-	2	-	2	3
HUT200.5	-	-	-	-	-	-	-	3	-	-	2	-	2	3
<b>HUT200</b>	-	-	-	-	-	-	-	<b>2.6</b>	-	-	<b>2</b>	-	<b>2</b>	<b>3</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
HUT200.1	PO8	2	Students will be able to understand the core values that shape the ethical behavior and apply ethical principles in profession
	PO11	2	Students will be able to recognize the importance of ethical principles throughout their life
	PSO1	2	Students will be able to practice ethical principles in their profession.
	PSO2	3	Students will be able to grow professionally in their career to achieve their professional aims ethically.
HUT200.2	PO8	2	Students will be able to adopt a good character and follow an ethical life
	PO11	2	Students will be able to recognize the importance of ethical principles throughout their life
	PSO1	2	Students will be able to practice ethical principles in their profession
	PSO2	3	Students will be able to grow professionally in their career to achieve their professional aims ethically.
HUT200.3	PO8	3	Students will be able to explain the role and responsibility in technological development by keeping personal ethics and legal ethics
	PO11	2	Students will be able to recognize the importance of ethical principles throughout their life
	PSO1	2	Students will be able to practice ethical principles in their profession
	PSO2	3	Students will be able to grow professionally in their career to achieve their professional aims ethically
HUT200.4	PO8	3	Students will be able to Solve moral and ethical problems through exploration and assessment by established experiments
	PO11	2	Students will be able to recognize the importance of ethical principles throughout their life
	PSO1	2	Students will be able to practice ethical principles in their profession
	PSO2	3	Students will be able to grow professionally in their career to achieve their professional aims ethically
HUT200.5	PO8	3	Students will be able to Apply the knowledge of human values and social values to contemporary ethical values and global issues

	PO11	2	Students will be able to recognize the importance of ethical principles throughout their life
	PSO1	2	Students will be able to practice ethical principles in their profession
	PSO2	3	Students will be able to grow professionally in their career to achieve their professional aims ethically

<b>B. Tech Semester III</b>	
<b>MCN201</b>	<b>Sustainable Engineering</b>
<i>Student able to :</i>	
<b>C206.1</b>	Understand the relevance and the concept of sustainability and the global initiatives in this direction
<b>C206.2</b>	Explain the different types of environmental pollution problems and their sustainable solutions
<b>C206.3</b>	Discuss the environmental regulations and standards
<b>C206.4</b>	Outline the concepts related to conventional and non-conventional energy
<b>C206.5</b>	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

<b>MCN201</b>	<b>Introduction to Sustainable Engineering</b>													
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>C206.1</b>	-	-	-	-	-	2	3	-	-	-	-	2	-	1
<b>C206.2</b>	-	-	-	-	-	2	3	-	-	-	-	2	1	2
<b>C206.3</b>	-	-	-	-	-	2	3	-	-	-	-	3	2	3
<b>C206.4</b>	-	-	-	-	-	2	3	-	-	-	-	2	2	3
<b>C206.5</b>	-	-	-	-	-	2	3	-	-	-	-	2	2	3
<b>Average</b>	-	-	-	-	-	<b>2</b>	<b>3</b>	-	-	-	-	<b>2</b>	<b>1.8</b>	<b>2.5</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO6	2	Obtain knowledge on the evolution and concepts related to sustainability
	PO7	3	The knowledge on various sustainable issues will enable the student to address problems faced by the society
	PO12	2	The student can learn and practice sustainability concepts in long term basis
	PSO2	1	The student will be able to include sustainability in their career which can help to meet their professional goals ethically
CO2	PO6	2	Understands various pollution problems and can use technical knowledge to work for solutions for the same.
	PO7	3	Obtain knowledge on various environmental issues
	PO12	2	The student can recognize the need and to find solutions for ever increasing problem of different types of pollution
	PSO1	1	The student can apply sustainability concepts of reducing environmental pollution in wide areas of civil engineering.
	PSO2	2	The student will be able to find solutions for pollution problems which can help to meet their professional goals ethically and with cultural competency.
CO3	PO6	2	Use the sustainability management tools when working in a team to find solutions for a problem.
	PO7	3	Use knowledge of various sustainability tools to work for betterment of society.
	PO12	3	Work using various tools like LCA, Biomimicry etc.
	PSO1	2	The student can apply sustainability management tools in wide areas of civil engineering to achieve sustainability goals.
	PSO2	3	The student will be able to include sustainability management tools in their career which can help to meet their professional goals ethically for betterment of society.
CO4	PO6	2	Civil engineers can utilize their knowledge in implementing renewable energy projects
	PO7	3	Engineers can use their expertise when working as a team.
	PO12	2	Research work is to be carried out in wide extent to improve existing renewable energy technologies.
	PSO1	2	The student can apply sustainable energy methods during construction in wide areas of civil engineering to obtain energy efficiency.
	PSO2	3	The student will be able to include renewable energy concepts in their career which can help to meet their professional goals ethically
CO5	PO6	2	Civil engineers can use their professional knowledge on design and function of various infrastructure projects.



	PO7	3	Renewable energy projects are implemented in a team
	PO12	2	Engineers can indulge in life-long learning related to green buildings and practices followed.
	PSO1	2	The student can apply sustainability infrastructure methods of construction in wide areas of civil engineering to obtain material efficiency.
	PSO2	3	The student will be able to include infrastructure sustainability concepts in their career, which can help to meet their professional goals.

<b>COURSE CODE:</b> <b>CEL203</b>	<b>COURSE NAME: SURVEY LAB</b>	<b>SEMESTER: 3</b>
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**Pre-requisite:** Nil

**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>CEL203.1</b>	Use conventional surveying tools such as chain/tape and compass for plotting and area determination.
<b>CEL203.2</b>	Apply levelling principles in field
<b>CEL203.3</b>	Solve triangulation problems using theodolite
<b>CEL203.4</b>	Employ total station for field surveying
<b>CE2L03.5</b>	Demonstrate the use of distomat and handheld GPS

<b>COURSE CODE:</b> <b>CEL203</b>			<b>COURSE NAME:</b> <b>SURVEY LAB</b>									<b>SEMESTER: 3</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL203.1	3	-	-	-	-	-	-	1	2	-	-	-	2	2
CEL203.2	3	-	-	1	-	-	-	1	2	-	-	-	2	2
CEL203.3	3	-	-	1	-	-	-	1	2	-	-	-	2	2
CEL203.4	3	-	-	1	3	-	-	1	2	-	-	2	3	2
CEL203.5	3	-	-	-	3	-	-	1	-	-	-	2	3	2
<b>CEL203</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2.4</b>	<b>2</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CEL203.1	PO1	3	Students will be able to use conventional surveying tools such as chain/tape and compass
	PO8	1	Understand the responsibility of engineers and importance of surveying
	PO9	2	Students will function effectively as an individual and as a team during lab
	PSO1	2	Students will be able to practice surveying for plotting areas
	PSO2	2	Students will be able to grow professionally in their career by plotting areas by different methods of surveying as per the requirement of any client.
CEL203.2	PO1	3	Students will be able to apply the knowledge of levelling in the field
	PO4	1	Students will be able to analyze and interpret the level difference between two points
	PO8	1	Understand the responsibility of engineers and importance of levelling
	PO9	2	Students will function effectively as an individual and as a team during lab
	PSO1	2	Students will be able to practice levelling principles in field
	PSO2	2	Students will be able to grow professionally in their career having good engineering knowledge in levelling
CEL203.3	PO1	3	Students will be able to apply the knowledge to solve triangulation problems using theodolite.
	PO4	1	Students will be able to analyze and solve triangulation problems using theodolite.
	PO8	1	Understand the responsibility of engineers and importance of using theodolite for surveying
	PO9	2	Students will function effectively as an individual and as a team during lab
	PSO1	2	Students will be able to practice triangulation problems using theodolite.
	PSO2	2	The students can build up good profession/ career in the field of surveying using theodolite
CEL203.4	PO1	3	Students will be able to apply the basic engineering knowledge of total station for field surveying
	PO4	1	Students will be able to analyze and conduct investigation in of total station for field surveying

	PO5	3	Students will be able to select and apply modern tools like total station for surveying
	PO8	1	Understand the responsibility of engineers and importance of using total station for surveying
	PO9	2	Students will function effectively as an individual and as a team during lab
	PO12	2	Students will have a life-long learning in surveying
	PSO1	3	Students will be able to practice triangulation problems using total station
	PSO2	2	The students can build up good profession/ career in the field of surveying using total station.
CEL203.5	PO1	3	Students will be able to apply the basic engineering fundamentals to demonstrate the use of distomat and handheld GPS
	PO5	3	Students can use various modern tools like distomat and GPS for surveying
	PO8	1	Understand the responsibility of engineers and importance of using distomat and handheld GPS for surveying
	PO12	2	Students will have a life-long learning in surveying
	PSO1	3	Students will be able to practice surveying using distomat and handheld GPS
	PSO2	2	Students can grow professionally in their career in the field of surveying using distomat and GPS

<b>COURSE CODE:</b> <b>CEL201</b>	<b>COURSE NAME: CIVIL ENGINEERING PLANNING &amp; DRAFTING LAB</b>	<b>SEMESTER: 3</b>
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**Pre-requisite:** ENGINEERING GRAPHICS

**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL201.1	Illustrate ability to organize civil engineering drawings systematically and professionally
CEL201.2	Prepare building drawings as per the specified guidelines
CEL201.3	Assess a complete building drawing to include all necessary information
CEL201.4	Create a digital form of the building plan using any drafting software

<b>COURSE CODE:</b> <b>CE231</b>		<b>COURSE NAME: CIVIL ENGINEERING DRAFTING LAB</b>										<b>SEMESTER: 3</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL201.1	3	-	-	-	-	-	-	2	3	3	-	-	1	2
CEL201.2	3	-	-	-	-	-	-	2	3	3	-	-	2	2
CEL201.3	3	-	-	-	-	-	-	2	3	3	-	-	1	1
CEL201.4	3	-	-	-	-	-	-	2	2	3	-	-	2	2
<b>CEL201</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2.75</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>1.5</b>	<b>1.75</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CEL201. 1	PO1	3	Students will be able to apply the basic concept and visualization of civil engineering drawing with respect to the site conditions and client requirement
	PO8	2	Students will be able to apply principles and professional ethics by ensuring the rules and laws during the preparation of a civil engineering drawing
	PO9	3	Students will be able to organize civil engineering drawings in a professional manner by conducting discussions with all stakeholders as a result of teamwork
	PO10	3	Students will be able to communicate effectively with a detailed explanation/ presentation on the drawings to the client
	PSO1	1	Students will be able to practice civil engineering drawing as a part of planning and implementation stages of project
	PSO2	2	Students will be able to grow professionally in their career by giving suitable building drawings as per the requirement of the client.
CEL201. 2	PO1	3	Students will be able to apply draw the plan, sectional view and elevation of buildings with respect to specific guidelines (NBC, KMBR, KPBR etc.)
	PO8	2	Students will be able to apply principles and professional ethics by ensuring the rules and laws during the preparation of building drawings
	PO9	3	Students will be able to finalize drawings of various buildings in a professional manner by conducting discussions with all stakeholders as a result of teamwork
	PO10	3	Students will be able to explain the plan, section and elevation of a building drawing in a realistic manner by providing a clear understanding about the building
	PSO1	2	Students will be able to plot any civil engineering drawings with respect to specific guidelines
	PSO2	2	Students will be able to grow professionally in their career by giving suitable building drawings with all the technical specifications as per the requirement of the client
	PO1	3	Students will be able to assess a civil engineering drawing to ensure necessary information

CEL201. 3	PO8	2	Students will be able to apply principles and professional ethics during the assessment of a building drawing with verification of necessary informations which is provided in the drawings
	PO9	3	Students will be able to assess drawings of various buildings to ensure necessary information in the drawings through various discussions with each team members
	PO10	3	Students will be able to communicate or to make presentation on the necessary information provided in the drawings
	PSO1	1	Students will be able to practice as a Civil Engineer/ Architect to assess any engineering drawings for ensuring necessary information related to the project
	PSO2	1	Students will be able to grow professionally in their career by giving suitable building drawings with all the technical specifications as per the requirement of the client
CEL201. 4	PO1	3	Students will be able to draw the plan, section, elevation and 3D of any civil engineering structures using any drawing software (AutoCAD, 3D max etc.) and generate output in a digital form
	PO8	2	Students will be able to apply principles and professional ethics for the preparation of drawings using any software
	PO9	2	Students will be able to work as a team to draw various components of a civil engineering project by assigning roles to each team member
	PO10	3	Students can make an effective presentation of a civil engineering project in all aspects with 2D and 3D drawings using any drawing software
	PSO1	2	Students will be able to practice as Civil Engineer/ Architect by providing various types of drawings using any drafting softwares
	PSO2	2	Students will be able to grow professionally in their career to create 2D and 3D forms of engineering drawings

<b>COURSE CODE:</b> MAT 201	<b>COURSE NAME: PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS</b>	<b>SEMESTER: 3</b>
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**Prerequisite:** Nil

**Course Outcomes:** After completion of the course the student will be able to:

<b>CO 1</b>	Understand the concept and the solution of partial differential equation
<b>CO 2</b>	Analyze and solve one dimensional wave equation and heat equation.
<b>CO 3</b>	Understand complex functions, its continuity differentiability with the use of Cauchy Riemann equations.
<b>CO 4</b>	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula, and understand the series expansion of analytic function.
<b>CO 5</b>	Understand the series expansion of complex functions about a singularity and Apply residue theorem to compute several kinds of real integrals.

**Mapping of course outcomes with program outcomes (Minimum requirement)**

<b>CO</b>	<b>P O 1</b>	<b>P O 2</b>	<b>P O 3</b>	<b>P O 4</b>	<b>P O 5</b>	<b>P O 6</b>	<b>P O 7</b>	<b>P O 8</b>	<b>P O 9</b>	<b>P O 10</b>	<b>P O 11</b>	<b>P O 12</b>	<b>PS O 1</b>	<b>PS O 2</b>
<b>CO 1</b>	3	3	3	3	2	1	-	-	-	2	-	2	1	
<b>CO 2</b>	3	3	3	3	2	1	-	-	-	2	-	2	1	
<b>CO 3</b>	3	3	3	3	2	1	-	-	-	2	-	2	2	
<b>CO 4</b>	3	3	3	3	2	1	-	-	-	2	-	2	2	
<b>CO 5</b>	3	3	3	3	2	1	-	-	-	2	-	2	2	



### JUSTIFICATIONS FOR CO-PO MAPPING

C O	PO	LEV EL	REMARKS
CO 1	PO 1	3	By understanding the concept and solution of partial differential equations students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding the concept and solution of partial differential equations students will be able to identify, formulate and analyse simple engineering problems.
	PO 3	3	By understanding the concept and solution of partial differential equations students will be able to develop solutions for very simple engineering problems.
	PO4	3	By understanding the concept and solution of partial differential equations students will be able to use research knowledge for the analysis and interpretation of data.
	PO5	2	By understanding the concept and solution of partial differential equations students will be able to use modern tools like Matlab for the implementation of concepts.
	PO6	1	By understanding the concept and solution of partial differential equations students will be able to solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in electronics and engineering fundamentals to cater needs of society.
	PO1 0	2	By understanding the concept and solution of partial differential equations students will be able to communicate on complex engineering activities with the engineering community.
	PO1 2	2	By understanding the concept and solution of partial differential equations students will be able to engage in continuous learning.

	PSO 1	1	By understanding the concept and solution of partial differential equations students will be able to provide civil engineering with industry government and provide practice, working towards sustainable solution in a wide array of specialities, including construction environmental geotechnical, structural transportation and water resources.
CO 2	PO 1	3	By understanding the concept and solution of wave and heat equations students will be able to apply the knowledge in complex engineering problems.
	PO 2	3	By understanding how to solve solve one dimensional wave equation and heat equation, the students will be able to apply identify, formulate and analyze simple engineering problems.
	PO3	3	By understanding the modern theory of continuous probability distribution students will be able to design solutions for very simple engineering problems.
	PO4	3	By understanding how to solve one dimensional wave equation and heat equation students will be able to use research knowledge for the analysis and interpretation of data.
	PO5	2	By understanding how to solve one dimensional wave equation and heat equation students will be able to use modern tools for the implementation of concepts
	PO6	1	By understanding how to solve one dimensional wave equation and heat equation students will be able to communicate on complex engineering activities with the engineering community and with the society.
	PO1 0	2	By understanding the concept and solution of partial differential equations students will be able to communicate on complex engineering activities with the engineering community.

	PO1 2	2	By understanding how to solve one dimensional wave equation and heat equation students will be able to engage in continuous learning.
	PSO 1	1	By understanding how to solve one dimensional wave equation and heat equation students will be able to provide civil engineering with industry government and provide practice, working towards sustainable solution in a wide array of specialities, including construction environmental geotechnical, structural transportation and water resources..
CO 3	PO 1	3	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, students will be able to apply the knowledge to find solution of complex engineering problems.
	PO 2	3	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to identify, analyze and make conclusions of simple engineering problems.
	PO 3	3	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to design solutions for simple engineering problems.
	PO 4	3	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to conduct investigations of complex problems and provide valid conclusions.
	PO 5	2	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to use modern tools like R for the implementation of concepts.
	PO 6	1	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to communicate effectively on complex engineering activities with the engineering community.

	PO10	2	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to engage in continuous learning.
	PO12	2	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations students will be able to engage in continuous learning.
	PSO1	1	By understanding complex functions, its continuity, differentiability with the use of Cauchy- Reimann equations, the student will be able to provide civil engineering with industry government and provide practice, working towards sustainable solution in a wide array of specialities, including construction environmental geotechnical, structural transportation and water resources.

CO 4	PO 1	3	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to apply the knowledge on complex engineering problems.
	PO 2	3	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	3	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to design solutions for simple engineering problems.
	PO 4	3	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to use research knowledge for the analysis and interpretation of data.
	PO 5	2	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to use modern tools like Matlab, Mathematica, Maple etc. for the implementation of concepts.
	PO 6	1	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to communicate effectively on complex engineering activities with the engineering community.
	PO10	2	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to engage in continuous learning.
	PO1 2	2	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the students will be able to engage in continuous learning.
	PSO 1	1	By understanding how to evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula and understand series expansion of analytic functions, the student will be able to provide civil engineering with industry government and provide practice, working towards sustainable

			solution in a wide array of specialities, including construction environmental geotechnical, structural transportation and water resources..
CO 5	PO 1	3	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to apply the knowledge on complex engineering problems.
	PO 2	3	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	3	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to design solutions for simple engineering problems.
	PO 4	3	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to use research knowledge for the analysis and interpretation of data.
	PO 5	2	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to use modern tools for the implementation of concepts.
	PO 6	1	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to communicate effectively on complex engineering activities with the engineering community.
	PO10	2	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to the student will be able to engage in continuous learning.
	PO1 2	2	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the students will be able to engage in continuous learning.
	PSO 1	1	By understanding the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals, the student will be able to provide civil engineering with industry government and provide practice, working towards sustainable solution in a wide array of

			specialities, including construction environmental geotechnical, structural transportation and water resources.
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<b>CET 201</b>	<b>COURSE NAME: MECHANICS OF SOLIDS</b>	<b>SEMESTER: 3</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CET201.1	Understand the fundamental terms and theorems associated with mechanics of linear elastic deformable bodies.
CET201.2	calculate internal stresses/strains, stress resultants in structural elements subjected to axial load
CET201.3	Calculate stresses due to temperature, instantaneous loads in axially loaded bar and stresses in thin shells.
CET201.4	Calculate the internal forces in members subjected to transverse loads and plot their distributions.
CET201.5	Compute the stresses of members subjected to transverse loads.
CET201.6	Perform stress transformations, compute buckling load of columns and calculate the internal stresses of a circular shaft subjected to torsion.

<b>CET 201</b>			<b>COURSE NAME: MECHANICS OF SOLIDS</b>									<b>SEMESTER: 3</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET201.1	3	1	1	1	-	-	-	-	-	-	-	-	3	3
CET201.2	3	2	1	1	1	-	-	-	-	-	-	-	3	3
CET201.3	3	2	2	1	1	-	-	-	-	-	-	-	3	3
CET201.4	3	3	2	1	1	-	-	-	-	-	-	-	3	3
CET201.5	3	3	2	1	1	-	-	-	-	-	-	-	3	3
CET201.6	3	3	3	2	2	-	-	-	-	-	-	-	3	3
<b>CET201</b>	<b>3.00</b>	<b>2.33</b>	<b>1.83</b>	<b>1.17</b>	<b>0.86</b>	-	-	-	-	-	-	-	<b>3.00</b>	<b>3.00</b>



**JUSTIFICATIONS FOR CO-PO MAPPING:**

<b>CO</b>	<b>PO</b>	<b>LEVEL</b>	<b>REMARKS</b>
CE201.1	PO1	3	Apply the fundamental knowledge to understand complex engineering problems
	PO2	1	Understanding fundamentals is important in identifying, formulating and solving problems in engineering practice
	PO3	1	Understanding of fundamental concepts helps the engineer to design the engineering systems, duly considering the economy and safety.
	PO4	1	The basic knowledge of terms and theorems forms the fundamentals of research and experimentation.
	PSO1	3	Fundamental understanding of stress and loads help the engineer to practice civil engineering efficiently
	PSO2	3	Helps to grow in their career.
CE201.2	PO1	3	Apply the fundamental knowledge to understand complex engineering problems
	PO2	2	Understanding this is important in identifying, formulating and solving problems in engineering practice
	PO3	1	Understanding of these help the engineer to design the engineering systems, duly considering the economy and safety.
	PO4	1	The basic knowledge of forms the fundamentals of research and experimentation.
	PO5	1	The basic knowledge help to use modern engineering packages effectively
	PSO1	3	Fundamental understanding of these help the engineer to practice civil engineering efficiently
	PSO2	3	Helps to grow in their career.
CE201.3	PO1	3	Apply the fundamental knowledge to understand complex engineering problems with thermal stress, impact and blast loads
	PO2	2	Understanding this is important in identifying, formulating and solving problems in engineering practice
	PO3	2	Understanding of these help the engineer to design the engineering systems, duly considering the economy and safety.

	PO4	1	The basic knowledge of forms the fundamentals of research and experimentation.
	PO5	1	The basic knowledge help to use modern engineering packages effectively
	PSO1	3	Fundamental understanding of these help the engineer to practice civil engineering efficiently
	PSO2	3	Helps to grow in their career.
CE201.4	PO1	3	Understanding of bending moment and shear force help the engineer to solve complex behaviour of beams
	PO2	3	Help to identify complex problems regarding beams in engineering practice.
	PO3	2	Help the engineer to design the beams
	PO4	1	The basic knowledge of forms the fundamentals of research and experimentation.
	PO5	1	Enable the engineer to use modern packages efficiently with sufficient counterchecks.
	PSO1	3	This will help the engineer to practice civil engineering in the field of structural engineering and construction
	PSO2	3	This will help to grow in profession with technical skills
CE201.5	PO1	3	Computation of stresses help the engineer to apply it in designing RCC and steel beams
	PO2	3	Complex structural components can be analysed based on this concept.
	PO3	2	Design of beams
	PO4	1	Formulate research problems like composite beams, beams subjected to fire etc.
	PO5	1	Help to use modern FE tools
	PSO1	3	Enable to design and practice structural engineering
	PSO2	3	Enable to grow professionally.
CE201.6	PO1	3	Apply the knowledge in engineering practice – buckling of structures, design for torsion
	PO2	3	Analyse and synthesise practical problems
	PO3	3	Develop solutions for designing and retrofitting of structural members.
	PO4	2	Experimental investigations
	PO5	2	Enable to use the modern packages efficiently
	PSO1	3	Enable to design and practice structural engineering
	PSO2	3	Enable to grow professionally.

### 3. CO–PO–PSO Mapping and Justification - Semester 4

<b>COURSE CODE:</b> EST 200	<b>COURSE NAME:</b> DESIGN AND ENGINEERING	<b>SEMESTER: 4</b>
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**Pre-requisite:**

**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>EST200.1</b>	Explain the different concepts and principles involved in design engineering.
<b>EST200.2</b>	Apply design thinking while learning and practicing engineering.
<b>EST200.3</b>	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

<b>COURSE CODE:</b> EST 200			<b>COURSE NAME:</b> DESIGN AND ENGINEERING									<b>SEMESTER: 4</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
EST200.1	2	1	-	-	-	-	1	-	-	1	-	-	3	2
EST200.2	-	2	-	-	-	1	-	1	-	-	-	2	3	2
EST200.3	-	-	2	-	-	1	1	-	2	2	-	1	3	2
<b>AVG.</b>	<b>2</b>	<b>1.5</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1.5</b>		<b>1.5</b>	<b>3</b>	<b>2</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEV EL	REMARKS
EST200.1	PO1	2	Illustrate the different concept and principles in Design Engineering.
	PO2	1	Analyze the different concepts in Design Engineering, in order to choose best design solution.
	PO7	1	Apply the different concepts and principles in Design Engineering to develop a sustainable design solution.
	PO10	1	Communicating the numerous design solutions developed by the designer effectively to the client through proper documentation.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Use the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth
EST200.2	PO2	2	Analyze the different design thinking approaches, inorder to reach a sustainable design solution.
	PO6	1	Apply the design thinking approach to develop design solution in context with societal needs and aspects.
	PO8	1	Apply ethical principles while proposing design solution to the client, by following norms of engineering practices.
	PO12	2	Use the knowledge in design engineering through out the phase of career development and provide effectual problem solution to the habitué.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Apply the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth
EST200.3	PO3	2	Evaluate the various adaptive and development level design to formulate a new design solution.
	PO6	1	Apply the design thinking approach to develop design solution in context with societal needs and aspects.
	PO7	1	Apply the proficiency in Design Engineering to develop a sustainable design solution.
	PO9	2	Construct design solution efficaciously in team environment or as an individual.

	PO10	2	Communicating the numerous design solutions developed by the designer effectively to the client through proper documentation.
	PO12	1	Use the knowledge in design engineering through out the phase of career development and provide effectual problem solution to the habitu�.
	PSO1	3	Practice various Design thinking approaches to develop a sustainable and economical design solution in Civil Engineering sector.
	PSO2	2	Apply the different concept, principles and design thinking approaches in proposing design solution, leading to professional career growth

<b>CET202</b>	<b>COURSE NAME: ENGINEERING GEOLOGY</b>	<b>SEMESTER: 4</b>
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**Pre-requisite:** NIL

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET 202.1	Recall the fundamental concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors in civil engineering constructions
CET 202.2	Identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors in civil engineering constructions
CET 202.3	Apply the basic concepts of surface and subsurface processes, minerals, rocks, groundwater and geological characteristics in civil engineering constructions
CET 202.4	Analyze and classify geological processes, earth materials and groundwater
CET 202.5	Evaluation of geological factors in civil engineering constructions

<b>CET202</b>			<b>COURSE NAME: ENGINEERING GEOLOGY</b>									<b>SEMESTER: 4</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET 202.1	2	-	-	-	-	1	2	-	-	-	-	-	1	1
CET 202.2	3	-	-	-	-	-	-	-	-	-	-	-	2	1
CET 202.3	3	-	-	-	-	-	-	-	-	-	-	-	1	2
CET 202.4	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CET 202.5	3	1	3	-	-	3	3	2	-	-	-	2	2	2
<b>CET202</b>	<b>2.8</b>	<b>1.5</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2.5</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>1.6</b>	<b>1.6</b>

CO	PO	LEVEL	REMARKS
CET202. 1	PO1	2	Students will be able to recall the basic concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors in civil engineering constructions
	PO6	1	Students will be able to apply the contextual knowledge on various geological processes, geological factors and general flow of groundwater with respect to the site conditions
	PO7	2	Students will be able to assess the environmental and social factors with respect to the geological nature of site condition, which will lead to sustainability
	PSO1	1	Students will be able to get sustainable solutions related to geological nature of the area considered which will benefit socio- environmental- economical factors of the society
	PSO2	1	Students will be able to get scientific knowledge for sustainable engineering solutions in a professional manner
CET202. 2	PO1	3	Students will be able to identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors as part of planning, designing and implementation of civil engineering constructions
	PSO1	2	Students will be able to get sustainable solutions related to geological nature of the area considered, which will benefit socio- environmental- economical factors of a civil engineering project
	PSO2	1	Students will be able to get scientific knowledge for sustainable engineering solutions in a professional manner
CET202. 3	PO1	3	Students will be able to apply the basic concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors while planning, designing and implementation of civil engineering constructions
	PSO1	1	Students will be able to get sustainable solutions related to geological nature of the area considered which will benefit socio- environmental- economical factors of a civil engineering project
	PSO2	2	Students will be able to get scientific knowledge for sustainable engineering solutions in a professional manner

CET202. 4	PO1	3	Students will be able to analyze and classify the geological processes, earth materials and flow of groundwater in a project site during planning, designing and implementation of civil engineering constructions
	PO2	2	The students will be able to provide sustainable solutions during complex situations related to the geological nature of a construction site
	PSO1	2	Students will be able to get sustainable solutions related to geological nature of the area considered which will benefit socio- environmental- economical factors of a civil engineering project
	PSO2	2	Students will be able to get scientific knowledge for sustainable engineering solutions in a professional manner
CET202. 5	PO1	3	Students will be able to evaluate the geological factors during planning, designing and implementation of civil engineering constructions
	PO2	1	The students will be able to provide sustainable solutions during complex situations related to the geological factors of a civil engineering project
	PO3	3	Students will be able to design structures by considering the geological factors of a site during complex situations
	PO6	3	Students will be able to apply the contextual knowledge on various geological factors with respect to the site conditions
	PO7	3	Students will be able to assess the environmental and social factors with respect to the geological factors of the project site
	PO8	2	Students will be able to apply ethical principles, professional ethics and engineering standards (IS/BIS) while considering the geological factors of a civil engineering project
	PO12	2	Students will be able to update their knowledge in geological context through a life- long learning process by considering various technological changes in the world
	PSO1	2	Students will be able to get sustainable solutions related to geological factors of the area considered which will benefit socio- environmental- economical factors of a civil engineering project
	PSO2	2	Students will be able to get scientific knowledge for sustainable engineering solutions in a professional manner



<b>COURSE CODE:</b> <b>CEL202</b>	<b>COURSE NAME: MATERIAL TESTING LAB 1</b>	<b>SEMESTER: 4</b>
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**Pre-requisite:** Engineering Physics, Mechanics of Materials. Knowledge in the use of Vernier Caliper and micro metre screw gauge.

**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL202.1	Understand the behaviour of Engineering Materials under various forms and stages of loading
CEL202.2	Characterize the elastic properties of various materials
CEL202.3	Evaluate the strength and stiffness properties of engineering materials under various loading conditions.

<b>COURSE CODE:</b> <b>CEL202</b>			<b>COURSE NAME: MATERIAL TESTING LAB 1</b>									<b>SEMESTER: 4</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL202.1	3	2	2	2	1	3	-	-	2	2	-	2	3	-
CEL202.2	3	2	2	2	1	3	-	-	2	2	-	2	3	-
CEL202.3	3	2	2	2	1	3	-	-	2	2	-	2	3	-
<b>CEL202</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>-</b>	<b>2</b>	<b>3</b>	<b>-</b>

### JUSTIFICATIONS FOR CO-PO MAPPING:

CO	PO	LEVEL	REMARKS
CEL202.1	PO1	3	Apply the stress strain characteristics of engineering materials to the solution of complex problems
	PO2	2	Assess the safety issues based on the test results of engineering materials.
	PO3	2	Demonstration of fatigue test will help them to be aware about safety while designing solutions for engineering problems.
	PO4	2	Study of strain gauges, LVDTs, load cells etc will help to design experiments, analyse and interpret datas.
	PO5	1	Study of strain gauges, LVDTs, load cells and data acquisition systems will help to model complex engineering activities
	PO6	3	By understanding the behaviour of Engineering Materials health and safety issues related to structures can be addressed.
	PO9	2	By having sound knowledge of the behaviour of engineering materials, one can be confident while working in a team assessing the strength aspects of structures
	PO10	2	Communicate to the public as well as to the concerned authorities about the strength and safety aspects of any structures
	PO12	2	Knowledge on methods of testing of engineering materials will help to study the behaviour of newly developed engineered materials
	PSO1	3	Knowledge on behaviour of materials under various loading conditions will surely have applications in all branches of civil engineering
CEL202.2	PO1	3	Assessing the elastic properties helps to solve complex engineering problems.
	PO2	2	Characterizing the elastic properties of engineering materials helps to analyze complex problems
	PO3	2	Elastic properties of materials used should be known to design different structures
	PO4	2	Knowledge on elastic properties of available materials helps to design newer composite materials and conduct experiments
	PO5	1	Know the elastic properties using modern engineering equipments

	PO6	3	Knowledge of elastic properties of materials used in construction helps to monitor the structural health in case of safety issues
	PO9	2	Able to work effectively in a team while addressing the causes of failures of structures
	PO10	2	Able to communicate and give clear instructions and write effective reports about the properties of materials used in construction
	PO12	2	Updating the testing methods using modern equipments helps life long learning
	PSO1	3	Characterizing the elastic properties helps to practice Civil Engineering within industry as well as service sectors.
CEL202.3	PO1	3	Evaluate the strength and stiffness properties of engineering materials to the solution of complex problems
	PO2	2	Evaluation of the strength and stiffness properties of engineering materials helps to identify and analyse complex engineering problems.
	PO3	2	Strength and stiffness properties of materials used should be known to design different structures
	PO4	2	After evaluating strength and stiffness properties investigations of complex problems can be conducted
	PO5	1	Know the properties using modern engineering equipments
	PO6	3	Knowledge of properties of materials used in construction helps to monitor the structural health in case of safety issues
	PO9	2	Able to work effectively in a team while addressing the causes of failures of structures
	PO10	2	Able to communicate and give clear instructions and write effective reports about the strength and stiffness properties of materials used in construction
	PO12	2	Updating the testing methods using modern equipments helps life long learning
	PSO1	3	Evaluating the strength and stiffness properties helps to practice Civil Engineering within industry as well as service sectors.

**B. Tech Semester IV**

**CET 204    GEOTECHNICAL ENGINEERING 1**

At the end of course, the student will be able to :

<b>CO 1</b>	Explain the fundamental concepts of basic and engineering properties of soil
<b>CO 2</b>	Describe the laboratory testing methods for determining soil parameters
<b>CO 3</b>	Solve the basic properties of soil by applying functional relationships
<b>CO 4</b>	Calculate the engineering properties of soil by applying the laboratory test results and the fundamental concepts of soil mechanics
<b>CO 5</b>	Analyze the soil properties to identify and classify the soil

<b>CET204</b>	<b>GEOTECHNICAL ENGINEERING 1</b>													
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>C204.1</b>	3	-	-	-	-	-	-	-	-	-	-	-	3	3
<b>C204.2</b>	3	-	-	-	-	-	-	-	-	-	-	-	3	3
<b>C204.3</b>	2	3	-	-	-	-	-	-	-	-	-	-	3	3
<b>C204.4</b>	2	3	-	-	-	-	-	-	-	-	-	-	3	3
<b>C204.5</b>	2	3	-	-	-	-	-	-	-	-	-	-	3	3
<b>Average</b>	<b>2.4</b>	<b>3</b>	-	-	-	-	-	-	-	-	-	-	<b>3</b>	<b>3</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO1	3	The student will be able to apply knowledge of mathematics, science and fundamentals to understand the basic and engineering properties of soil.
	PSO1	3	The student will be able to apply knowledge in basic soil properties in various areas of civil engineering like foundation design, geo-environmental engineering etc. throughout their career.
	PSO2	3	The student will obtain knowledge in basic soil properties which when applied to soil related problems helps to grow professionally in their careers
CO2	PO1	3	Apply fundamental concepts and mathematical knowledge to perform index tests and analyse results.
	PSO1	3	The student will be able to apply knowledge in basic soil properties in various areas of civil engineering.
	PSO2	3	The student will obtain knowledge in soil test procedures and soil classification which when applied to soil related problems helps to grow professionally in their careers
CO3	PO1	2	Apply fundamental concepts to solve the basic properties of soil by applying functional relationships.
	PO2	3	The student will be able to apply knowledge of functional relationship to calculate properties of soil.
	PSO1	3	The student will be able to apply knowledge of functional relationship to calculate properties of soil in various areas of civil engineering like foundation design, geo-environmental engineering, water resources engineering, etc. throughout their career.
	PSO2	3	The student will obtain knowledge of functional relationship to calculate properties of soil which can be applied to soil related problems.
CO4	PO1	2	The student will be able to calculate the engineering properties of soil by applying the laboratory test results and the fundamental concepts of soil mechanics.
	PO2	3	Interpret soil properties by applying suitable soil tests to various types of soils.
	PSO1	3	The student will be able to apply knowledge in the engineering properties of soil in various areas of civil engineering like foundation design, design of earth retaining structures, etc.
	PSO2	3	The student will obtain knowledge in the engineering properties of soil to find sustainable solutions to complex soil related problems.
CO5	PO1	2	The student will be able to analyse the soil properties to identify and classify the soil.
	PO2	3	Analyse soil problems and reach conclusions regarding design of structures like foundations, retaining walls etc.
	PSO1	3	The student will be able to analyse the soil properties to identify and classify the soil for solutions in various areas of civil engineering like foundation design, design of earth retaining structures, etc.

	PSO2	3	The student will apply knowledge to identify and classify the soil which makes him equipped when choosing a career in civil engineering.
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<b>COURSE CODE:</b> <b>CEL 204</b>	<b>COURSE NAME: FLUID MECHANICS LAB</b>	<b>SEMESTER: 4</b>
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**Course Outcome:**

After the successful completion of this course, the student will be able to:

CO 1	Apply fundamental knowledge of Fluid Mechanics to corresponding experiments
CO 2	Apply theoretical concepts in Fluid Mechanics to respective experiments
CO 3	Analyse experimental data and interpret the results
CO 4	Document the experimentation in prescribed manner

<b>CEL204</b>	<b>FLUID MECHANICS LAB</b>													
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>C204.1</b>	2	2	-	-	-	1	-	2	3	-	-	-	3	3
<b>C204.2</b>	2	2	-	-	-	2	-	2	3	-	-	-	3	3
<b>C204.3</b>	3	3	-	2	-	1	-	2	3	3	-	-	3	3
<b>C204.4</b>	1	-	-	-	-	-	-	2	2	3	-	-	3	3
<b>Average</b>	<b>2</b>	<b>2.33</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1.33</b>	<b>-</b>	<b>2</b>	<b>2.75</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>3</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO1	2	The student will be able to apply fundamental knowledge of Fluid Mechanics to corresponding experiments
	PO2	2	The student will be able to apply his knowledge to perform laboratory experiments.
	PO6	1	The student will be able to apply his knowledge in fluid mechanics as part of consequent responsibilities of professional life.
	PO8	2	The student will be able to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
	PO9	3	The student will be able to function effectively as an individual, and as a member in diverse teams and in multidisciplinary settings.
	PSO1	3	The student will be able to apply knowledge of Fluid Mechanics in various areas of civil engineering like water resources engineering, irrigation engineering, environmental engineering etc. throughout their career.
	PSO2	3	The knowledge in fluid mechanics will enhance the capacities of a civil engineer to grow professionally in their careers.
CO2	PO1	2	The student will be able to apply theoretical concepts of Fluid Mechanics to respective experiments.
	PO2	2	The student will be able to apply his knowledge to perform respective experiments.
	PO6	2	The student will be able to apply his knowledge in theoretical concepts of fluid mechanics as part of consequent responsibilities in professional life.
	PO8	2	The student will be able to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
	PO9	3	The student will be able to function effectively as an individual, and as a member in diverse teams and in multidisciplinary settings.
	PSO1	3	The student will be able to apply theoretical concepts of Fluid Mechanics in various areas of civil engineering like water resources engineering, irrigation engineering, environmental engineering etc. throughout their career.
	PSO2	3	The knowledge to apply theoretical concepts of Fluid Mechanics will enhance the capacities of a civil engineer to find sustainable solutions to everyday problems and thus grow professionally in their careers.
CO3	PO1	3	The student will be able to analyse experimental data and interpret the results.



	PO2	3	The student will be able to apply his knowledge to analyse experimental data and interpret the results.
	PO4	2	The student will be able to use knowledge in analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
	PO6	1	The student in his professional life can serve the society in relevant fields by analysing real life problems.
	PO8	2	The student will be able to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
	PO9	3	The student will be able to function effectively as an individual, and as a member in diverse teams and in multidisciplinary settings.
	PO10	3	The student will be able to communicate effectively on complex engineering activities with the engineering community and with society.
	PSO1	3	The student will be able to analyse experimental data and interpret the results in various areas of civil engineering like water resources engineering, irrigation engineering, environmental engineering etc. throughout their career.
	PSO2	3	The knowledge to analyse experimental data and interpret the results will enhance the capacities of a civil engineer to grow professionally in their careers in fields like environmental engineering, water resources engineering etc..
CO4	PO1	3	The student can apply his knowledge in conducting experiments relating to various flow problems, interpret and analyse data and report results.
	PO8	2	The student will be able to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
	PO9	2	The student will be able to function effectively as an individual, and as a member in diverse teams and in multidisciplinary settings.
	PO10	3	The student will be able to communicate effectively on complex engineering activities with the engineering community and with society.
	PSO1	3	The student will be able to apply knowledge of documentation on real field problems throughout their career.
	PSO2	3	The knowledge in documentation of analysis and reports of engineering experimentation will enhance the capacities of a civil engineer to grow professionally in their careers.

<b>COURSE CODE:</b> <b>CET206</b>	<b>COURSE NAME:</b> <b>TRANSPORTATION ENGINEERING</b>	<b>SEMESTER: 4</b>
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**Pre-requisite:** Nil

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET206.1	Apply the basic principles of Highway planning and design highway geometric elements
CET206.2	Apply standard code specifications in judging the quality of highway materials, designing mixes and pavements
CET206.3	Explain phenomena in road traffic by collection, analysis and interpretation of traffic data through surveys, creative design of traffic control facilities
CET206.4	Understand about railway systems, tunnels, harbor and docks
CET206.5	Express basics of airport engineering and design airport elements

<b>COURSE CODE:</b> <b>CET206</b>		<b>COURSE NAME:</b> <b>TRANSPORTATION ENGINEERING</b>										<b>SEMESTER: 4</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET206.1	3	3	3	1	-	1	3	1	-	2	-	1	2	3
CET206.2	3	1	3	1	-	1	1	1	-	1	-	1	2	2
CET206.3	3	2	2	1	-	-	-	-	1	2	-	2	2	3
CET206.4	2	-	-	-	-	-	2	1	-	-	-	2	2	3
CET206.5	3	3	3	-	-	3	-	2	-	-	-	-	2	3
<b>CET206</b>	<b>2.8</b>	<b>2.25</b>	<b>2.75</b>	<b>3</b>	<b>-</b>	<b>1.67</b>	<b>2</b>	<b>1.25</b>	<b>1</b>	<b>1.67</b>	<b>-</b>	<b>1.5</b>	<b>2.00</b>	<b>2.8</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET206.1	PO1	3	Apply the knowledge of recent developments in Highway Engineering and Highway geometric elements
	PO2	3	Identify, formulate and analyse Highway Engineering problems and arriving the solutions to the Engineering problems.
	PO3	3	Design and development of Highway systems in civil engineering.
	PO4	1	Conduct investigation and research methods in the designing of Highway geometric elements
	PO6	1	Apply knowledge to access social and safety issues in Highway engineering
	PO7	3	Understand the impact of Highway engineering solutions and demonstrate the knowledge and need for sustainable development
	PO8	1	Apply the Ethical principles and responsibilities of engineering practices
	PO10	2	Effective communication on Highway engineering activities with engineering community and society
	PO12	1	Recognize the need for Highway Engineering and having the ability to engage in life-long learning in the context of technological change
	PSO1	2	To practice Highway engineering within government and private practice, working towards sustainable solutions in transportation
PSO2	3	To grow professionally in their career and to achieve their professional aims ethically	
CET206.2	PO1	3	Apply the knowledge in specifying standard code and judging the quality of highway materials, designing mixes and pavements
	PO2	1	Identify and formulate standard code, design mixes and pavements.
	PO3	3	Design and judge the highway materials and develop design mixes
	PO4	1	Conduct Investigations in codes and quality of highway materials
	PO6	1	Apply reasoning to access social issues in quality of highway materials
	PO7	1	Understand the importance of codes and design mixes in social and environmental contexts.
	PO8	1	Apply the Ethical principles and responsibilities of engineering practices

	PO10	1	Effective communication regarding quality of Highway materials and codes with engineering community and society
	PO12	1	Recognize the importance of codes, design mixes and having the ability to engage in life-long learning in the context of technological change
	PSO1	2	Knowledge on Recent Advances in codes and design mixes which helps towards practicing as good Civil Engineers in public as well as private fields.
	PSO2	2	Help to grow professionally in technical aspect
CET206.3	PO1	3	Apply the knowledge regarding road traffic through surveys, creative design of traffic control facilities
	PO2	2	Identification, collection, analysis and interpretation of traffic data through surveys, creative design of traffic control facilities
	PO3	2	Develop phenomena in road traffic by collection and Design of traffic control facilities
	PO4	1	Conduct investigation for collection, analysis and interpretation of traffic data
	PO9	1	Function effectively as individual and teamwork for road traffic collection, analysis and interpretation
	PO10	2	Communicate effectively in surveys for the collection of traffic data
	PO12	2	Recognize the importance of survey, data collection and having the ability to engage in life-long learning in the context of technological change
	PSO1	2	Aid to practice civil engineering in design of traffic control facilities
	PSO2	3	Help to grow professionally in technical aspect
CET206.4	PO1	2	Understanding and applying knowledge about railway systems, tunnels, harbor and docks
	PO7	2	Understand the importance of about railway systems, tunnels, harbor and docks foe sustainable development
	PO8	1	Understand the responsibility of engineers in development of railway systems, tunnels, harbor and docks
	PO12	2	Recognize the need for railway systems, tunnels, harbor and docks
	PSO1	2	Aid to practice civil engineering in railway systems, tunnels, harbor and docks
	PSO2	3	Help to grow professionally in technical aspect

CET206.5	PO1	3	Enable to understand the basics of airport engineering and design airport elements
	PO2	3	Analyze, formulate problems in airport engineering
	PO3	3	Design of airport elements and development of solutions
	PO6	3	Understand the relevance of airport engineering in society
	PO8	2	Apply the ethical principles professionally regarding airport engineering
	PSO1	2	Aid to practice civil engineering in airport engineering and design airport elements
	PSO2	3	Help to grow professionally in technical aspect



### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
MCN202.1	PO6	3	Understand the Constitution to live as part of the society and to uphold constitutional values in daily life.
MCN202.2	PO6	3	Understand fundamental duties and rights to reflect them in life
MCN202.3	PO6	3	Understand the Union system
MCN202.4	PO6	3	Understand the state system
MCN202.5	PO6	3	Understand the special provisions and statutory institutions and make use if necessary
MCN202.6	PO6	3	Show national and patriotic spirit as responsible citizen of the country.

## 4. CO–PO–PSO Mapping and Justification - Semester 5

<b>COURSE CODE:</b> CET301	<b>COURSE NAME:</b> STRUCTURAL ANALYSIS 1	<b>SEMESTER: 5</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>CET301.1</b>	Apply the principles of solid mechanics to analyse trusses.
<b>CET301.2</b>	Apply various methods to determine deflections in statically determinate structures.
<b>CET301.3</b>	Identify the problems with static indeterminacy and tackling such problems by means of the method of consistent deformations and energy principles.
<b>CET301.4</b>	Apply specific methods such as slope deflection and moment distribution methods of structural analysis for typical structures with different characteristics.
<b>CET301.5</b>	Apply suitable methods of analysis for various types of structures including cables, suspension bridges and arches.
<b>CET301.6</b>	Analyse the effects of moving loads on structures using influence lines.

<b>COURSE CODE:</b> CET301			<b>COURSE NAME:</b> STRUCTURAL ANALYSIS 1									<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET301.1	2	2	1	-	-	-	-	-	-	-	-	-	3	3
CET301.2	2	2	1	-	-	-	-	-	-	-	-	-	3	3
CET301.3	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CET301.4	3	2	1	-	-	-	-	-	-	-	-	-	3	3
CET301.5	3	2	1	-	-	-	-	-	-	-	-	-	3	3
CET301.6	3	2	1	-	-	-	-	-	-	-	-	-	3	3
<b>CET301</b>	<b>2.67</b>	<b>2.17</b>	<b>1</b>	-	-	-	-	-	-	-	-	-	<b>3.00</b>	<b>3.00</b>



### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET301.1	PO1	2	Apply the fundamental methods to analyse trusses
	PO2	2	Analyse complex engineering problems
	PO3	1	Help in designing trusses
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures
CET301.2	PO1	2	Apply the fundamental methods to compute deflection
	PO2	2	Analyse complex engineering problems
	PO3	1	Help in serviceability checks
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures
CET301.3	PO1	3	Apply the fundamental methods to analyse statically indeterminate systems
	PO2	3	Analyse complex engineering problems related to redundant systems
	PO3	1	Help in designing redundant structures
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures
CET301.4	PO1	3	Apply the fundamental methods to analyse statically indeterminate systems
	PO2	2	Analyse complex engineering problems related to redundant systems
	PO3	1	Help in designing redundant structures
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures
CET301.5	PO1	3	Apply the fundamental methods to analyse cables and arches
	PO2	2	Analyse complex engineering problems related
	PO3	1	Help in designing cables and arches
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures
CET301.6	PO1	3	Apply the fundamental methods to analyse systems subjected to moving loads
	PO2	2	Analyse complex engineering problems related to moving loads
	PO3	1	Help in designing bridges
	PSO1	3	Analyse solution in future
	PSO2	3	Prepare plan, drawings and estimate modern structures

<b>COURSE CODE: CEL331</b>	<b>COURSE NAME: Material Testing Lab II</b>	<b>SEMESTER: 5</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL331. 1	To describe the basic properties of various construction materials
CEL331. 2	Characterize the physical and mechanical properties of various construction materials.
CEL331. 3	Interpret the quality of various construction materials as per IS Codal provisions.

<b>COURSE CODE: CEL331</b>		<b>COURSE NAME: Material Testing Lab II</b>										<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>P O 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL331. 1	3	2	2	2	1	3	-	-	2	2	-	2	2	2
CEL331. 2	3	2	2	2	1	3	-	-	2	2	-	2	2	2
CEL331. 3	3	2	2	2	1	3	-	-	2	2	-	2	2	2
<b>AVG.</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>2</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CEL331. 1	PO1	3	Students will be able to apply knowledge of concrete technology to the solution of properties of various construction materials.
	PO2	2	Students will be able to identify, formulate and analyse the problem in concrete technology using engineering sciences
	PO3	2	Students will be able to make use of properties of various construction materials for concrete mix design.
	PO4	2	Students will be able to interpret quality of construction materials and its application to various constructions.
	PO5	1	Student will be able to use modern tools for predicting properties of construction materials.
	PO6	3	Student will be able to gain hands-on experience in conducting laboratory tests on various construction materials and thereby evaluate material quality and performance to ensure the safety of the building.
	PO9	2	Students will be able to work as a team to evaluate the properties of different construction materials.
	PO10	2	Student will be able to explain the quality of construction materials from the test results.
	PO12	2	Student's basic knowledge on properties of materials builds the awareness and thirst for life long learning in the students about recent advancements in the concrete technology.
	PSO1	2	Students will be able to gain knowledge on concrete technology, which helps them to practice civil engineering in industry government, private practice etc
	PSO2	2	Students will be able to gain knowledge on analyzing the experimental results which helps them to grow professionally in their career.
CEL331. 2	PO1	3	Students will be able to apply knowledge of concrete technology to determine the strength of various construction materials.

	PO2	2	Students will able to identify, formulate and analyse the problem in concrete technology using engineering sciences.
	PO3	2	Students will be able to make use of properties of various construction materials for concrete mix design.
	PO4	2	Students will be able to interpret quality and strength of construction materials and its application to various constructions.
	PO5	1	Student will be able to use modern tools for predicting strength of construction materials.
	PO6	3	Student will be able to gain hands-on experience in conducting laboratory tests on various construction materials and thereby evaluate material quality and performance to ensure the safety of the building.
	PO9	2	Students will be able to work as a team to evaluate the physical and mechanical properties of various construction materials.
	PO10	2	Student will be able to explain the strength of construction materials from the test results.
	PO12	2	Students basic knowledge on properties of materials builds the awareness and thirst for life long learning in the students about recent advancements in the concrete technology.
	PSO1	2	Students will be able to gain knowledge on concrete technology, which helps them to practice civil engineering in industry government, private practice etc
	PSO2	2	Students will be able to gain knowledge on analyzing the experimental results which helps them to grow professionally in their career.
CEL331. 3	PO1	3	Students will be able to apply knowledge of mix design to the solution of properties of various construction materials.
	PO2	2	Students will able to identify, formulate and analyse the problem in concrete technology using engineering sciences.
	PO3	2	Students will be able to make use of properties of various construction materials for concrete mix design.
	PO4	2	Students will be able to interpret quality of concrete from mix design and can be able to bring innovations by designing new mixes.

	PO5	1	Student will be able to use modern tools for predicting strength of concrete
	PO6	3	Student will be able design the mix for concrete which gives the required strength so that safety of structures can be ensured.
	PO9	2	Students will be able to work as a team to design a mix for concrete of required strength.
	PO10	2	Student will be able to explain the strength of concrete from the test results.
	PO12	2	Students basic knowledge on mix design builds the awareness and thirst for life long learning in the students about recent advancements in the concrete technology.
	PSO1	2	Students will be able to gain knowledge on concrete technology, which helps them to practice civil engineering in industry government, private practice etc
	PSO2	2	Students will be able to gain knowledge on analyzing the experimental results which helps them to grow professionally in their career.

<b>COURSE CODE:</b> CEL333	<b>COURSE NAME:</b> GEOTECHNICAL ENGINEERING LAB	<b>SEMESTER: 5</b>
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**Pre-requisite:** CET 204 GEOTECHNICAL ENGINEERING I

**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL333.1	Identify and classify soil based on standard geotechnical experimental methods.
CEL333.2	Perform and analyze permeability tests.
CEL333.3	Interpret engineering behavior of soils based on test results
CEL333.4	Perform laboratory compaction, CBR and in-place density test for fill quality control in the field.
CEL333.5	Evaluate the strength of soil by performing various tests viz. direct shear test, unconfined compressive strength test and triaxial shear test.
CEL333.6	Evaluate settlement characteristics of soils.

<b>COURSE CODE:</b> CEL333			<b>COURSE NAME:</b> GEOTECHNICAL ENGINEERING LAB									<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL333.1	3	-	-	-	1	-	-	-	2	2	-	-	3	2
CEL333.2	3	-	-	-	2	-	-	-	2	2	-	-	2	2
CEL333.3	3	2	-	-	-	-	-	-	2	2	-	-	2	2
CEL333.4	3	-	-	-	1	-	-	-	2	2	-	-	2	2
CEL333.5	3	-	-	-	2	-	-	-	2	2	-	-	3	2
CEL333.6	3	1	-	-	2	-	-	-	2	2	-	-	3	3
<b>CEL333</b>	<b>3</b>	<b>1.5</b>	-	-	<b>1.6</b>	-	-	-	<b>2</b>	<b>2</b>	-	-	<b>2.5</b>	<b>2.16</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CEL333 .1	PO1	3	Apply the knowledge in geotechnical engineering to identify and classify soil based on standard experimental methods.
	PO5	1	Predict the behaviour of soil from the identified soil characteristics
	PO9	2	The students can function as a team in performing lab experiments.
	PO10	2	The students can communicate to perform, tabulate and write report on performing experiments.
CEL333 .2	PO1	3	Apply the knowledge in geotechnical engineering to perform and analyze permeability tests.
	PO5	2	Predict the behaviour of soil from permeability tests.
	PO9	2	The students can function as a team in performing permeability tests.
	PO10	2	The students can communicate to perform, tabulate and write report on performing experiments.
CEL333 .3	PO1	3	Apply the knowledge in geotechnical engineering to interpret engineering behavior of soils based on test results
	PO2	2	The student will be able to analyse behaviour of soil based on test results
	PO9	2	The students can function as a team to interpret engineering behavior of soils based on test results
	PO10	2	The students can communicate to perform, tabulate and write report on performing experiments.
CEL333 .4	PO1	3	Apply the knowledge in geotechnical engineering to perform laboratory compaction, CBR and in-place density test for fill quality control in the field.
	PO5	1	Predict the behaviour of soil from laboratory compaction, CBR and in-place density test for fill quality control in the field.
	PO9	2	The students can function as a team to interpret engineering behavior of soils based on test results
	PO10	2	The students can communicate to perform, tabulate and write report on laboratory compaction, CBR and in-place density test for fill quality control in the field.

CEL333 .5	PO1	3	Apply the knowledge in geotechnical engineering to evaluate the strength of soil by performing various tests viz. direct shear test, unconfined compressive strength test and triaxial shear test.
	PO5	2	The students can evaluate the strength of soil by performing various tests
	PO9	2	The students can function as a team to interpret the strength of soil based on test results.
	PO10	2	The students can communicate to perform, tabulate and write report on strength characteristics of soil.
CEL333 .6	PO1	3	Apply the knowledge in geotechnical engineering to evaluate settlement characteristics of soils.
	PO2	1	The student will be able to analyse settlement characteristics of soil based on test results
	PO5	2	The students can evaluate settlement of soil by performing various tests
	PO9	2	The students can function as a team to interpret the settlement characteristics of soil based on test results.
	PO10	2	The students can communicate to perform, tabulate and write report on settlement characteristics of soil.



<b>COURSE CODE:</b> <b>CET305</b>	<b>COURSE NAME:</b> <b>GEOTECHNICAL ENGINEERING-II</b>	<b>SEMESTER: 5</b>
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**Pre-requisite:** CE305 Geotechnical Engineering II

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET305.1	Understand soil exploration methods
CET305.2	Explain the basic concepts, theories and methods of analysis in foundation engineering
CET305.3	Calculate bearing capacity, pile capacity, foundation settlement and earth pressure
CET305.4	Analyze shallow and deep foundations
CET305.5	Solve the field problems related to geotechnical engineering

<b>COURSE CODE:</b> <b>CE305</b>			<b>COURSE NAME:</b> <b>GEOTECHNICAL ENGINEERING II</b>									<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET305.1	3	-	-	3	-	-	-	-	-	-	-	-	3	2
CET305.2	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CET305.3	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CET305.4	2	2	3	-	-	-	-	-	-	-	-	-	2	2
CET305.5	3	3	-	-	-	-	-	-	-	-	-	-	3	2
<b>CET305</b>	<b>2.60</b>	<b>2.67</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2.40</b>	<b>2</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET305.1	PO1	3	Apply the concept and principle of soil exploration in solving related geotechnical engineering problems.
	PO4	3	Identification of various soil exploration methods and its suitability in the field is essential in practical problem solving area in the field of Civil Engineering.
	PSO 1	3	Basic knowledge on various soil exploration methods helps to work in the field of geotechnical engineering.
	PSO 2	2	Basic knowledge on various soil exploration methods helps them to grow professionally in the geotechnical career.
CET305.2	PO1	3	Apply the basic concepts, theories and methods of analysis in foundation engineering with the geotechnical engineering fundamentals for solving foundation design related engineering problem.
	PSO 1	2	Basic knowledge on the concepts, theories and methods of analysis in foundation engineering helps to work in the field of geotechnical and foundation engineering
	PSO 2	2	Basic knowledge on the concepts, theories and methods of analysis in foundation engineering helps them to grow professionally in their career.
CET305.3	PO1	2	Apply the concept bearing capacity, pile capacity, foundation settlement and earth pressure with geotechnical engineering fundamentals for solving the engineering related problems.
	PO2	3	Study of bearing capacity, pile capacity, foundation settlement and earth pressure for practical problem solving area in Civil Engineering.
	PSO 1	2	Knowledge on basic geotechnical concepts bearing capacity, pile capacity, foundation settlement and earth pressure helps to work in the field of geotechnical engineering.
	PSO 2	2	Knowledge on bearing capacity, pile capacity, foundation settlement and earth pressure helps them to grow professionally in their career.
CET305.4	PO1	2	Apply the concept and principles of shallow as well as deep foundation with for solving the engineering problems related to shallow and deep foundation.

	PO2	2	Identification and analysis of design parameters of shallow and deep foundation is a promising practical problem solving area in Civil Engineering.
	PO3	3	Design concepts of shallow as well as deep foundation imparts strong knowledge to solve foundation related complex problems
	PSO 1	2	Knowledge on design concepts of shallow and deep foundation helps them to work in the field of civil engineering.
	PSO 2	2	Knowledge on various design concepts of shallow and deep foundation helps them to grow professionally in their career.
CET305.5	PO1	3	Apply the basic concepts of geotechnical engineering fundamentals for solving the field problems related to geotechnical engineering.
	PO2	3	Identification and analysis of various design parameters for solving the field problems related to geotechnical engineering.
	PSO 1	3	Knowledge on basic concepts of geotechnical engineering parameters and field problem solving skills helps to work in the field of structural engineering.
	PSO 2	2	Knowledge on basic concepts of geotechnical engineering parameters and field problem solving skills helps them to grow professionally in their career.

<b>CET303</b>	<b>COURSE NAME: DESIGN OF CONCRETE STRUCTURES I</b>	<b>SEMESTER: 5</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CET303.1	Recall the fundamental concepts of limit state design and code provisions for design of concrete members under bending, shear, compression and torsion.
CET303.2	Analyse reinforced concrete sections to determine the ultimate capacity in bending, shear and compression.
CET303.3	Design and detail beams, slab, stairs and footings using IS code provisions.
CET303.4	Design and detail columns using IS code and SP 16 design charts
CET303.5	Explain the criteria for earthquake resistant design of structures and ductile detailing of concrete structures subjected to seismic forces.

<b>CET303</b>			<b>COURSE NAME: DESIGN OF CONCRETE STRUCTURES I</b>									<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET303.1	1	-	1	-	-	-	-	-	-	-	-	-	2	2
CET303.2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CET303.3	3	-	3	-	-	-	-	2	-	-	-	-	3	2
CET303.4	3	-	3	-	-	-	-	2	-	-	-	-	3	2
CET303.5	1	-	1	-	-	-	-	-	-	-	-	-	2	2
<b>CET303</b>	<b>2.2</b>	<b>3</b>	<b>2</b>	-	-	-	-	<b>2</b>	-	-	-	-	<b>2.83</b>	<b>2.00</b>

CO	PO	LEVEL	REMARKS
CET303.1	PO1	1	Students will be able to apply the concepts of limit state design and code provisions for design of concrete members under bending, shear, compression, torsion and mathematics to solve different types of problems.
	PO3	1	Students will be able to identify singly reinforced beams using first principles of mathematics and engineering sciences.
	PSO1	2	Students will be able to gain knowledge on basic design methods, which helps them to work in the field of structural engineering.
	PSO2	2	Students will be able to gain knowledge on analyzing the structural members which helps them to grow professionally in their career.
CET303.2	PO1	3	Students will be able to apply the concept of limit state design and mathematics to solve different types of beams.
	PO2	3	Students will be able to apply the limit state concept to analyze beams.
	PSO1	3	Students will be able to gain knowledge on basic design methods, which helps them to work in the field of structural engineering.
	PSO2	2	Students will be able to gain knowledge on design of structural members which helps them to grow professionally in their career.
CET303.3	PO1	3	Students will be able to apply the concept of limit state design and mathematics to solve different types of structural components such as beams, slabs stairs and footings.
	PO3	3	Students will be able to design different the types of structural components such as beams, slabs stairs and footings. using first principles of mathematics and engineering sciences.
	PO8	2	Students will be able to apply the ethical principle to design the different types of structural components such as beams, slabs stairs and footings using relevant IS codes.
	PSO1	3	Students will be able to gain knowledge on basic design methods, which helps them to work in the field of structural engineering.
	PSO2	2	Students will be able to gain knowledge on design of structural members which helps them to grow professionally in their career.
CET303.4	PO1	3	Students will be able to apply the knowledge of limit state design to solve problems related to compression member design.
	PO3	3	Students will be able to identify and analyze columns using first principles of mathematics and engineering sciences.
	PO8	2	Students will be able to apply the ethical principle for the design of columns using relevant IS codes.
	PSO1	3	Students will be able to gain knowledge on basic design methods, which helps them to work in the field of structural engineering.

	PSO2	2	Students will be able to gain knowledge on design of structural members which helps them to grow professionally in their career.
CET303.5	PO1	1	Students will be able to apply the knowledge of ductile detailing for the design of earthquake resistant structures.
	PO3	1	Students will be able to identify and analyze structures subjected to earthquake forces using first principles of mathematics and engineering sciences.
	PSO1	2	Students will be able to gain knowledge on basic design methods, which helps them to work in the field of structural engineering.
	PSO2	2	Students will be able to gain knowledge on design of structural members which helps them to grow professionally in their career.

<b>COURSE CODE:</b> <b>CET307</b>	<b>COURSE NAME: HYDROLOGY &amp; WATER RESOURCES ENGINEERING</b>	<b>SEMESTER: 5</b>
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**Pre-requisite:** Nil

**Course Outcome:** After the successful completion of this course, the student will be able:

CET307.1	Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data.
CET307.2	Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering.
CET307.3	Perform the estimation of streamflow and/or describe the river behavior and control structures.
CET307.4	Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life.
CET307.5	Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells.

<b>COURSE CODE:</b> <b>CET307</b>		<b>COURSE NAME: HYDROLOGY &amp; WATER RESOURCES ENGINEERING</b>										<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET307.1	3	3	-	1	-	-	1	-	-	-	-	-	2	2
CET307.2	3	3	-	-	-	-	1	-	-	-	-	-	2	2
CET307.3	3	2	-	-	-	-	1	-	-	-	-	-	2	2
CET307.4	3	3	-	-	-	-	1	-	-	-	-	-	2	2
CET307.5	3	3	-	-	-	-	1	-	-	-	-	-	2	2
<b>CET307</b>	<b>3.00</b>	<b>2.83</b>	<b>-</b>	<b>1.00</b>	<b>-</b>	<b>-</b>	<b>1.00</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2.00</b>	<b>2.00</b>

## JUSTIFICATIONS FOR CO PO MAPPING

CO	PO	LEVEL	REMARKS
CET307.1	PO1	3	Apply the knowledge of Hydrologic Cycle for solving the engineering problems relating to Water Resources Engineering
	PO2	3	Identification of the various components of Hydrologic Cycle and arriving at valid solutions for problems in the field of Water Resources Engineering
	PO4	1	Interpretation of Hydrometeorological data for valid conclusions on precipitation.
	PO7	1	Understanding the impact meteorological information on IDF Curves of various catchments.
	PSO1	2	Knowledge on Hydrologic Cycle aspects helps towards practicing as good Civil Engineers in Hydrologic Research and Development Organizations.
	PSO2	2	Knowledge on analysis of the Hydrological Concepts in Water Resources Engineering helps them to grow professionally in their career.
CET307.2	PO1	3	Apply the concepts of Hydrograph and Hydrograph analysis fundamentals for solving the problems in Water Resources Engineering.
	PO2	3	Analyzing of the Hydrograph and Unit Hydrograph is a promising solution area in Civil Engineering.
	PO7	1	Knowledge of SPF, PMF and Return period will help in arriving at valid conclusions and projection of Flood probabilities.
	PSO1	2	Knowledge on Hydrograph aspects helps towards practicing as good Civil Engineers in Hydrologic Research and Development Organizations.
	PSO2	2	Knowledge on analysis of the Hydrograph Concepts in Water Resources Engineering helps them to grow professionally in their career.
CET307.3	PO1	3	Apply the concept of Crop Water Requirements for solving the engineering problems related to Water Resources Engineering.
	PO2	2	Formulating valid conclusions on Crop Water Requirements for System Design is a promising practical application area in Civil Engineering.
	PO7	1	Design and Development of solutions on Irrigation Systems and allied studies leads towards arriving at viable solutions on Civil Engineering problems.
	PSO1	2	Knowledge on Crop Water Requirement aspects help towards practicing as good Civil Engineers in Government Organizations.



	PSO2	2	Knowledge on analyzing the Irrigation System Concepts and Water Resources Engineering helps them to grow professionally in their career.
CET307.4	PO1	3	Apply the Knowledge of Storage Capacity of Reservoirs for arriving at suitable Conclusions on the Reservoir Life.
	PO2	3	Formulate suitable solutions to the practical problems arising in the area of Water Resources Engineering and in Civil Engineering.
	PO7	1	Demonstration of System Components of Dams and Reservoirs help the engineers to work on more complicated structures and develop feasible solutions.
	PSO1	2	Knowledge on Storage Capacity Estimation of Reservoirs help towards practicing as good Civil Engineers in Government Organizations
	PSO2	2	Knowledge on analysis of the Useful Life of Reservoirs help them to grow professionally in their career.
CET307.5	PO1	3	Apply the knowledge on Yield of Aquifers and Wells, for solving the engineering problems
	PO2	3	Formulate Conclusions from the Knowledge and Experience of Yield of Wells and Aquifers and apply them for Practical applications.
	PO7	1	The impact of environment on Yield of Aquifers and Wells help to conduct more studies in the field and help towards arriving at valid engineering solutions.
	PSO1	3	Knowledge on Yield of Aquifers and Wells help towards practicing as good Civil Engineers in Various Organizations including Government.
	PSO2	2	Knowledge on analysis about the Yield of Wells and Water Resources Engineering help them to grow professionally in their career.

<b>COURSE CODE:</b> MCN 301	<b>COURSE NAME:</b> DISASTER MANAGEMENT	<b>SEMESTER: 5</b>
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**Pre-requisite:** Nil

**Course Outcome:** After the successful completion of this course, the student will be able to:

MCN301.1	Define and use various terminologies in use in disaster management parlance and organize each of these terms in relation to the disaster management cycle
MCN301.2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment
MCN301.3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk.
MCN301.4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community.
MCN301.5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions
MCN301.6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level.

<b>COURSE CODE:</b>			<b>COURSE NAME:</b>									<b>SEMESTER: 5</b>		
<b>MCN 301</b>			<b>DISASTER MANAGEMENT</b>											
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
MCN301.1	-	2	-	-	-	2	-	-	-	2	-	2	1	1
MCN301.2	2	3	2	-	2	2	3	-	-	3	-	2	2	2
MCN301.3	2	3	2	2	2	2	3	-	-	3	-	2	2	2
MCN301.4	3	3	3	-	2	2	3	-	-	-	-	2	3	3
MCN301.5	3	3	-	-	2	2	3	-	-	-	-	2	2	2
MCN301.6	3	-	-	-	-	2	3	3	-	-	-	2	2	2
<b>MCN301</b>	<b>2.6</b>	<b>2.8</b>	<b>2.33</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2.67</b>	<b>-</b>	<b>2</b>	<b>2.00</b>	<b>2</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
MCN301.1	PO2	2	Understand the various Terminologies which help to grow professionally in technical aspect.
	PO6	2	Apply the knowledge gained to assess the disasters and take necessary measures.
	PO10	2	Help to document the Disasters for future reference.
	PO12	2	Recognize the need for Identification and proper management of Disaster.
	PSO1	1	Help to understand the various terminological aspects in industry.
	PSO2	1	Aid to prepare record of any Disasters.
MCN301.2	PO1	2	Sharpest weapon to win against disaster
	PO2	3	Enable to analyse and solve complex disaster related problems
	PO3	2	Development of new and sustainable measures to fight disaster.
	PO5	2	Hazard mapping to analyse the characteristics of Hazard.
	PO6	2	Apply the knowledge to assess the societal, health, safety and cultural issues.
	PO7	3	Apply the engineering solutions for the sustainable development.
	PO10	3	Communicate effectively with the society and professionals to give clear instructions and document in the context of disaster.
	PO12	2	Prepare to be updated everyday about the technological changes in assessment.
	PSO1	2	Aid to practice the knowledge gained in Disaster Management.
	PSO2	2	Help to grow professionally in technical aspect
MCN301.3	PO1	2	Apply the understanding of risk assessments in the advent of disasters.
	PO2	3	To put in appropriate methodologies to solve the after effects of Disasters.
	PO3	2	Design solutions with the assessment methodologies in the disaster scenario.
	PO4	2	Apply research methods and knowledge in the analysis and interpretation of Risks.
	PO5	2	Utilize appropriate methodologies to assess Risks
	PO6	2	Aware about the responsibilities and necessity of Risk assessment
	PO7	3	Utilization of Risk assessment in Societal and Environmental Context

	PO10	3	Efficient transfer of instructions regarding assessed risks and and to draft reports.
	PO12	2	To be aware of the recent technologies in risk assessment.
	PSO1	2	To develop sustainable solutions for the effective management of Disasters.
	PSO2	2	To develop technical and management skills.
MCN301.4	PO1	3	To utilize the knowledge Disaster Risk Management to solve complex disaster related issues.
	PO2	3	To identify and analyse the problems and develop possible measures to reduce disaster risks.
	PO3	3	Applying risk assessment methodologies with the proper consideration for public health and safety.
	PO5	2	Utilize the idea of phases of Disaster risk management and analyse its limitations
	PO6	2	Utilize the contextual knowledge to practice professional engineering.
	PO7	3	Recognize and demonstrate knowledge for Sustainable development
	PO12	2	Understand the need for updation of knowledge in Risk assessment measures.
	PSO1	3	Help to practice civil engineering in safeguarding the safety of environment and society
	PSO2	3	Enable career growth with the effective utilization of skills.
MCN301.5	PO1	3	Understand the nature of Disaster response and apply the knowledge to solve related problems
	PO2	3	Analyse the various disaster response actions
	PO5	2	Frame and apply Disaster response actions effectively
	PO6	2	Assess safety and health issues relevant to the disaster scenario
	PO7	3	Understand the effect of professional engineering solutions for effective management of disaster.
	PO12	2	Life long learning in the context of technological changes in the various disaster response actions
	PSO1	2	Aid to put in the knowledge to develop sustainable solutions in Practical working environment.
	PSO2	2	To be competent in work with the effective disaster response actions taken.

MCN301.6	PO1	3	Apply the knowledge of disaster management and risk reduction as solution for Disaster related problems.
	PO6	2	Apply contextual knowledge of various legislations to assess societal, safety, legal and cultural issues.
	PO7	3	practices for disaster management and risk reduction for sustainable development
	PO8	3	Apply disaster legislations maintaining ethical principles.
	PO12	2	Recognize the need for updating knowledge of risk reduction.
	PSO1	2	To practice the legislations and risk reduction measures at work in National and International levels.
	PSO2	2	Continual development of technical skills and management skills to work for disaster risk reduction globally.

<b>COURSE CODE:</b> <b>CET 309</b>	<b>COURSE NAME: CONSTRUCTION TECHNOLOGY &amp; MANAGEMENT</b>	<b>SEMESTER: 5</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CET 309.1	Describe the properties of materials used in construction
CET 309.2	Explain the properties of concrete and its determination
CET 309.3	Describe the various elements of building construction
CET 309.4	Explain the technologies for construction
CET 309.5	Describe the procedure for planning and executing public works
CET 309.6	Apply scheduling techniques in project planning and control

<b>COURSE CODE:</b> <b>CET 309</b>			<b>COURSE NAME: CONSTRUCTION TECHNOLOGY &amp; MANAGEMENT</b>									<b>SEMESTER: 5</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET 309.1	3	-	-	-	-	1	1	1	-	1	-	1	3	3
CET 309.2	3	-	-	-	-	1	-	1	-	1	-	1	3	3
CET 309.3	3	-	-	-	-	1	-	-	-	1	-	1	3	3
CET 309.4	3	-	-	-	-	2	1	-	-	1	-	1	3	3
CET 309.5	3	2	-	-	-	1	-	-	-	1	3	1	3	3
CET 309.6	3	3	3	-	1	-	-	-	2	1	3	1	3	3
<b>CET309</b>	<b>3</b>	<b>2.5</b>	<b>3</b>	<b>-</b>	<b>1</b>	<b>1.2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>

## JUSTIFICATIONS FOR CO- PO MAPPING

CO	PO	LEV EL	REMARKS
<b>CET 309.1</b>	PO1	3	Understand the properties of materials used in construction.
	PO6	1	Helps to apply the knowledge on the properties of materials used in construction for the societal requirements
	PO7	1	Helps to develop sustainable and environmental constructions
	PO8	1	Helps to use the different construction materials ethically and responsibly
	PO10	1	Setup an effective communication in construction site
	PO11	1	Apply the knowledge on different materials to manage the work site
	PSO1	3	Apply the knowledge on different materials to practice civil engineering in construction
	PSO2	3	Apply the knowledge on different materials to grow professionally in technical aspect
<b>CET 309.2</b>	PO1	3	Understand the properties of concrete used in construction.
	PO6	1	Helps to apply the knowledge on concrete for the societal requirements
	PO8	1	Helps to use the concrete ethically and responsibly
	PO10	1	Setup an effective communication in construction site
	PO12	1	Helps to adapt with the technological changes in the field
	PSO1	3	Apply the knowledge on concrete to practice civil engineering in construction
	PSO2	3	Apply the knowledge on concrete to grow professionally in technical aspect
<b>CET 309.3</b>	PO1	3	Understand various elements of building in construction.
	PO6	1	Helps to select appropriate building element for the societal requirements
	PO10	1	Setup an effective communication in construction site
	PO12	1	Helps to adapt with the technological changes in the field
	PSO1	3	Apply the knowledge on various building components to practice civil engineering in construction
	PSO2	3	Apply the knowledge on various building components to excel in professional career.
<b>CET 309.4</b>	PO1	3	Understand various building technologies used in construction.
	PO6	2	Helps to apply the knowledge on the building technologies for the societal requirements
	PO7	1	Helps to develop sustainable solutions and environmental constructions
	PO10	1	Setup an effective communication in construction site



	PO12	1	Helps to adapt with the technological changes in the field
	PSO1	3	Study various building technologies to practice civil engineering in construction
	PSO2	3	Apply the knowledge on various building technologies to excel in professional career.
<b>CET 309.5</b>	PO1	3	Understand the basics of construction planning.
	PO2	2	Helps to apply the knowledge on construction management formulate substantial conclusions on planning
	PO6	1	Helps to apply the basics of construction planning for the safe and healthy conduct of construction procedures
	PO10	1	Setup an effective communication in construction site
	PO11	3	Apply the knowledge on planning to manage the work site
	PO12	1	Helps to adapt with the technological changes in the field
	PSO1	3	Apply the knowledge on construction planning to practice civil engineering in construction
	PSO2	3	Apply the knowledge on management to grow professionally in technical aspect
<b>CET 309.5</b>	PO1	3	Understand the basics of scheduling techniques in project planning and control
	PO2	3	Helps to apply the knowledge on scheduling techniques to formulate substantial conclusions on planning
	PO3	3	Helps to plan constructions considering the safety, health and environmental considerations.
	PO5	1	Helps to select appropriate resources and techniques for the project
	PO9	2	Helps to function effectively in a multi-disciplinary settings of resources
	PO10	1	Setup an effective communication in construction site
	PO11	3	Apply the knowledge construction scheduling to manage the projects in multi-disciplinary environments
	PO12	1	Helps to adapt with the technological changes in the field
	PSO1	3	Apply the knowledge on construction scheduling to practice civil engineering in construction
	PSO2	3	Apply the knowledge on scheduling to grow professionally in technical aspect

## 5. CO–PO–PSO Mapping and Justification- Semester 6

<b>COURSE CODE:</b> HUT 300	<b>COURSE NAME: INDUSTRIAL ECONOMICS AND FOREIGN TRADE</b>	<b>SEMESTER: 6</b>
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**Prerequisite:** Nil

**Course Outcomes:** After completion of the course the student will be able to:

<b>CO 1</b>	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare.
<b>CO 2</b>	Take appropriate decisions regarding volume of output and to evaluate the social cost of production
<b>CO 3</b>	Determine the functional requirement of a firm under various competitive conditions
<b>CO 4</b>	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society
<b>CO 5</b>	Determine the impact of changes in global economic policies on the business opportunities of a firm

### Mapping of course outcomes with program outcomes (Minimum requirement)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	-	-	-	-	-	-	-	-	-	3	-	1	-
CO 2	2	2	-	-	2	2	3	-	-	-	3	-	1	-
CO 3	2	2	1	-	-	-	-	-	-	-	3	-	1	-
CO 4	2	2	1	-	-	1	-	-	-	-	3	-	1	-
CO 5	2	2	1	-	-	-	-	-	-	-	3	-	1	-
<b>Average</b>	2	2	1	-	2					-	3	-	1	-

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO 1	PO 1	2	By understanding the Scarcity and choice – Basic economic problems - PPC
	PO11	3	By understanding the changes in demand and supply and its effects student will be able to engage in continuous learning.
	PSO1	1	By understanding the basic concepts and demand, supply analysis, the students will be able to Apply knowledge of mathematics ,science and engineering to design commission and maintain various type of electrical systems and address challenges in the field.
CO 2	PO 1	2	By understanding the Production function and law of variable proportion.
	PO 2	2	By understanding the Economies of scale – internal and external economies of scale.
	PO5	2	By understanding the Cost concepts, students will be able to communicate on complex engineering activities with the engineering community and with the society.
	PO6	2	By understanding the Short run cost curves & Long run cost curves.
	PO7	3	By analyzing the Revenue (concepts) – shutdown point – Break-even points students will be able to engage in continuous learning
	PO11	3	By analyzing the production and cost student will be able to engage in continuous learning.
	PSO1	1	By understanding the production and cost, the students will be able to Apply knowledge of mathematics ,science and engineering to design commission and maintain various type of electrical systems and address challenges in the field.
	PO 1	2	By analyzing the market structure, types and product pricing, the student will be able to apply the knowledge to find solution of complex engineering problems.

CO 3	PO 2	2	By analyzing market structure , types and product pricing , the student will be able to identify, analyze and make conclusions of simple engineering problems.
	PO 3	1	By analyzing market structure, types and product pricing,, the student will be able to design solutions for simple engineering problems.
	PO 11	3	By analyzing market structure, types and product pricing, the student will be able to conduct investigations of complex problems and provide valid conclusions.
	PSO1	1	By analysing, market structure,types and product pricing the student will be able to apply knowledge of mathematics ,science and engineering to design commission and maintain various type of electrical systems and address challenges in the field

CO 4	PO 1	2	By understanding the macro economic concepts, Inflation and business financing, the student will be able to apply the knowledge on complex engineering problems.
	PO 2	2	By understanding the macro economic concepts, Inflation and business financing, the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	1	By understanding the macro economic concepts, Inflation and business financing , the student will be able to engage in continuous learning..
	PO6	1	By understanding the macro economic concepts, Inflation and business financing , the student will be able to engage in continuous learning.
	PO 11	3	By understanding the macro economic concepts, Inflation and business financing the student will be able to conduct investigations of complex problems and provide valid conclusions.
	PSO1	1	By understanding the macro economic concepts, Inflation and business financing , the student will be able to apply knowledge of mathematics ,science and engineering to design commission and maintain various type of electrical systems and address challenges in the field
CO 5	PO 1	2	By understanding international trade, trade policy and tariff and non-tariff barriers the students will be able to apply the knowledge on complex engineering problems..
	PO 2	2	By understanding international trade, trade policy and tariff and non-tariff barriers the student will be able to identify formulate and analyze simple engineering problems.
	PO 3	1	By understanding international trade, trade policy and tariff and non-tariff barriers the student will be able to design solutions for simple engineering problems.
	PO 11	3	By understanding international trade, trade policy and tariff and non-tariff barriers , the student will be able to conduct investigations of complex problems and provide valid conclusions.
	PSO 1	1	By understanding international trade, trade policy and tariff and non-tariff barriers the students will be able to apply knowledge of mathematics ,science and engineering to design commission and maintain various type of electrical systems and address challenges in the field.

<b>COURSE CODE:</b> <b>CET306</b>	<b>COURSE NAME: DESIGN OF HYDRAULIC STRUCTURES</b>	<b>SEMESTER: 6</b>
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**Pre-requisite:** Water Resources Engineering

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET306.1	Elucidate the causes of failure, principles of design of different components of hydraulic structures
CET306.2	Describe the features of canal structures and perform the design of alluvial canals
CET306.3	Perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls, cross regulator
CET306.4	Prepare the scaled drawings of different minor irrigation structures
CET306.5	Describe the design principles and features of dams and perform the stability analysis of gravity dams

<b>COURSE CODE:</b> <b>CE302</b>			<b>COURSE NAME: DESIGN OF HYDRAULIC STRUCTURES</b>									<b>SEMESTER: 6</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CE302.1	3	2					1						2	2
CE302.2		2											2	2
CE302.3	3	3											2	2
CE302.4										3			2	2
CE302.5	3	2				1	1						2	2
<b>AVG.</b>	<b>3</b>	<b>2.5</b>				<b>1</b>	<b>1</b>			<b>3</b>			<b>2</b>	<b>2</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CE302.1	PO1	3	Applying engineering fundamentals and empirical equations to design diversion headworks
	PO2	2	Understand various failures of diversion headworks.
	PO7	1	Basics of designing weir for sustainable development of society.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for designing diversion headworks.
CE302.2	PO2	2	Understand various cross drainage works and regulators.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for designing canals and related structures.
CE302.3	PO1	3	Applying engineering fundamentals and empirical equations to design minor irrigation works.
	PO2	3	Understand various minor irrigation works.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for designing minor irrigation structures.
CE302.4	PO10	3	Basics of designing gravity dams for sustainable development of society.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for analyzing gravity dams.
CE302.5	PO1	3	Applying engineering fundamentals to analyze earth dams.
	PO2	2	Understanding failures of earth dams
	PO6	1	To understand basics of design considerations of earth and arch dams.
	PO7	1	Basics of designing dams for sustainable development of society.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for analyzing gravity dams.

<b>COURSE CODE:</b> <b>CET308</b>	<b>COURSE NAME: COMPREHENSIVE COURSE</b> <b>WORK</b>	<b>SEMESTER: 6</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CET308.1	Learn to prepare for a competitive examination
CET308.2	Comprehend the questions in Civil Engineering field and answer them with confidence.
CET308.3	Communicate effectively with faculty in scholarly environments.
CET308.4	Analyze the comprehensive knowledge gained in basic courses in the field of Civil Engineering

<b>COURSE CODE:</b> <b>CET308</b>		<b>COURSE NAME: COMPREHENSIVE COURSE</b> <b>WORK</b>										<b>SEMESTER: 6</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET308.1	3	1	1	-	-	2	-	-	-	-	-	-	2	1
CET308.2	3	1	-	-	-	2	-	-	-	3	-	-	1	1
CET308.3	3	1	-	-	1	2	-	-	-	3	-	-	1	2
CET308.4	3	3	-	-	1	2	-	-	-	-	-	-	1	1
<b>AVG.</b>	<b>3</b>	<b>1.5</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>1.25</b>	<b>1.25</b>



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET308.1	PO1	3	Comprehensive knowledge gained from mathematics and engineering fundamentals contribute to solving complex engineering problems.
	PO2	1	Comprehensive knowledge gained in basic courses relevant to the civil engineering branch contribute to identify, formulate, review research literature and analyse complex engineering problems.
	PO3	1	Comprehensive knowledge gained in basic courses can be utilized in designing and developing solutions for complex engineering problems.
	PO6	2	Comprehensive knowledge gained in design and engineering courses helps to apply reasoning informed by the contextual knowledge to assess societal and safety issues and the consequent responsibilities relevant to the professional engineering practice.
	PSO1	2	Comprehensive knowledge gained from different technical specialties helps them to practice civil engineering in industry government, private practice etc
	PSO2	1	Comprehensive knowledge gained gained in basic courses in civil engineering helps them to grow professionally in their career.
CET308.2	PO1	3	Comprehensive knowledge gained from mathematics and engineering fundamentals contribute to solving complex engineering problems.
	PO2	1	Comprehensive knowledge gained in basic courses relevant to the civil engineering branch contribute to identify, formulate, review research literature and analyse complex engineering problems.
	PO6	2	Comprehensive knowledge gained in design and engineering courses helps to apply reasoning informed by the contextual knowledge to assess societal and safety issues and the consequent responsibilities relevant to the professional engineering practice.
	PO10	3	Comprehensive knowledge gained in basic courses in civil engineering helps them to communicate effectively on complex engineering activities with confidence.
	PSO1	1	Comprehensive knowledge gained from different technical specialties helps them to practice civil engineering in industry government, private practice etc

	PSO2	1	Comprehensive knowledge gained from the course helps them to grow professionally in their career.
CET308.3	PO1	3	Comprehensive knowledge gained from mathematics and engineering fundamentals contribute to solving complex engineering problems.
	PO2	1	Comprehensive knowledge gained in basic courses relevant to the civil engineering branch contribute to identify, formulate, review research literature and analyse complex engineering problems.
	PO5	1	Comprehensive knowledge gained from different courses in civil engineering helps them to use modern tools to model complex engineering activities.
	PO6	2	Comprehensive knowledge gained in design and engineering courses helps to apply reasoning informed by the contextual knowledge to assess societal and safety issues and the consequent responsibilities relevant to the professional engineering practice.
	PO10	3	Comprehensive knowledge gained in basic courses in civil engineering helps them to communicate effectively on complex engineering activities with confidence.
	PSO1	1	Comprehensive knowledge gained from different technical specialties helps them to practice civil engineering in industry government, private practice etc
	PSO2	2	Comprehensive knowledge gained from the course helps them to grow professionally in their career.
CET308.4	PO1	3	Comprehensive knowledge gained from mathematics and engineering fundamentals contribute to solving complex engineering problems.
	PO2	3	Comprehensive knowledge gained in basic courses relevant to the civil engineering branch contribute to identify, formulate, review research literature and analyse complex engineering problems.
	PO5	1	Comprehensive knowledge gained from different courses in civil engineering helps them to use modern tools to model complex engineering activities.
	PO6	2	Comprehensive knowledge gained in design and engineering courses helps to apply reasoning informed by the contextual knowledge to assess societal and safety issues and the consequent responsibilities relevant to the professional engineering practice.

	PSO1	1	Comprehensive knowledge gained from different technical specialties helps them to practice civil engineering in industry government, private practice etc
	PSO2	1	Comprehensive knowledge gained from the course helps them to grow professionally in their career.

<b>COURSE CODE:</b> CEL 332	<b>COURSE NAME: TRANSPORTATION ENGINEERING LAB</b>	<b>SEMESTER: 6</b>
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**Pre-requisite:** CET 206 TRANSPORTATION ENGINEERING I

**Course Outcome:** After the successful completion of this course, the student will be able:

CO 1	Analyse the suitability of soil as a pavement subgrade material
CO 2	Assess the suitability of aggregates as a pavement construction material
CO 3	Characterize bitumen based on it's properties so as to recommend it as a pavement construction material
CO 4	Design Bituminous mixes for pavement layers
CO 5	Assess functional adequacy of pavements based on roughness of pavement surface.

<b>COURSE CODE:</b> CEL 332			<b>COURSE NAME: TRANSPORTATION ENGINEERING LAB</b>									<b>SEMESTER: 6</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CO1	3	-	-	2	-	-	-	1	2	-	-	-	2	2
CO2	3	-	-	2	-	-	-	1	2	-	-	-	2	2
CO3	3	-	-	2	-	-	-	1	2	-	-	2	2	2
CO4	3	-	-	2	-	-	-	1	2	-	-	2	2	2
CO5	3	-	-	2	-	-	-	1	2	-	-	2	2	2
	<b>3.00</b>	-	-	<b>2.00</b>	-	-	-	<b>1.00</b>	<b>2.00</b>	-	-	<b>2.00</b>	<b>2.00</b>	<b>2.00</b>

### JUSTIFICATIONS FOR CO-PO MAPPING:

CO	PO	LEVEL	REMARKS
CEL332.1	PO1	3	Apply the knowledge of Transportation Engineering for analysing the soil as a pavement subgrade material based on standard experimental methods.
	PO4	2	Interpretation of valid conclusions on suitability of soil as a pavement subgrade material from the identified soil characteristics.
	PO8	1	Commit to professional ethics and responsibilities and norms of the Engineering practice.
	PO9	2	The students can function as a team in performing lab experiments.
	PSO1	2	Knowledge on suitability of the soil as a pavement subgrade helps towards practicing as good Civil Engineers in Public Works Department and other Engineering Organizations.
	PSO2	2	Knowledge on analysis of soil as a pavement subgrade material, helps them to grow professionally in their career.
CEL332.2	PO1	3	Apply the knowledge in transportation engineering to perform experiments on aggregates for assessing suitability as a pavement construction material.
	PO4	2	Interpretation of valid conclusions on assessing the suitability of given aggregates as a pavement construction material.
	PO8	1	Commit to professional ethics while arriving at valid conclusions in assessment of suitability of aggregates as a pavement material.
	PO9	2	The students can perform as a team in performing tests on aggregates.
	PSO1	2	Knowledge on assessing the suitability of aggregates as a pavement construction material helps in practising as good Civil Engineer.
	PSO2	2	Knowledge on assessment of suitability of given aggregates help them to grow professionally in their career.
CEL332.3	PO1	3	Apply the knowledge in transportation engineering to perform experiments on bitumen to characterize it as a pavement construction material.
	PO4	2	Interpretation of valid conclusions on characterizing bitumen based on it's properties as a pavement construction material.
	PO8	1	Commit to professional ethics in recommending the particular bitumen as a pavement construction material.
	PO9	2	The students can perform as a team in performing tests on bitumen.

	PO12	2	Recognize the ability in life - long learning on characterizing bitumen based on it's properties as a pavement construction material.
	PSO1	2	Knowledge on characterizing bitumen based on it's properties as a pavement construction material help towards practicing as good Civil Engineer in Organizations.
	PSO2	2	Knowledge on characterizing and recommending bitumen based on it's properties assessed by lab. experiments helps them to grow professionally in their career.
CET307.4	PO1	3	Apply the Knowledge of transportation engineering in the design of bituminous mixes for pavement layers.
	PO4	2	Interpretation of valid conclusions in design of bituminous mixes for pavement layers.
	PO8	1	Commit to professional ethics in recommending the bituminous mixes for pavement layers.
	PO9	2	The students can perform as a team in performing experiments on bituminous mix design.
	PO12	2	Recognize the need and ability in life-long learning for design of bituminous mixes for pavements layers.
	PSO1	2	Knowledge on design of bituminous mixes help towards practicing as good Civil Engineers in various Organizations.
	PSO2	2	Knowledge on design of bituminous mixes help them to grow professionally in their career.
CET307.5	PO1	3	Apply the knowledge on transportation engineering in assessing the functional adequacy of pavements based on roughness measured experimentally.
	PO4	2	Interpretation of valid conclusions on functional adequacy of pavements based on roughness.
	PO8	1	Commit to professional ethics in recommending the pavement layers based on roughness assessed through experiments.
	PO9	2	The students can perform as a team in performing experiments on assessing pavement roughness.
	PO12	2	Recognize the need and ability in life-long learning for assessing functional adequacy based on roughness of pavement surface.

	PSO1	3	Knowledge on assessing the functional adequacy of pavements based on roughness helps in practicing as good Civil Engineers in Various Organizations including Government.
	PSO2	2	Knowledge on assessing roughness of pavement layers help them to grow professionally in their career.

<b>COURSE CODE:</b> <b>CET362</b>	<b>COURSE NAME:</b> <b>ENVIRONMENTAL IMPACT ASSESSMENT</b>	<b>SEMESTER: 6</b>
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**Pre-requisite:** NIL

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET362.1	To appreciate the need for minimizing the environmental impacts of developmental activities
CET362.2	To understand environmental legislation & clearance procedure in the country
CET362.3	To apply various methodologies for assessing the environmental impacts of any developmental activity
CET362.4	To prepare an environmental impact assessment report
CET362.5	To conduct an environmental audit

<b>COURSE CODE:</b> <b>CET362</b>			<b>COURSE NAME:</b> <b>ENVIRONMENTAL IMPACT ASSESSMENT</b>									<b>SEMESTER: 6</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET362.1	-	-	-	-	-	2	2	-	-	-	-	-	2	2
CET362.2	-	-	-	-	-	2	-	-	-	-	-	-	2	2
CET362.3	2	-	-	3	2	-	3	-	-	-	-	-	2	2
CET362.4	-	-	-	2	-	2	2	3	-	3	-	-	2	2
CET362.5	-	-	-	2	1	-	2	2	-	2	-	-	2	2
<b>AVG.</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2.33</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>2.5</b>	<b>-</b>	<b>2.5</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET362.1	PO6	2	Students will be able to assess intelligibly societal, health, safety, legal and cultural issues associated with developmental activities
	PO7	2	Students will be able to suggest sustainable solutions for impacts associated with different developmental activities in societal and environmental contexts.
	PSO1	2	Knowledge on various impacts of developmental activities helps to grow as a civil engineer working towards sustainable solutions in different facets of civil engineering.
	PSO2	2	Knowledge on various impacts of developmental activities helps civil engineering graduates to grow professionally in their career and to achieve their professional aims ethically and with cultural competency.
CET362.2	PO6	2	Students will be able to apply contextual knowledge of environmental legislation and clearance procedure in the country.
	PSO1	2	Knowledge on environmental legislation and clearance procedure in the country helps to practice civil engineering within industry, government and private sectors.
	PSO2	2	Knowledge on environmental legislation and clearance procedure helps civil engineering graduates to grow professionally in their career.
CET362.3	PO1	2	Students will be able to apply the knowledge of science and engineering to assess the environmental impacts of any developmental activity.
	PO4	3	Students will be able to apply various methodologies for assessing, analyzing and interpreting the environmental impacts of any developmental activity by using research based knowledge.
	PO5	2	Students will be able to apply modern engineering and IT tools for predicting the impacts of developmental activities.
	PO7	3	Students will be able to understand the socio-economic impacts of different projects and demonstrate the need for sustainable development.
	PSO1	2	Knowledge on the various methodologies for assessing the environmental impacts of different projects helps to work in the field of civil engineering.
	PSO2	2	Knowledge on various methodologies for assessing the environmental impacts helps the graduates to grow professionally in their career through continued development of technical, management and communication skills.
CET362.4	PO4	2	Students will be able to use research based knowledge and research methods for the preparation of environmental impact assessment report.

	PO6	2	Students will be able to apply reasoning informed by the contextual knowledge for the preparation of environmental impact assessment report.
	PO7	2	Students will be able to demonstrate the knowledge and need for sustainable development while preparing the environmental impact assessment report.
	PO8	3	Students will be able to apply ethical principles and commitment to professional ethics for the preparation of environmental impact assessment report.
	PO10	3	Communicate effectively on the impacts of development activities with the engineering community and society as well, comprehend and write effective reports and make effective presentations.
	PSO1	2	Preparation of environmental impact assessment report helps to work in the field of civil engineering involving developmental activities.
	PSO2	2	Preparation of environmental impact assessment report helps the graduates to grow professionally in their career as their communication, documentation and presentation skills are improved.
CET362.5	PO4	2	Students will be able to analyse, interpret data and synthesis information to provide valid conclusions while conducting environmental audit.
	PO5	1	Student will be able to use modern engineering and IT tools while conducting the environmental audit.
	PO7	2	Students will be able to demonstrate the knowledge of and need for sustainable development while conducting the environmental audit.
	PO8	2	Students will develop a commitment to professional ethics while conducting the environmental audit.
	PO10	2	Students will be able to develop their communication skills, write effective reports, make effective presentation and design documentation while conducting the environmental audit.
	PSO1	2	Knowledge on conducting environmental audit helps the graduates to perform environmental audits in the field of civil engineering.
	PSO2	2	Knowledge on conducting environmental audit helps the graduates to grow professionally in their career and strive towards development of their communication and presentation skills and ability to give and clear receive instructions.



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET304.1	PO6	2	Knowledge gained in environmental engineering helps in applying reasoning informed by the contextual knowledge to assess societal issues related to water supply and waste water disposal and the consequent responsibilities relevant to the professional engineering practice.
	PO7	2	The impact of environmental engineering solutions in the context of environment and society can be utilized in demonstrating the need towards sustainable development
	PSO1	3	The knowledge gained from environmental engineering helps the students to practice in industry, government and also for private practice.
	PSO2	3	The knowledge gained about this water and waste water systems helps the students to grow professionally in their career.
CET304.2	PO1	3	The knowledge gained about the collection and conveyance of water and waste water can contribute to solving complex engineering problems.
	PO3	3	The knowledge gained about the collection and conveyance of water and waste water can contribute to the design solutions for complex engineering problems to meet the specified needs of the society with special consideration to public health.
	PSO1	3	The knowledge gained about the collection and conveyance of water and waste water can help in practicing in industry, government, and also for private practice.
	PSO2	3	The knowledge gained in this course helps the students to grow professionally in their career.
CET304.3	PO1	3	Knowledge gained about natural water purification processes in an engineered environment can contribute to solving complex engineering problems.
	PO3	3	Knowledge gained about natural water purification processes helps the students to use modern tools to model complex engineering activities.
	PSO1	3	The knowledge gained about water purification processes help the students to practice in industry, government, private practice etc.

	PSO2	3	The knowledge gained about the purification processes help the students to grow professionally in their career.
CET304.4	PO1	3	The understanding of appropriate technology for water and waste water treatment helps the students to apply their knowledge in contribute to solving complex problems.
	PO3	3	The knowledge gained about the appropriate technology for water and waste water treatment helps the students in identification and analysis of complex engineering problems.
	PSO1	3	The knowledge gained about the appropriate technology for water and waste water treatment helps the students to practice in various industries related to the expulsion of waste water and the treatment required before expulsion into natural water bodies.
	PSO2	3	The knowledge gained about various technologies for water and waste water treatment helps the students to grow professionally in their career.

<b>CET302</b>	<b>COURSE NAME: STRUCTURAL ANALYSIS 2</b>	<b>SEMESTER: 6</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CET302.1	Understand the principles of plastic theory and its applications in structural analysis.
CET302.2	Examine the type of structure and decide on the method of analysis.
CET302.3	Apply approximate methods of analysis for framed structures to ascertain stress resultants approximately but quickly.
CET302.4	Apply the force method to analyse framed structures.
CET302.5	Apply the displacement methods to analyse framed structures
CET302.6	Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures

<b>CET302</b>			<b>COURSE NAME: STRUCTURAL ANALYSIS</b>									<b>SEMESTER: 6</b>		
			<b>2</b>											
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET302.1	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CET302.2	3	3	2	-	-	-	-	-	-	-	-	-	2	2
CET302.3	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CET302.4	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CET302.5	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CET302.6	3	3	1	-	-	-	-	-	-	-	-	-	2	2
<b>CET302</b>	<b>3.00</b>	<b>2.83</b>	<b>1.20</b>	-	-	-	-	-	-	-	-	-	<b>2.50</b>	<b>2.50</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET302.1	PO 1	3	Apply the concept of Plastic analysis for solving the engineering problems
	PO 2	2	Basic knowledge of Plastic Theory will help to analyse the structures more effectively which is similar to the real life civil engineering problem.
	PSO 1	2	Knowledge on basic structural analysis methods helps to work in the field of structural engineering.
	PSO 2	2	Knowledge on application of plastic theory on analysis helps them to grow professionally in their career.
CET302.2	PO 1	3	Apply the fundamental knowledge to decide on the different methods to analyse civil engineering structures
	PO 2	3	Identify and formulate solutions for the concerned problem
	PO 3	2	Development of solutions for the civil engineering problems
	PSO 1	2	Knowledge on different structural analysis methods helps to work in the field of structural engineering
	PSO 2	2	Knowledge on different structural analysis methods helps to grow professionally in career.
CET3023	PO 1	3	Apply the fundamental knowledge to decide on the different methods to analyse framed structures under different types of loading
	PO 2	3	Identify and formulate solutions to analyse framed structures under different types of loading
	PO 3	1	Development of solutions to analyse framed structures under different types of loading
	PSO 1	3	Knowledge on different structural analysis methods helps to work in the field of structural engineering
	PSO 2	3	Knowledge on different structural analysis methods helps to grow professionally in career.

CET302.4	PO 1	3	Apply basic knowledge in force method of analysis for solving framed structures
	PO 2	3	Analyse framed structures using force method of analysis
	PO 3	1	Formulate solutions for the structural safety of framed buildings using force method of analysis
	PSO 1	3	Matrix methods are fundamental principle in many real life applications in civil engineering.
	PSO 2	3	Matrix methods follows main field applications in the analysis of large and complex structures and helps to grow professionally in career.
CET302.5	PO 1	3	Apply basic knowledge in displacement method of analysis for solving framed structures
	PO 2	3	Analyse framed structures using displacement method of analysis
	PO 3	1	Formulate solutions for the structural safety of framed buildings using displacement method of analysis
	PSO 1	3	Matrix methods are fundamental principle in many real life applications in civil engineering.
	PSO 2	3	Matrix methods follows main field applications in the analysis of large and complex structures and helps to grow professionally in career.
CET302.6	PO 1	3	Apply the concept of dynamic behavior for solving the engineering problems
	PO 2	3	Basic knowledge of dynamic behavior will help to analyse the structures more effectively which is similar to the real life civil engineering problem.
	PO 3	1	Basic concept of dynamic behavior helps in designing structures for dynamic loadings.
	PSO 1	2	Knowledge on dynamic behavior helps to work in the field of structural engineering.



	PSO 2	2	Knowledge on dynamic behavior of structures helps to handle real life analysis for earthquake/wind loads and help to grow professionally in career.
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<b>COURSE CODE: CEL334</b>	<b>COURSE NAME: CIVIL ENGINEERING SOFTWARE LAB</b>	<b>SEMESTER: 6</b>
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**Pre-requisite:** Civil Engineering drawing, structural analysis and design courses, surveying lab.

**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL334.1	To undertake analysis and design of multi-storeyed framed structure, schedule a given set of project activities using a software.
CEL334.2	To prepare design details of different structural components, implementation plan for a project.
CEL334.3	To prepare a technical document on engineering activities like surveying , structural design and project planning.

<b>COURSE CODE: CE302</b>			<b>COURSE NAME: DESIGN OF HYDRAULIC STRUCTURES</b>									<b>SEMESTER: 6</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL334.1	3	2	2	2	1	3			2	2			2	2
CEL334.2	3	2	2	2	1	3			2	2			2	2
CEL334.3	3	2	2	2	1	3			2	2			2	2
<b>AVG.</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>			<b>2</b>	<b>2</b>			<b>2</b>	<b>2</b>

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CEL334.1	PO1	3	Graduates can apply the knowledge of mathematics, science, engineering fundamentals for analysis and design of multi-storeyed framed structure
	PO2	2	An ability to identify, formulate analysis and design of multi-storeyed framed structure reaching conclusions using principles of mathematics and engineering sciences.
	PO3	2	An ability to plan, analysis and design of multi-storeyed framed structure and implement engineering problems and design system components or processes to meet the specified needs.
	PO4	2	An ability to design of experiments, analysis and design of multi-storeyed framed structure and interpretation of data, and synthesis of the information to provide valid conclusions.
	PO5	1	An ability to apply appropriate techniques, resources, and modern engineering and IT tools for analysis and design of multi-storeyed framed structure
	PO6	3	An ability to apply contextual knowledge to assess responsibilities relevant to analysis and design of multi-storeyed framed structure.
	PO9	2	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to accomplished a common goal.
	PO10	2	An ability to communicate effectively on analysis and design of multi-storeyed framed structure with the engineering community and write effective reports and design documentation, and make effective presentations.
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for designing and analysis of structures along with time and cost management knowledge.
CEL334.2	PO1	3	Graduates can apply the knowledge of mathematics, science, engineering fundamentals for design detailing and project planning.
	PO2	2	An ability to identify, formulate and analyze Civil engineering problems for design detailing and project planning ,reaching substantiated conclusions using principles of mathematics and engineering sciences.
	PO3	2	An ability to plan, analyze, design and implement engineering problems and design system components or processes to meet the specified needs.
	PO4	2	An ability to design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
	PO5	1	An ability to apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
	PO6	3	An ability to apply contextual knowledge to assess responsibilities relevant to design detailing and project planning.
	PO9	2	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to accomplished a common goal.
	PO10	2	An ability to communicate effectively on for design detailing and project planning and write effective reports and design documentation, and make effective presentations
	PSO1	2	Knowledge to provide sustainable solutions for the society.

	PSO2	2	Develop technical competency for designing and analysis of structures along with time and cost management knowledge.
CEL334.3	PO1	3	Graduates can apply the knowledge of mathematics, science, engineering fundamentals for surveying , structural design and project planning.
	PO2	2	An ability to identify, formulate and analyze for surveying , structural design and project planning, reaching substantiated conclusions using principles of mathematics and engineering sciences.
	PO3	2	An ability to plan, analyze, design and implement surveying , structural design and project planning and design system components or processes to meet the specified needs.
	PO4	2	An ability to design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
	PO5	1	An ability to apply appropriate techniques, resources, and modern engineering and IT tools for surveying , structural design and project planning.
	PO6	3	An ability to apply contextual knowledge to assess responsibilities relevant to surveying , structural design and project planning.
	PO9	2	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to accomplished a common goal.
	PO10	2	An ability to communicate effectively on engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, and make effective presentations
	PSO1	2	Knowledge to provide sustainable solutions for the society.
	PSO2	2	Develop technical competency for designing and analysis of structures along with time and cost management knowledge.

## 6. CO–PO–PSO Mapping and Justification - Semester 7

<b>COURSE CODE:</b> CET401	<b>COURSE NAME: DESIGN OF STEEL STRUCTURES</b>	<b>SEMESTER: 7</b>
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**Pre-requisite:** CE302 Structural Analysis II

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET401.1	Explain the behavior and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice
CET401.2	Analyses the behavior of structural steel members and undertake design at both serviceability and ultimate limit states
CET401.3	Explain the theoretical and practical aspects of Design of composite Steel Structure along with the planning and design aspects
CET401.4	Apply a diverse knowledge of Design of Steel engineering practices applied to real life problems
CET401.5	Demonstrate experience in the implementation of design of structures on engineering concepts which are applied in field Structural Engineering

<b>COURSE CODE:</b> CE401			<b>COURSE NAME: DESIGN OF STEEL STRUCTURES</b>									<b>SEMESTER: 7</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CE401.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CE401.2	2	3	2	-	-	-	-	-	-	-	-	-	3	3
CE401.3	2	3	2	-	-	-	-	-	-	-	-	-	3	3
CE401.4	2	3	3	-	-	-	-	-	-	-	-	-	3	3
CE401.5	2	3	3	-	-	-	-	-	-	-	-	-	3	3
<b>AVG.</b>	<b>2.2</b>	<b>3</b>	<b>2.5</b>	-	-	-	-	-	-	-	-	-	<b>3</b>	<b>3</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CE401.1	PO1	3	Apply the knowledge of fundamental concepts of basic structural behavior in steel structures
	PSO1	3	Apply basic theories of steel structural members and its analysis while working as civil engineers.
	PSO2	3	Apply the knowledge in evolving new innovative designs
CE401.2	PO1	2	Apply the fundamental concepts of different structural members to the solution of complex problems.
	PO2	3	Apply the knowledge in analysing and designing structural members to analyse any problems
	PO3	2	Design solutions of problems related to structural members.
	PSO1	3	Knowledge on design of structural members helps to work in the field of structural engineering.
	PSO2	3	Knowledge on designing members helps them to grow professionally in their career.
CE401.3	PO1	2	Apply the knowledge of mathematics and engineering fundamentals for designing composite steel structure.
	PO2	3	Analyse complex problems considering theoretical and practical aspects of design
	PO3	2	Design solutions considering practical as well as theoretical aspects of design.
	PSO1	3	Knowledge on theoretical and practical aspects of design of composite steel structure helps to work in the field of structural engineering.
	PSO2	3	Knowledge on structural design helps them to grow professionally in their career.
CE401.4	PO1	2	Apply the knowledge of mathematics and engineering fundamentals while designing and maintaining steel buildings.
	PO2	3	Apply a diverse knowledge of design of steel engineering practices in problem analysis
	PO3	3	Design solutions to problems by applying a diverse knowledge in design.
	PSO1	3	Knowledge on designing steel structures helps to work in the field of structural engineering.

	PSO2	3	Diverse knowledge on design practice helps them to grow professionally in their career.
CE401.5	PO1	2	Apply the basic engineering fundamentals for the solution of complex problems.
	PO2	3	Anayse complex problems related to design and reaching conclusions
	PO3	3	Design solutions to problems related to social considerations and its implimentation
	PSO1	3	Knowledge on designing innovative designs helps to work in the field of structural engineering.
	PSO2	3	Knowledge on designing new sustainable designs helps them to grow professionally in their career.

<b>COURSE CODE:</b> <b>CEL411</b>	<b>COURSE NAME: ENVIRONMENTAL ENGINEERING LAB</b>	<b>SEMESTER: 7</b>
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**Pre-requisite:** CET304 Environmental Engineering

**Course Outcome:** After the successful completion of this course, the student will be able to:

CEL411.1	Analyse various physico- chemical and biological parametres of water
CEL411.2	Compare the quality of water with drinking water standards and recommend its suitability for drinking purposes.

<b>COURSE CODE: CE 431</b>			<b>COURSE NAME: ENVIRONMENTAL ENGINEERING LAB</b>									<b>SEMESTER: 7</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CEL411.1	3	3	3	1	-	3	3	-	-	-	-	3	3	2
CEL411.2	3	3	3	1	-	3	3	-	-	-	-	3	3	2
<b>AVG.</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>2</b>



## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEV EL	REMARKS
CEL411.1	PO1	3	Analyse the characteristics of given water sample for designing solutions to purify it
	PO2	3	Analyse and reach conclusions based on the test results of water sample.
	PO3	3	Knowledge on finding the characteristics of water sample helps to develop methods to purify it.
	PO4	1	Knowledge on testing of water sample helps them to investigate the problem and provide valid conclusions.
	PO6	3	Assess the safety issues based on the test results of water sample and act as a responsible engineer.
	PO7	3	Understand the importance of protecting the water sources and need for sustainable development
	PO12	3	Recognise the need for life long learning in the context of technological change.
	PSO1	3	Knowledge on finding the characteristics of water sample helps to work in the field of environmental engineering.
	PSO2	2	Knowledge on testing of water sample helps them to grow professionally in their career.
CEL411.2	PO1	3	Analyse the characteristics of given water sample for designing solutions to purify it
	PO2	3	Analyse and compare the quality of water with drinking water standards based on the test results of water sample.
	PO3	3	Knowledge on finding the characteristics of water sample helps to develop methods to purify it.
	PO4	1	Knowledge on testing of water sample helps them to investigate the problem and provide valid conclusions.
	PO6	3	Assess the safety issues based on the test results of water sample and act as a responsible engineer.
	PO7	3	Understand the importance of protecting the water sources and need for sustainable development
	PO12	3	Recognise the need for life long learning in the context of technological change.

	PSO1	3	Knowledge on finding the suitability of water sample for drinking purpose helps to work in the field of environmental engineering.
	PSO2	2	Knowledge on testing of water sample helps them to grow professionally in their career.

<b>COURSE CODE:</b> CET423	<b>COURSE NAME: GROUND IMPROVEMENT TECHNIQUES</b>	<b>SEMESTER: 7</b>
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**Pre-requisite:** GEOTECHNICAL ENGINEERING- I, GEOTECHNICAL ENGINEERING- II

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET423.1	Classify different ground improvement methods based on the soil suitability
CET423.2	Outline the basic concept/ design aspects of various ground improvement methods
CET423.3	Identify the construction procedure of different ground improvement methods
CET423.4	Choose different application of geosynthetics and soil stabilisation in ground improvement

<b>COURSE CODE: CET 423</b>			<b>COURSE NAME: GROUND IMPROVEMENT TECHNIQUES</b>									<b>SEMESTER: 7</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET423.1	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CET423.2	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CET423.3	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CET423.4	3	2	-	-	-	-	-	-	-	-	-	-	2	2
<b>AVG.</b>	<b>2.5</b>	<b>2</b>	-	-	-	-	-	-	-	-	-	-	<b>2</b>	<b>2</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET423.1	PO1	2	Students will be able to apply the engineering knowledge for modern ground improvement methodologies with respect to the site condition and will be able to know the importance of ground improvement prior to any construction projects.
	PSO1	2	Students will be able to practice different Civil Engineering projects using modern methods for ground improvement leads to a sustainable development
	PSO2	2	The application of professional methods could be gained by the students in ground improvement methods in buildings, road construction projects etc., by considering environmental problems, climate change issues.
CET423.2	PO1	2	Students will be able to apply engineering knowledge about the feasibility of ground improvement methods especially the design considerations of blasting, soil nailing with respect to proposed site for project.
	PSO1	2	Students will be able to practice suitable and economic designs for ground improvement which is useful in Civil Engineering projects or in industry etc.
	PSO2	2	Students will get a good professional and technical knowledge in ground improvement methods to improve the structural stability in various construction projects.
CET423.3	PO1	3	Students will be able to get good engineering knowledge in grouting techniques to be adopted for ground improvement for construction projects.
	PO2	2	Students will be able identify and propose suitable grouting solutions/ technologies for ground improvement and various drainage methods as per the site specific conditions
	PSO1	2	Students can practice sustainable and economic site specific solutions/ grouting techniques for construction projects.
	PSO2	2	The students will be able to develop professional feasible grouting techniques and drainage methods for construction projects.
	PO1	3	Students will be able to apply basic engineering knowledge to install the geosynthetics/ textiles for ground improvement in various weak site conditions

CET423.4	PO2	2	Students will be able to identify and propose suitable soil stabilization methods as per the site specific conditions.
	PSO1	2	Students can practice the installation of appropriate geosynthetics/ textiles in various Civil Engineering projects.
	PSO2	2	Students can grow professionally with recent technical knowledge for choosing geosynthetics/ textiles for the soil stabilization

<b>COURSE CODE:</b> CET 415	<b>COURSE NAME:</b> ENVIRONMENTAL IMPACT ASSESSMENT	<b>SEMESTER: 7</b> (Open Elective)
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**Pre-requisite:** NIL

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET415.1	To appreciate the need for minimizing the environmental impacts of developmental activities
CET415.2	To understand environmental legislation & clearance procedure in the country
CET415.3	To apply various methodologies for assessing the environmental impacts of any developmental activity
CET415.4	To prepare an environmental impact assessment report
CET415.5	To conduct an environmental audit

<b>COURSE CODE:</b> CET415		<b>COURSE NAME:</b> ENVIRONMENTAL IMPACT ASSESSMENT										<b>SEMESTER: 7</b>		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CET415.1	-	-	-	-	-	2	2	-	-	-	-	-	2	2
CET415.2	-	-	-	-	-	2	-	-	-	-	-	-	2	2
CET415.3	2	-	-	3	2	-	3	-	-	-	-	-	2	2
CET415.4	-	-	-	2	-	2	2	3	-	3	-	-	2	2
CET415.5	-	-	-	2	1	-	2	2	-	2	-	-	2	2
<b>AVG.</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2.33</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>2.5</b>	<b>-</b>	<b>2.5</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>

CO	PO	LEVEL	REMARKS
CET415.1	PO6	2	Students will be able to assess intelligibly societal, health, safety, legal and cultural issues associated with developmental activities
	PO7	2	Students will be able to suggest sustainable solutions for impacts associated with different developmental activities in societal and environmental contexts.
	PSO1	2	Knowledge on various impacts of developmental activities helps to grow as a civil engineer working towards sustainable solutions in different facets of civil engineering.
	PSO2	2	Knowledge on various impacts of developmental activities helps civil engineering graduates to grow professionally in their career and to achieve their professional aims ethically and with cultural competency.
CET415.2	PO6	2	Students will be able to apply contextual knowledge of environmental legislation and clearance procedure in the country.
	PSO1	2	Knowledge on environmental legislation and clearance procedure in the country helps to practice civil engineering within industry, government and private sectors.
	PSO2	2	Knowledge on environmental legislation and clearance procedure helps civil engineering graduates to grow professionally in their career.
CET415.3	PO1	2	Students will be able to apply the knowledge of science and engineering to assess the environmental impacts of any developmental activity.
	PO4	3	Students will be able to apply various methodologies for assessing, analyzing and interpreting the environmental impacts of any developmental activity by using research based knowledge.
	PO5	2	Students will be able to apply modern engineering and IT tools for predicting the impacts of developmental activities.
	PO7	3	Students will be able to understand the socio-economic impacts of different projects and demonstrate the need for sustainable development.
	PSO1	2	Knowledge on the various methodologies for assessing the environmental impacts of different projects helps to work in the field of civil engineering.
	PSO2	2	Knowledge on various methodologies for assessing the environmental impacts helps the graduates to grow professionally in their career through continued development of technical, management and communication skills.
CET415.4	PO4	2	Students will be able to use research based knowledge and research methods for the preparation of environmental impact assessment report.
	PO6	2	Students will be able to apply reasoning informed by the contextual knowledge for the preparation of environmental impact assessment report.
	PO7	2	Students will be able to demonstrate the knowledge and need for sustainable development while preparing the environmental impact assessment report.
	PO8	3	Students will be able to apply ethical principles and commitment to professional ethics for the preparation of environmental impact assessment report.
	PO10	3	Communicate effectively on the impacts of development activities with the engineering community and society as well, comprehend and write effective reports and make effective presentations.
	PSO1	2	Preparation of environmental impact assessment report helps to work in the field of civil engineering involving developmental activities.

	PSO2	2	Preparation of environmental impact assessment report helps the graduates to grow professionally in their career as their communication, documentation and presentation skills are improved.
CET415.5	PO4	2	Students will be able to analyse, interpret data and synthesis information to provide valid conclusions while conducting environmental audit.
	PO5	1	Student will be able to use modern engineering and IT tools while conducting the environmental audit.
	PO7	2	Students will be able to demonstrate the knowledge of and need for sustainable development while conducting the environmental audit.
	PO8	2	Students will develop a commitment to professional ethics while conducting the environmental audit.
	PO10	2	Students will be able to develop their communication skills, write effective reports, make effective presentation and design documentation while conducting the environmental audit.
	PSO1	2	Knowledge on conducting environmental audit helps the graduates to perform environmental audits in the field of civil engineering.
	PSO2	2	Knowledge on conducting environmental audit helps the graduates to grow professionally in their career and strive towards development of their communication and presentation skills and ability to give and clear receive instructions.



**Semester VII****CEQ413 SEMINAR**

Student will be able to:

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: Apply).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: Analyze).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: Create).
CO4	Give a presentation about an academic document (Cognitive knowledge level: Apply).
CO5	Prepare a technical report (Cognitive knowledge level: Create).

CEQ413	SEMINAR													
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	2	2	1	1	-	2	1	-	-	-	-	3	3	3
<b>CO2</b>	3	3	2	3	-	2	1	-	-	-	-	3	3	3
<b>CO3</b>	3	2	-	-	3	-	-	1	-	2	-	3	3	3
<b>CO4</b>	3	-	-	-	2	-	-	1	-	3	-	3	3	3
<b>CO5</b>	3	3	3	3	2	2	-	2	-	3	-	-	3	3
<b>Average</b>	<b>2.8</b>	<b>2.5</b>	<b>2</b>	<b>2.33</b>	<b>2.33</b>	<b>2</b>	<b>1</b>	<b>1.33</b>	<b>-</b>	<b>2.66</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>3</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO1	PO1	2	Apply knowledge of civil engineering to identify academic documents from the literature which are related to her/his areas of interest.
	PO2	2	Analyse an academic documents from the literature which are related to her/his areas of interest
	PO3	1	Identify academic documents from the literature which are related to her/his areas of interest that meet specified needs with appropriate consideration for public health and safety, and cultural, societal and environmental considerations
	PO4	1	Use research based – knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions
	PO6	2	Select a seminar topic by applying reasoning informed by contextual knowledge to assess societal, safety, health, legal and cultural issues
	PO7	1	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
	PO12	3	Recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change in the area of interest.
	PSO1	3	The student can practice civil engineering working toward sustainable solutions in specialties including construction, environmental, geotechnical, structural, transportation, and water resources
	PSO2	3	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO2	PO1	3	Apply knowledge of civil engineering to read and apprehend an academic document from the literature
	PO2	3	Read and apprehend an academic document from the literature to reach at sustainable conclusions which is related to her/ his areas of interest
	PO3	2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest
	PO4	3	Use research based – knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions
	PO6	2	Obtain an all-round knowledge on topic by applying reasoning informed by contextual knowledge to assess societal, safety, health, legal and cultural issues

	PO7	1	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development
	PO12	3	Recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change in the area of interest.
	PSO1	3	The student can practice civil engineering working toward sustainable solutions in specialties including construction, environmental, geotechnical, structural, transportation, and water resources
	PSO2	3	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO3	PO1	3	Apply knowledge of civil engineering to prepare a presentation about an academic document
	PO2	2	Analyse research literature and prepare a presentation
	PO5	3	Apply appropriate techniques, resources and modern engineering and IT tools to prepare a seminar presentation
	PO8	1	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice during preparation of seminar presentation.
	PO10	2	Communicate effectively during seminar presentation with the engineering community such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions
	PO12	3	Recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change in the area of interest.
	PSO1	3	The student can practice civil engineering working toward sustainable solutions in specialties including construction, environmental, geotechnical, structural, transportation, and water resources
	PSO2	3	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO4	PO1	3	Apply knowledge of civil engineering to give a presentation about an academic document
	PO5	2	Apply appropriate techniques, resources and modern engineering and IT tools to give a seminar presentation
	PO8	1	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice during seminar presentation.
	PO10	3	Communicate effectively during seminar presentation with the engineering community such as being able to comprehend and

			write effective reports and design documentation, make effective presentations and give and receive clear instructions
	PO12	3	Recognize the need for and have the preparation and ability to engage in independent and life-long learning broadest context of technological change in the area of interest.
	PSO1	3	The student can practice civil engineering working toward sustainable solutions in specialties including construction, environmental, geotechnical, structural, transportation, and water resources
	PSO2	3	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO5	PO1	3	Apply knowledge of civil engineering to prepare a technical report.
	PO2	3	Analyse academic document from the literature to reach at sustainable conclusions to prepare a technical report.
	PO3	3	Prepare a technical report
	PO4	3	Prepare a seminar report using research based – knowledge and research methods to provide valid conclusions
	PO5	2	Apply appropriate techniques, resources and modern engineering and IT tools to prepare a technical report.
	PO6	2	Prepare a technical report by applying reasoning informed by contextual knowledge to assess societal, safety, health, legal and cultural issues
	PO8	2	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice during preparation of technical report.
	PO10	3	Communicate effectively during seminar presentation with the engineering community such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions
	PSO1	3	The student can practice civil engineering working toward sustainable solutions in specialties including construction, environmental, geotechnical, structural, transportation, and water resources
	PSO2	3	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.

<b>B. Tech Semester VII</b>	
<b>MCN401</b>	<b>INDUSTRIAL SAFETY ENGINEERING</b>
At the end of course, the student will be able to :	
<b>CO 1</b>	Describe the theories of accident causation and preventive measures of industrial accidents. (Cognitive Knowledge level: Understand)
<b>CO 2</b>	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping. (Cognitive Knowledge level: Understand)
<b>CO 3</b>	Explain different issues in construction industries. (Cognitive Knowledge level: Understand)
<b>CO 4</b>	Describe various hazards associated with different machines and mechanical material handling. (Cognitive Knowledge level: Understand)
<b>CO 5</b>	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards. (Cognitive Knowledge level: Apply)

<b>MCN401</b>	<b>INDUSTRIAL SAFETY ENGINEERING</b>													
<b>COs/POs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2	2	-	-	-	2	2	2	-	-	-	1	-	-
<b>CO2</b>	2	1	2	-	1	1	1	1	-	-	-	1	-	1
<b>CO3</b>	2	2	2	-	1	1	1	1	1	1	-	1	-	2
<b>CO4</b>	2	2	2	-	1	1	1	1	1	1	-	1	-	1
<b>CO5</b>	2	2	2	1	1	1	1	1	1	1	-	1	-	1
<b>Average</b>	<b>2</b>	<b>1.8</b>	<b>2</b>	<b>1</b>	<b>1.33</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>1.25</b>

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	MAPPING	JUSTIFICATION
CO1	PO1	2	Students will be able to describe the theories of accident causation and preventive measures of industrial accidents.
	PO2	2	Students will be able to identify, formulate research literature and analyse accident causation incidents reaching sustainable conclusions for prevention of industrial accidents.
	PO6	2	Students will be able to apply knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant to prevention of industrial accidents.
	PO7	2	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts.
	PO8	2	Students will be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
	PO12	1	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning related to industrial safety.
CO2	PO1	2	Students will be able to explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.
	PO2	1	Students will be able to identify and analyse the criteria of selection, safety performance & indicators of various personal protective equipment
	PO3	2	Students will be able to design solutions for selection, safety performance & indicators to manufacture personal protective equipment that meet specified needs with appropriate consideration for public health and safety, and cultural, societal and environmental considerations
	PO5	1	Student will be able to apply appropriate techniques and modern engineering and IT tools including prediction and modelling to design solutions for selection, safety performance & indicators to manufacture personal protective equipment
	PO6	1	Students will be able to apply knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant to prevention of industrial accidents.
	PO7	1	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts.
	PO8	1	Students will be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
	PO12	1	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning related to industrial safety.
	PSO2	1	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO3	PO1	2	Students will be able to explain different issues in construction industries

	PO2	2	Students will be able to identify and analyse different issues in construction industries
	PO3	2	Students will be able to design solutions for safety performance in construction industries.
	PO5	1	Student will be able to apply appropriate techniques and modern engineering and IT tools including prediction and modelling to safety performance in construction industries.
	PO6	1	Students will be able to apply knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant in construction industries.
	PO7	1	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts.
	PO9	1	Students will be able to function effectively as an individual and as a member or leader in diverse teams to reduce industrial accidents.
	PO10	1	Students will be able to communicate effectively with the engineering community and society, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions on aspects of construction safety.
	PO12	1	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning related to industrial safety.
	PSO2	2	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO4	PO1	2	Students will be able to describe various hazards associated with different machines and mechanical material handling
	PO2	2	Students will be able to identify and analyse hazards associated with different machines and mechanical material handling
	PO3	2	Students will be able to design solutions for safety performance with different machines and mechanical material handling.
	PO5	1	Student will be able to apply appropriate techniques and modern engineering and IT tools including prediction and modelling to mechanical material handling devices.
	PO6	1	Students will be able to apply knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant in manufacturing industries.
	PO7	1	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts.
	PO8	1	Students will be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
	PO9	1	Students will be able to function effectively as an individual and as a member or leader in diverse teams to reduce accidents in manufacturing industries.
	PO10	1	Students will be able to communicate effectively with the engineering community and society, such as being able to comprehend and write effective reports and design

			documentation, make effective presentations and give and receive clear instructions on aspects of manufacturing safety.
	PO12	1	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning related to industrial safety.
	PSO2	1	The student will be equipped to grow professionally in their careers through solving problems which require engineering expertise.
CO5	PO1	2	Students will be able to utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards.
	PO2	2	Students will be able to reach at sustainable solutions for safety with the knowledge of different types of chemical hazards and the different hazard identification tools in different industries
	PO3	2	Students will be able to design sustainable solutions for different types of chemical hazards
	PO4	1	Students will be able to Use research based – knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions on different types of chemical hazards.
	PO5	1	Student will be able to apply appropriate techniques and modern engineering and IT tools including prediction and modelling to chemical industrial processes.
	PO6	1	Students will be able to apply knowledge to assess societal, safety, health, legal and cultural issues and the consequent responsibilities relevant in chemical industries.
	PO7	1	Students will be able to understand the impact of professional engineering solutions in societal and environmental contexts.
	PO8	1	Students will be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
	PO9	1	Students will be able to function effectively as an individual and as a member or leader in diverse teams to reduce accidents in chemical industries.
	PO10	1	Students will be able to communicate effectively with the engineering community and society, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions on aspects of chemical safety.
	PO12	1	Students will be able to recognize the need for and have the preparation and ability to engage in independent and life-long learning related to industrial safety.
		PSO2	1



<b>COURSE CODE:</b> <b>CED415</b>	<b>COURSE NAME: PROJECT PHASE I</b>	<b>SEMESTER: 7</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: <b>Apply</b> ).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: <b>Apply</b> ).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: <b>Apply</b> ).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: <b>Apply</b> ).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: <b>Analyze</b> ).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: <b>Apply</b> ).

<b>COURSE CODE:</b> <b>CED 415</b>			<b>COURSE NAME: DPROJECT PHASE I</b>									<b>SEMESTER: 7</b>		
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2	2	2	1	2	2	2	1	1	1	1	2	3	3
<b>CO2</b>	2	2	2		1	3	3	1	1		1	1	3	3
<b>CO3</b>									3	2	2	1	3	3
<b>CO4</b>					2			3	2	2	3	2	3	3
<b>CO5</b>	2	3	3	1	2							1	3	3
<b>CO6</b>					2			2	2	3	1	1	3	3

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO1	PO1	3	the students will be able to identify the techniques and algorithms to implement the problem.
	PO2	3	the students will be able to develop design methodologies for the system to be developed.
	PO3	3	the students will be able to model each components in the system.
	PO4	3	the students will be able to find a feasible solution for the problem designed.
	PO5	3	the students will be able to find the relevant tools to implement the problem stated.
	PO6	3	the students will be able to find solution for some societal needs.
	PO7	3	the students will be able to finds solutions for environmental safety.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
PSO2	3	the students will be able to grow professionally.	
CO 2	PO1	3	the students will be able to develop the techniques and algorithms to implement the problem.
	PO2	3	the students will be able to develop design methodologies for the system to be developed.
	PO3	3	the students will be able to develop each components in the system.
	PO5	3	the students will be able to develop tools to implement the problem stated.
	PO6		the students will be able to find solution for some societal needs.
	PO7	3	the students will be able to finds solutions for environmental safety.

	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO 1	3	the students will be able to practice civil engineering in various sub streams.
	PSO 2	3	the students will be able to grow professionally.
CO 3	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.
CO 4	PO5	3	the students will be able to find the relevant plan to implement the problem stated.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to plan and work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to plan the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.

	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.
CO 5	PO1	4	the students will be able to identify the techniques and algorithms to implement the problem.
	PO2	4	the students will be able to develop design methodologies for the system to be developed.
	PO4	4	the students will be able to model each components in the system.
	PO5	4	the students will be able to find a feasible solution for the problem designed.
	PO12	4	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	4	the students will be able to practice civil engineering in various sub streams.
	PSO2	4	the students will be able to grow professionally.
CO 6	PO5	3	the students will be able to organize and communicate using the relevant tools to implement the problem stated.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to organize and communicate and work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.

## 7. CO–PO–PSO Mapping and Justification - Semester 8

<b>COURSE CODE:</b> <b>CED 456</b>	<b>COURSE NAME: REPAIR AND REHABILITATION OF BUILDINGS</b>	<b>SEMESTER: 8</b> Program Elective IV
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**Pre-requisite:** CET 303 Design of Concrete Structures

**Course Outcome:** After the successful completion of this course, the student will be able to:

CET456.1	Recall the basics ideas and theories associated with Concrete technology and Masonry structures.
CET456.2	Understand the need and methodology of repair and rehabilitation of structures, the various mechanisms used, and tools for diagnosis of structures
CET456.3	Identifying the criteria for repairing / maintenance and the types and properties of repair materials used in site. Learn various techniques for repairing damaged and corroded structures.
CET456.4	Proposing wholesom solutions for maintenance/rehabilitation and applying methodologies for repairing structures or demolishing structures.
CET456.5	Analyse and assess the damage to structures using various tests.

<b>COURSE CODE:</b> <b>CET456</b>		<b>COURSE NAME:</b> <b>REPAIR AND REHABILITATION OF BUILDINGS</b>										<b>SEMESTER: 8</b>		
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
CET456.1	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CET456.2	3	2	-	2	-	-	-	-	-	-	-	-	2	2
CET456.3	3	2	3	-	3	2	1	-	-	-	-	-	2	2
CET456.4	3	-	-	1	3	2	1	-	-	-	-	-	2	2
CET456.5	3	2	2	1	2	-	2	-	-	-	-	-	2	2
<b>AVG.</b>	<b>2.6</b>	<b>2</b>	<b>2.5</b>	<b>1.33</b>	<b>2.67</b>	<b>2</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>

**JUSTIFICATIONS FOR CO-PO MAPPING:**

<b>CO</b>	<b>PO</b>	<b>LEVEL</b>	<b>REMARKS</b>
CET456.1	PO1	1	Students will be able to apply the knowledge of theories of concrete technology and masonry structures.
	PSO1	2	Knowledge of theories and basic ideas of concrete technology and masonry structures helps to grow as a civil engineer working towards sustainable solutions in different facets of civil engineering.
	PSO2	2	Knowledge of theories of concrete technology and masonry structures helps civil engineering graduates to grow professionally in their career.
CET456.2	PO1	3	Students will be able to apply the fundamentals of the engineering specialization to understand the need and methodology of repair and rehabilitation of structures.
	PO2	2	Students will be able to identify and analyze the various mechanisms used for the repair and rehabilitation of structures and reach substantiated conclusions.
	PO4	2	Students will be able to use research based knowledge for the analysis and interpretation of data to understand the methodology for repair and rehabilitation of structures.
	PSO1	2	Knowledge on the need and methodology of repair and rehabilitation of structures helps to practice civil engineering within industry, government and private sectors.
	PSO2	2	Knowledge on tools to diagnose the structure and various repair and rehabilitation methods helps civil engineering graduates to grow professionally in their career.
CET456.3	PO1	3	Students will be able to apply the knowledge of science and engineering to assess the properties of repair materials used in site.
	PO2	2	Students will be able to identify and analyze the various techniques for repair and maintenance of damaged and corroded structures.
	PO3	3	Students will be able to design solutions and techniques for the repair and maintenance of damaged and corroded structures.
	PO5	3	Students will be able to select and apply appropriate techniques for the repair and maintenance of structures.
	PO6	2	Students will be able to apply reasoning informed by the contextual knowledge to assess the criteria for the repair and maintenance of structures.
	PO7	1	Students will be able to demonstrate the knowledge of various techniques for repair and demolishing of structures.
	PSO1	2	Knowledge of appropriate techniques for the repair and maintenance of structures helps to grow as a civil engineer working towards sustainable solutions in different facets of civil engineering
	PSO2	2	Knowledge of properties of repair materials and criteria for the repair and maintenance of structures helps civil engineering graduates to grow professionally in their career.
CET456.4	PO1	3	Students will be able to apply the knowledge of science and engineering for proposing wholesome solutions for maintenance/rehabilitation of structures.
	PO4	1	Students will be able to use research based knowledge for the analysis and interpretation of data for proposing wholesome solutions for maintenance/rehabilitation of structures.

	PO5	3	Students will be able to select and apply appropriate techniques for the repair and demolishing of structures.
	PO6	2	Students will be able to apply reasoning informed by the contextual knowledge for proposing wholesum solutions for maintenance/rehabilitation.
	PO7	1	Students will be able to demonstrate the knowledge of various techniques for repair and demolishment of structures.
	PSO1	2	Proposing wholesum solutions for maintenance/rehabilitation helps to work in the field of civil engineering involving repair and maintenance activities.
	PSO2	2	Applying methodologies for repairing structures or demolishing structures helps civil engineering graduates to grow professionally in their career.
CET415.5	PO1	3	Students will be able to apply the knowledge of theories of concrete technology to analyse the damages to structures.
	PO2	2	Students will be able to identify the various tests for assessing the damage to structures.
	PO3	2	Students will be able to able design solutions for various damages in structures.
	PO4	1	Students will be able to able design experiments for assessing various damages in structures.
	PO5	2	Students will able to select and apply appropriate tests for the assessment of damage caused to structures.
	PO7	2	Students will be able to demonstrate the knowledge of various tests for analyzing the damage to structures.
	PSO1	2	Knowledge of various tests to assess the damage to structure helps to practice civil engineering within industry, government and private sectors.
	PSO2	2	Knowledge on tools to diagnose the damages in structure and its causes helps civil engineering graduates to get involved in repair and rehabilitation activities.

<b>COURSE CODE:</b> <b>CED 404</b>	<b>COURSE NAME: COMPREHENSIVE COURSE</b> <b>VIVA</b>	<b>SEMESTER: 8</b>
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Pre-requisite: Nil

Course Outcome: After the successful completion of this course, the student will be able to:

CET404 .1	The student will acquire basic knowledge in the core courses in the curriculum and be confident in placement tests and other competitive examinations
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<b>COURSE CODE:</b> <b>CET404</b>		<b>COURSE NAME: COMPREHENSIVE COURSE</b> <b>VIVA</b>										<b>SEMESTER:8</b>		
CO	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CET 404 .1	2	2	1			1			1		2	1	2	2
AVG	2	2	1			1			1		2	1	2	2

#### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CE352.1	PO1	2	Comprehensive knowledge gained from mathematics and engineering fundamentals contribute to solving complex engineering problems
	PO2	2	Comprehensive knowledge gained in core courses relevant to the civil engineering branch contribute to identify, formulate, review research literature and analyse complex engineering problems
	PO3	1	Comprehensive knowledge gained in core courses can be utilized in designing and developing solutions for complex engineering problems
	PO6	1	Comprehensive knowledge gained in design and engineering courses helps to apply reasoning informed by the contextual knowledge to assess societal and safety issues and the consequent responsibilities relevant to the professional engineering practice
	PO9	1	Comprehensive knowledge gained in engineering courses will enable the student to become a productive member of a design team
	PO11	2	Comprehensive knowledge gained in core courses in civil engineering contribute to demonstrate knowledge and understanding of the engineering principles and apply these to one's own work
	PO12	1	The student will become aware of the need for lifelong learning and continued upgrading of technical knowledge
	PSO1	2	Comprehensive knowledge gained will help in practicing civil engineering working towards sustainable solutions.
	PSO2	2	Help to grow professionally in their career and achieve their professional aims with competency



<b>COURSE CODE:</b> <b>CET 464</b>	<b>COURSE NAME: AIR QUALITY MANAGEMENT</b>	<b>SEMESTER: 8</b>
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**Course Outcomes:** After completion of the course the student will be able to:

<b>CO 1</b>	Explain the sources of air pollution and different types of air pollutant.
<b>CO 2</b>	Describe the effect of air pollutants on vegetation, animals, materials and human health.
<b>CO 3</b>	Discuss the different methods of ambient air quality monitoring system which supports an air quality management program.
<b>CO 4</b>	Explain the meteorological aspects of air pollutant dispersion.
<b>CO 5</b>	Describe the various air pollution control strategies that can be undertaken to meet the air quality goals.

	<b>PO</b> <b>1</b>	<b>PO</b> <b>2</b>	<b>PO</b> <b>3</b>	<b>PO</b> <b>4</b>	<b>PO</b> <b>5</b>	<b>PO</b> <b>6</b>	<b>PO</b> <b>7</b>	<b>PSO</b> <b>1</b>	<b>PSO</b> <b>2</b>
<b>CO 1</b>	3					2	2	1	1
<b>CO 2</b>	3					2	1	1	1
<b>CO 3</b>	3					2	2	1	1
<b>CO 4</b>	3					3	2	1	1
<b>CO 5</b>	3					2	2	1	1

## JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO 1	PO 1	3	The concept of sources of air pollution and different types of air pollutant will develop an ability to independently carry out research/investigation and development work in engineering and allied streams
	PO 6	2	Students will be able to apply knowledge to assess the impacts of pollutants on societal and health effects
	PO 7	2	Students will be able to understand the impact of pollutants on climate change, ozone layer depletion, deforestation, land degradation and also impacts of development on vegetation and wildlife and need for sustainable development
	PSO 1	1	Knowledge acquired is helpful in the environmental sector
	PSO 2	1	Improves technical skills to achieve their professional aims.
CO 2	PO 1	3	Knowledge on the various types of air pollution and pollutants is required for proper air quality management by applying the knowledge of mathematics, science, engineering fundamentals
	PO 6	2	Students will be able to apply knowledge to assess the impacts of pollutants on societal and health effects
	PO 7	1	Students will be able to understand the impact of pollutants on climate change, ozone layer depletion, deforestation, land degradation and also impacts of development on vegetation and wildlife and need for sustainable development
	PSO 1	1	Knowledge acquired is helpful in the environmental sector
	PSO 2	1	Improves technical skills to achieve their professional aims.
CO 3	PO 1	3	Students will be able to apply the knowledge of mathematics, science fundamentals to know the different aspects of air pollution.
	PO 6	2	Students will be able to apply knowledge to assess the impacts of pollutants on societal and health effects
	PO 7	2	Students will be able to understand the impact of the environmental problems and need for sustainable development

	PSO 1	1	Knowledge acquired is helpful in the environmental sector
	PSO 2	1	Improves technical skills to achieve their professional aims.

CO 4	PO 1	3	The concept of meteorological aspects of air pollutant dispersion will develop an ability to independently carry out research/investigation and development work in engineering and allied streams
	PO 6	3	The knowledge and research in meteorological aspects of air pollutant dispersion helps the engineering fraternity and with society at large.
	PO 7	2	Students will be able to understand the impact of the environmental problems and need for sustainable development
	PSO 1	1	Knowledge acquired is helpful in the environmental sector
	PSO 2	1	Improves technical skills to achieve their professional aims.
CO 5	PO 1	3	The students will be able to analyze and interpret air quality standards
	PO 6	2	Students will be able to apply knowledge of air quality to assess societal and health effects.
	PO 7	2	Students will be able to understand the impact of the environmental problems and need for sustainable development
	PSO 1	1	Knowledge acquired is helpful in the environmental sector
	PSO 2	1	Improves technical skills to achieve their professional aims.

<b>COURSE CODE :</b> CET 458	<b>COURSE NAME:</b> SUSTAINABLE CONSTRUCTION	<b>SEMESTER : 8</b>
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**Pre-requisite :** MCN 201 Sustainable Engineering

**Course Outcome:** After the successful completion of this course, the students will be able to :

CO 1	Explain the fundamental concepts of sustainability
CO 2	Describe the properties and uses of sustainable building materials
CO 3	Identify suitable construction techniques and practices for sustainable buildings
CO 4	Discuss the standards and guidelines for sustainable buildings
CO 5	Comment on the role of BIM and automation in sustainable construction

<b>COURSE CODE:</b> CET 458		<b>COURSE NAME: SUSTAINABLE CONSTRUCTION</b>										<b>SEMESTER : 8</b>		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	-	-	-	-	2	3	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	2	3	-	-	-	-	2	-	-
CO 3	2	-	-	-	-	2	3	-	-	-	-	2	2	-
CO 4	2	-	-	-	-	2	3	-	-	-	-	2	2	-
CO 5	2	-	-	-	-	2	3	-	-	-	-	2	2	-

CO	PO	LEVEL	REMARKS
CO 1	PO1	2	Understanding the fundamental concepts of sustainability will help in applying the knowledge of engineering fundamentals, to the solution of complex engineering problems.
	PO6	2	Understanding the fundamental concepts of sustainability will help in applying the reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO7	3	Understanding the fundamental concepts of sustainability will help in understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
	PO12	2	Understanding the fundamental concepts of sustainability will help in recognizing the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
CO 2	PO1	2	Understanding the properties and uses of sustainable building materials will help in applying the knowledge of engineering fundamentals, to the solution of complex engineering problems.
	PO6	2	Understanding the properties and uses of sustainable building materials will help in applying the reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO7	3	Understanding the properties and uses of sustainable building materials will help in understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
	PO12	2	Understanding the properties and uses of sustainable building materials will help in recognizing the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
CO 3	PO1	2	Understanding the suitable construction techniques and practices for sustainable buildings will help in applying the knowledge of engineering fundamentals, to the solution of complex engineering problems.
	PO6	2	Understanding the suitable construction techniques and practices for sustainable buildings will help in applying the reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

	PO7	3	Understanding the suitable construction techniques and practices for sustainable buildings will help in understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
	PO12	2	Understanding the suitable construction techniques and practices for sustainable buildings will help in recognizing the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
	PSO 1		Understanding the suitable construction techniques and practices for sustainable buildings will help in practicing civil engineering within industry, government, and private practice
CO 4	PO1	2	Understanding the standards and guidelines for sustainable buildings will help in applying the knowledge of engineering fundamentals, to the solution of complex engineering problems.
	PO6	2	Understanding the standards and guidelines for sustainable buildings will help in applying the reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO7	3	Understanding the standards and guidelines for sustainable buildings will help in understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
	PO12	2	Understanding the standards and guidelines for sustainable buildings will help in recognizing the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
	PSO 1		Understanding the standards and guidelines for sustainable buildings will help in practicing civil engineering within industry, government, and private practice
CO 5	PO1	2	Understanding the role of BIM and automation in sustainable construction will help in applying the knowledge of engineering fundamentals, to the solution of complex engineering problems.
	PO6	2	Understanding the role of BIM and automation in sustainable construction will help in applying the reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
	PO7	3	Understanding the role of BIM and automation in sustainable construction will help in understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

	PO12	2	Understanding the role of BIM and automation in sustainable construction will help in recognizing the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
	PSO 1		Understanding the role of BIM and automation in sustainable construction will help in practicing civil engineering within industry, government, and private practice

<b>COURSE CODE:</b> CED 416	<b>COURSE NAME: PROJECT PHASE II</b>	<b>SEMESTER: 8</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: <b>Apply</b> ).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: <b>Apply</b> ).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: <b>Apply</b> ).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: <b>Apply</b> ).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: <b>Analyze</b> ).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: <b>Apply</b> ).

<b>COURSE CODE:</b> CED 416		<b>COURSE NAME: PROJECT PHASE II</b>												
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2	2	2	1	2	2	2	1	1	1	1	2	3	3
<b>CO2</b>	2	2	2		1	3	3	1	1		1	1	3	3
<b>CO3</b>									3	2	2	1	3	3
<b>CO4</b>					2			3	2	2	3	2	3	3
<b>CO5</b>	2	3	3	1	2							1	3	3
<b>CO6</b>					2			2	2	3	1	1	3	3



### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CO1	PO1	3	the students will be able to identify the techniques and algorithms to implement the problem.
	PO2	3	the students will be able to develop design methodologies for the system to be developed.
	PO3	3	the students will be able to model each components in the system.
	PO4	3	the students will be able to find a feasible solution for the problem designed.
	PO5	3	the students will be able to find the relevant tools to implement the problem stated.
	PO6	3	the students will be able to find solution for some societal needs.
	PO7	3	the students will be able to finds solutions for environmental safety.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.
CO 2	PO1	3	the students will be able to develop the techniques and algorithms to implement the problem.
	PO2	3	the students will be able to develop design methodologies for the system to be developed.
	PO3	3	the students will be able to develop each components in the system.
	PO5	3	the students will be able to develop tools to implement the problem stated.
	PO6		the students will be able to find solution for some societal needs.
	PO7	3	the students will be able to finds solutions for environmental safety.

	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO 1	3	the students will be able to practice civil engineering in various sub streams.
	PSO 2	3	the students will be able to grow professionally.
CO 3	PO9	3	the students will be able to work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.
CO 4	PO5	3	the students will be able to find the relevant plan to implement the problem stated.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to plan and work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to plan the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.

	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.
CO 5	PO1	4	the students will be able to identify the techniques and algorithms to implement the problem.
	PO2	4	the students will be able to develop design methodologies for the system to be developed.
	PO4	4	the students will be able to model each components in the system.
	PO5	4	the students will be able to find a feasible solution for the problem designed.
	PO12	4	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	4	the students will be able to practice civil engineering in various sub streams.
	PSO2	4	the students will be able to grow professionally.
CO 6	PO5	3	the students will be able to organize and communicate using the relevant tools to implement the problem stated.
	PO8	3	the students will be able to apply ethical principles and commit to professional ethics.
	PO9	3	the students will be able to organize and communicate and work as a team and jointly find a solution for the problem.
	PO10	3	the students will be able to communicate their work in reviews and paper presentations.
	PO11	3	the students will be able to manage the various phases of project development.
	PO12	3	the students will be able to apply the communication and interpersonal skills acquired in their professional career.
	PSO1	3	the students will be able to practice civil engineering in various sub streams.
	PSO2	3	the students will be able to grow professionally.

<b>COURSE CODE:</b> CET 402	<b>COURSE NAME: QUANTITY SURVEYING AND VALUATION</b>	<b>SEMESTER: 8</b>
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**Course Outcome:** After the successful completion of this course, the student will be able to:

<b>CET402.1</b>	Define basic terms related to estimation, quantity surveying and contract document
<b>CET402.2</b>	Interpret the item of work from drawings and explain its general specification and unit of measurement.
<b>CET402.3</b>	Make use of given data from CPWD DAR/DSR for calculating the unit rate of different items of work associated with building construction
<b>CET402.4</b>	Develop detailed measurement (including BBS) and BoQ of a various work like buildings, earthwork for road, sanitary and water supply work
<b>CET402.5</b>	Explain various basic terms related to valuation of land and building
<b>CET402.6</b>	Develop valuation of buildings using different methods of valuation.

<b>COURSE CODE:</b> CET 402			<b>COURSE NAME:</b> QUANTITY SURVEYING AND VALUATION									<b>SEMESTER: 8</b>		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CET402.1</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CET402.2</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CET402.3</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>CET402.4</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>CET402.5</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>CET402.6</b>	2	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>AVG.</b>	<b>3</b>	<b>2</b>	-	-	-	-	-	-	-	-	-	-	-	-

### JUSTIFICATIONS FOR CO-PO MAPPING

CO	PO	LEVEL	REMARKS
CET402.1	PO1	2	Acquire and apply fundamental knowledge of estimation and quantity surveying to solve complex practical problems
CET402.2	PO1	2	Understand item of work and unit and apply the same.
CET402.3	PO1	3	Calculation of unit rate of items and apply the same
	PO2	2	Calculate unit rate from literature and apply to solve complex engineering problems.
CET402.4	PO1	3	Develop BBS and BOQ from fundamentals and apply
	PO2	2	Identify detailed measurements from analysis of drawings and apply
CET402.5	PO1	2	Valuation of land and building applying fundamental principles
	PO2	2	Valuation data to be identified and formulated, conclusions to be made
CET402.6	PO1	3	Valuation of building applying fundamentals of economics and science
	PO2	2	Formulate and analyse valuation problem.

## **8. CO–PO–PSO Attainment Calculation Process**

Course Outcomes (COs) defines the learning skills the student should achieve when he/she completes a course. Course Outcomes are statements clearly describing the specific type and level of new learning students will have achieved – and can reliably demonstrate– by the end of a course. The COs are developed based on the course syllabus as given from the University giving emphasis on Programme Outcomes (POs) and Programme Specific Outcomes (PSOs).

Each course under the B. Tech Programme has a specific set of COs. These COs are set to various target levels based on Revised Bloom’s Taxonomy. The COs of a course is established by the faculty member who is assigned with the course having the desired specialization in consultation with the stream coordinator. The COs are reviewed and is approved by DAC headed by HoD. The CO attainment of each student is calculated from his/her performance from various evaluations during the semester like internal tests, assignments, university exam, laboratory performances, project presentations etc. The CO attainment is a very important part in the calculation of Programme Outcome. The COs of each course is provided by the university from 2019 regulations onwards.

Direct Assessment comprises of Continuous Internal Evaluation (CIE) by faculty and End Semester Examination (ESE) by university. CIE is done by internal tests and assignments. This assessment is done giving 70% weightage for marks obtained in internal exams and assignments taken together, remaining 30% weightage for marks obtained in university exam. Indirect assessment is done through course exit survey at the end of each semester.

Table 1 to and 2 give the various tools for direct and indirect assessments in CO attainment calculations

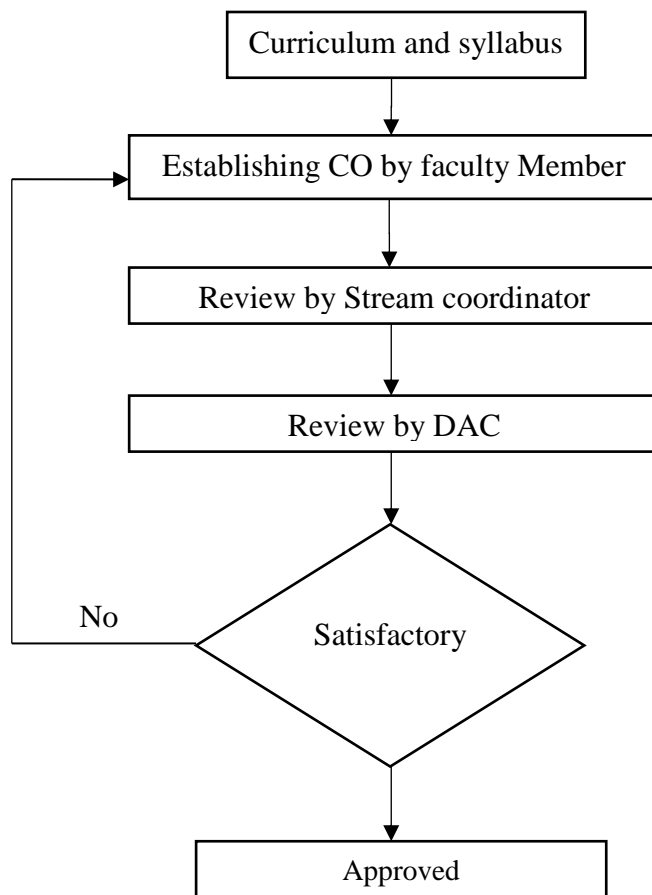


Fig: 1 Flow chart for formulation of Course Outcomes

**Table 1 Various Tools for Direct Assessment of Theory courses**

Assessment tool	Assessment Process
Internal Tests	<ul style="list-style-type: none"> <li>➤ After commencement of the course, two internal tests are scheduled in accordance with the academic calendar of events.</li> <li>➤ The entire exam schedule is supervised by the Exam cell.</li> <li>➤ The faculty member will prepare the Question papers in which cognitive level is based on Revised Blooms Taxonomy for the respective course and is submitted to the stream coordinator to check the quality and correctness of the question paper.</li> </ul>

	<ul style="list-style-type: none"> <li>➤ This question paper is collected by the exam cell coordinator of the department well in advance.</li> <li>➤ The course in-charges prepares evaluation scheme and solutions for each test and evaluate the performance of students as per the evaluation scheme.</li> </ul>
Assignments	<ul style="list-style-type: none"> <li>➤ The assignment questions are planned during the course plan by the faculty member.</li> <li>➤ After commencement of the course, minimum two assignments, is scheduled in accordance with the academic calendar of events.</li> <li>➤ The questions follow the cognitive levels as per Revised Blooms Taxonomy.</li> </ul>
End Semester Examinations (ESE)	<ul style="list-style-type: none"> <li>➤ Conducted by the university.</li> <li>➤ Conduct of exams, evaluation and publication of the results are done by the University.</li> </ul>

**Table 2 Various Tools for Direct Assessment of Lab courses**

<b>Assessment tool</b>	<b>Assessment Process</b>
Continuous Internal Evaluation (CIE)	<ul style="list-style-type: none"> <li>➤ CIE is evaluated from the daily performance of the student.</li> <li>➤ Performance is assessed after completion of each experiment by faculty members.</li> <li>➤ For 2015 regulations, the evaluation for each experiment is done for 70 marks, which is split into Performance (20), Output/ Results(20), Observation/ Record(20) and Viva(10).</li> <li>➤ For 2019 regulations, the evaluation for each experiment is done for 50 marks, which is split into Classwork (20), Assessment (20) and Viva (10).</li> </ul>
End Semester Examinations (ESE)	<ul style="list-style-type: none"> <li>➤ For APJAKTU, ESE are conducted internally, for a maximum of 30 marks for 2015 scheme.</li> <li>➤ One faculty member from the department, appointed by the Head of the department, other than the faculty in charge conducts the lab examination.</li> </ul>



	<ul style="list-style-type: none"> <li>➤ After the examination, marks are tabulated and the answer scripts and marks are kept confidentially by Head of the Department.</li> <li>➤ From the commencement of 2019, ESE are conducted internally for Semester 1 and 2. For higher semesters an external examiner is appointed by university to conduct ESE.</li> </ul>
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**Table 3 Various Tools for Direct Assessment of Seminar / Projects/ Design Project**

<b>Assessment tool</b>	<b>Assessment Process</b>
Continuous Internal Evaluation (CIE)	<ul style="list-style-type: none"> <li>➤ Project batches are formed as per the instructions given by project coordinators.</li> <li>➤ Based on the specialization and competency skills of faculty members, project batches are allotted.</li> <li>➤ Project guide continuously monitor the progress project/seminar.</li> <li>➤ An evaluation panel is constituted by the Head of the Department.</li> <li>➤ The project/seminar guide along with coordinator and Panel of evaluation members conduct a minimum of 2 reviews (1 presentation for seminar) and submit the Internal Assessment marks to the Coordinator.</li> </ul>

**Table 4 Various Tools for Indirect Assessment for all courses**

<b>Assessment tool</b>	<b>Assessment Process</b>
Course Exit Survey	<ul style="list-style-type: none"> <li>➤ Course exit survey is conducted at the end of the course by the faculty member.</li> <li>➤ The data is evaluated on a five-point scale.</li> </ul>

## **Record the attainment of Course Outcome of all courses with respect to set attainment levels**

The attainment of Course Outcomes is evaluated by direct assessment tools and indirect assessment tools. The direct assessment contributes 80% of the CO attainment while the remaining 20% is contributed by the indirect assessment. Direct Assessment comprises of internal assessment by faculty and external assessment by university. This assessment is done giving 70% weightage for marks obtained in internal exams and assignments taken together, remaining 30% weightage for marks obtained in university exam. Indirect assessment is done through course exit survey at the end of each semester.

### **Fixing Target Values**

Prior to the calculation of course outcome, initially a target value is fixed for each COs based on Revised Bloom's Taxonomy.

K1 level CO	-	70%
K2 level CO	-	60%
K3 level or above	-	50%

### **Fixing Target Grade for University Examinations**

The Department Advisory Committee (DAC) has chosen the initial target grade of the university examination based on the previous results of the same course. If the course is new, the toughness level of the course is considered to set the target value by DAC. Based on the percentage of the students attaining the specified target grade, attainment level is set.

The marks scored by each student in internal exams and assignments for each CO is entered separately along with the university grades into an internally developed template for calculation purpose. Course exit survey is carried out by the respective faculty member at the end of each course in a five-point scale. This feedback is also evaluated for final attainment calculations.

When the attainment level is 3 for all course outcomes, the target is achieved for the batch for which computation is made. Once the target is achieved, the target is to be revised and set as; Attained target value + 5% fixed to the next multiple of 5. When the course is offered for the next time without target attainment, the target values are to be retained same till it is achieved. The College was affiliated to Mahatma Gandhi University till 2014 admissions. The students from 2015 admissions follow the regulations and scheme under the APJ Abdul Kalam

Technological University. The regulations and curriculum were revised from 2019 admissions, where the university provides the expected course outcomes to be achieved. Direct assessment target from ESE is affixed based on the previous university exam results.

Tables 5 and 6 give details of the grading system for APJ Abdul Kalam Technological University.

**Table 5 Grading system of APJAKTU for university examinations (2015 regulations)**

<b>Grades</b>	<b>Grade Point (GP)</b>	<b>% of Total marks obtained</b>
O (S)	10	90% & above
A+	9	85 % & above, less than 90 %
A	8	80 % above, less than 85 %
B+	7	70 % above, less than 80 %
B	6	60 % above, less than 70 %
C	5	50 % above, less than 60 %
P	4	45 % above, less than 50%
F	0	Less than 45 %, (Failed)
FE	0	Failed due to ineligibility
I	0	Incomplete (for Lab/ workshops)

**Table 6 Grading system of APJAKTU for university examinations (2019 regulations)**

<b>Grades</b>	<b>Grade Point (GP)</b>	<b>% of Total Marks obtained</b>
S	10	90% and above
A+	9.0	85% and above but less than 90%
A	8.5	80% and above but less than 85%
B+	8.0	75% and above but less than 80%
B	7.5	70% and above but less than 75%
C+	7.0	65% and above but less than 70%
C	6.5	60% and above but less than 65%
D	6.0	55% and above but less than 60%
P(Pass)	5.5	50% and above but less than 55%
F(Fail)	0	Below 50% (CIE + ESE) or Below 40 % for ESE
FE	0	Failed due to lack of eligibility criteria

I	0	Could not appear for the end semester examination but fulfills the eligibility criteria.
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### Fixing Attainment Level

The assessment rubrics for course outcome are given in Table 7

**Table 7 Course Outcome assessment Rubrics**

Assessment Tool	Attainment Level			
	3	2	1	0
CIE	More than 70% of students scoring target value	More than 60% and up to 70% of students scoring target value	From 50% and up to 60% of students scoring target value	Less than 50% of students scoring target value
ESE	More than 70% of students scoring target grade	More than 60% and up to 70% of students scoring target grade	From 50% and up to 60% of students scoring target grade	Less than 50% of students scoring target grade
Course Exit Survey	More than 70% of students scoring target value	More than 60% and up to 70% of students scoring target value	From 50% and up to 60% of students scoring target value	Less than 50% of students scoring target value

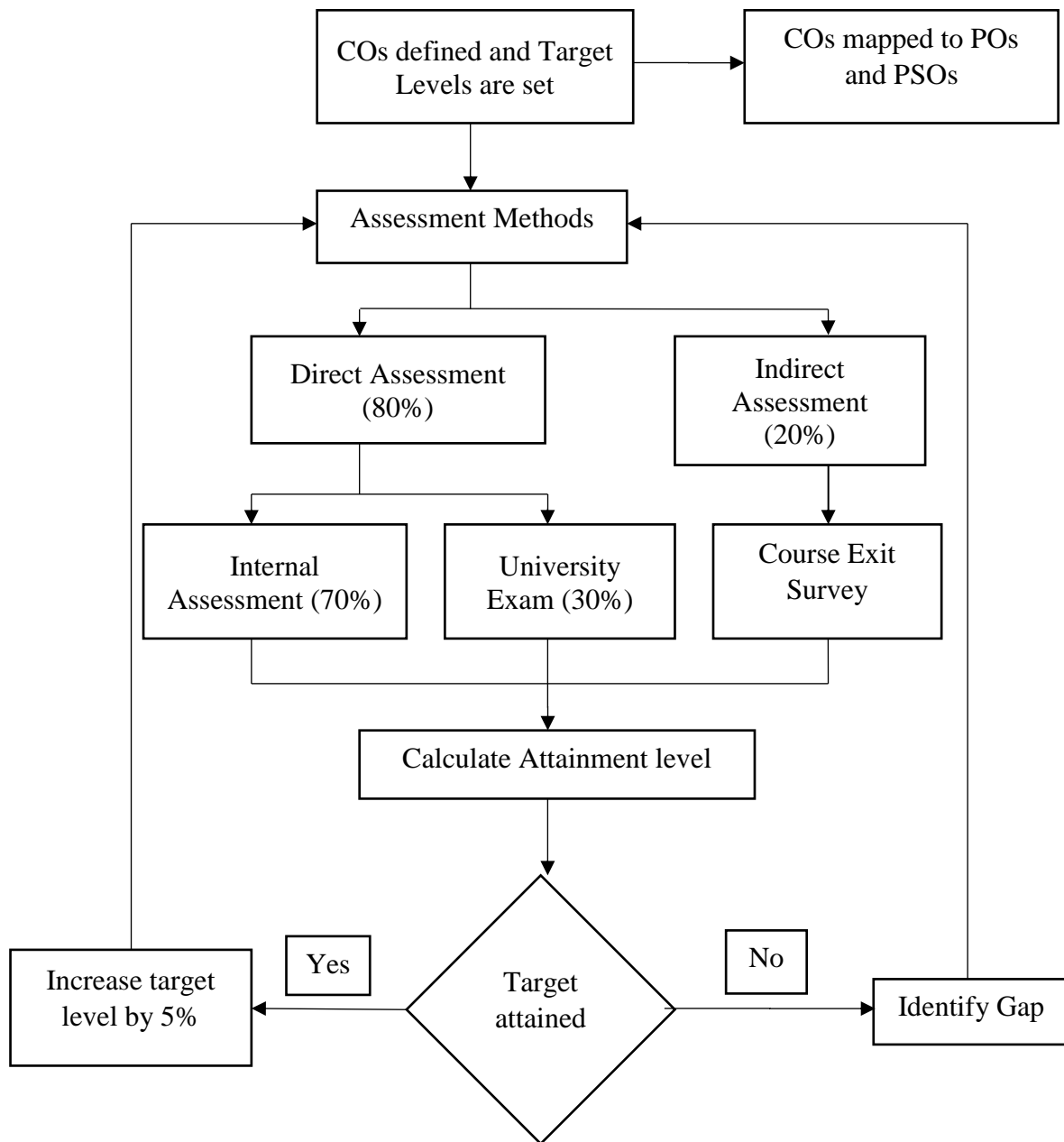


Fig 2 Process of calculation of CO Attainment

**Table 8 Sample CO attainment-Course Code C 311**

CO	Attainment of Internal Test 1	Attainment of Internal Test 2	Attainment of Assignments	Total Attainment of CIE	Attainment of ESE	Direct Attainment (70% CIE + 30% ESE)	Indirect Attainment	CO Attainment (80% Direct Attainment + 20% Indirect Attainment)
C 311.1	2	-	3	2.5	3	2.65	3	2.72
C 311.2	0	-	3	1.5	3	1.95	3	2.16
C 311.3	1	-	3	2	3	2.3	3	2.44
C 311.4	-	3	-	3	3	3	3	3
C 311.5	-	3	-	3	3	3	3	3
C 311.6	-	3	3	3	3	3	3	3
<b>Average</b>				<b>2.5</b>	<b>3</b>	<b>2.65</b>	<b>3</b>	<b>2.72</b>

**Table 9 Record of CO attainment of Courses for the Batch 2017-21**

SL NO.	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
<b>C 201</b>	3.00	3.00	3.00	2.44	1.32	3.00
<b>C 202</b>	2.76	2.76	2.76	2.76	2.76	2.76
<b>C 203</b>	2.52	2.52	2.52	2.52	2.52	2.52
<b>C 204</b>	2.24	2.32	2.44	3.00	1.88	2.80
<b>C 205</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 206</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 207</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 208</b>	2.76	2.76	2.76	2.76	2.76	2.76
<b>C 209</b>	1.40	1.96	1.96	2.52	2.52	2.52
<b>C 210</b>	3.00	2.44	3.00	1.88	3.00	3.00
<b>C 211</b>	3.00	2.16	3.00	3.00	3.00	3.00
<b>C 212</b>	2.20	2.20	2.76	2.76	2.76	2.76
<b>C 213</b>	3.00	2.72	2.72	2.16	2.72	2.72
<b>C 214</b>	1.32	1.32	2.44	3.00	3.00	3.00

<b>C 215</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 216</b>	3.00	3.00	3.00	3.00	-	-
<b>C 301</b>	3.00	1.32	2.16	1.32	3.00	3.00
<b>C 302</b>	2.48	2.20	2.76	2.20	2.76	2.76
<b>C 303</b>	2.72	1.88	2.16	2.16	1.32	3.00
<b>C 304</b>	3.00	3.00	2.44	2.72	3.00	3.00
<b>C 305</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 306</b>	3.00	2.16	2.44	3.00	2.72	3.00
<b>C 307</b>	3.00	3.00	3.00	3.00	-	-
<b>C 308</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 309</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 310</b>	3.00	3.00	3.00	3.00	3.00	-
<b>C 311</b>	2.72	2.16	2.44	3.00	3.00	3.00
<b>C 312</b>	2.60	3.00	2.20	3.00	3.00	3.00
<b>C 313</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 314</b>	2.60	3.00	2.20	3.00	3.00	3.00
<b>C 315</b>	3.00	2.20	2.60	3.00	3.00	3.00
<b>C 316</b>	3.00	2.20	2.60	3.00	3.00	3.00
<b>C 317</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 318</b>	3.00	-	-	-	-	-
<b>C 401</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 402</b>	3.00	3.00	2.24	3.00	3.00	3.00
<b>C 403</b>	3.00	3.00	3.00	3.00	3.00	2.16
<b>C 404</b>	3.00	2.72	3.00	3.00	3.00	3.00
<b>C 405</b>	3.00	3.00	3.00	3.00	-	-
<b>C 406</b>	3.00	3.00	3.00	3.00	2.72	2.16
<b>C 407</b>	3.00	2.80	2.80	1.32	1.12	1.12
<b>C 408</b>	3.00	3.00	3.00	3.00	-	-
<b>C 409</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 410</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 411</b>	3.00	3.00	3.00	3.00	3.00	3.00
<b>C 412</b>	3.00	3.00	3.00	3.00	3.00	-

### **Attainment of Program Outcomes and Program Specific Outcomes**

POs and PSOs are assessed based on direct and indirect methods. The assessment tools used for attainment of POs and PSOs are as follows:

#### **Direct Attainment Method**

The average of the CO-PO/PSO attainment values of each course with respect to CIE and ESE is tabulated and the average of each POs and PSOs of all courses are considered as the attainment value. The contribution from direct assessment in POs and PSOs attainment is 80%.

#### **Indirect Attainment Method**

Indirect attainment is calculated by conducting program exit survey. The program exit survey is conducted for final year students at the end of the programme. The data is evaluated as a five-point scale. The contribution from indirect assessment in POs and PSOs attainment is 20%.