



**Maharashtra State Board of Technical Education, Mumbai**  
**Teaching and Examination Scheme for Post S.S.C. Diploma Courses**

**Program Name : Civil Engineering Groups**

**Program Code : CE/CR/ CS**

**With Effect From Academic Year: 2017 - 18**

**Duration of Program : 6 Semesters**

**Duration : 16 Weeks**

**Semester : Fifth**

**Scheme - I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme														Grand Total
				L	T	P		Theory						Practical								
								ESE		PA		Total		ESE		PA		Total				
								Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks			
1	Water Resource Engineering	WRE	22501	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150	
2	Design of Steel and RCC Structures	DSR	22502	4	1	2	7	4	70	28	30*	00	100	40	25#	10	25	10	50	20	150	
3	Estimating and Costing	EAC	22503	3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200	
4	Public Health Engineering	PHE	22504	3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150	
<b>Elective (Any One)</b>																						
5	Rural Development	RDE	22505	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150	
	Energy Conservation and Green Building	ECG	22506	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150	
	Traffic Engineering	TEN	22507	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150	
	Precast and Pre-Stressed Concrete	PPC	22508	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150	
6	Industrial Training	ITR	22057	-	-	6	6	--	--	--	--	--	--	--	75#	30	75	30	150	60	150	
7	Capstone Project Planning	CPP	22058	-	-	2	2	--	--	--	--	--	--	--	25@	10	25	10	50	20	50	
<b>Total</b>				<b>16</b>	<b>1</b>	<b>20</b>	<b>37</b>	<b>--</b>	<b>350</b>	<b>--</b>	<b>150</b>	<b>--</b>	<b>500</b>	<b>--</b>	<b>250</b>	<b>--</b>	<b>250</b>	<b>--</b>	<b>500</b>	<b>--</b>	<b>1000</b>	

Student Contact Hours Per Week: **37 Hrs.**

Medium of Instruction: **English**

**Theory and practical periods of 60 minutes each.**

Total Marks : **1000**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical



@ Internal Assessment, # External Assessment, \*# On Line Examination , @^ Computer Based Assessment

\* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the “PA” part of practical of any course of any semester then the candidate shall be declared as “Detained” for that semester.**
- **Evaluation of Industrial Training and its reports is to done after completion of Industrial Training. Credits of Industrial Training will not affect the framing of time table.**



**Program Name** : All Branches of Diploma in Engineering and Technology.  
**Program Code** : CE/CR/CS/CH/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/  
 MU/EE/EP/EU/IS/IC/AE/FG/ME/PG/PT/DC/TX/TC  
**Semester** : Fifth  
**Course Title** : Capstone Project – Planning  
**Course Code** : 22058

### 1. RATIONALE

According to the requirement of National Board of Accreditation (NBA), 'learning to learn' is an important Graduate Attribute (GA No.11). It is required to develop this skill in the students so that they continue to acquire on their own new knowledge and skills from different 'on the job experiences' during their career in industry. An educational 'project' just does that and may be defined as *'a purposeful student activity, planned, designed and performed by a student or group of students to solve/ complete the identified problem/task, which require students to integrate the various skills acquired over a period to accomplish higher level cognitive and affective domain outcomes and sometimes the psychomotor domain outcomes as well'*. Projects mainly serve this purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

- a) Initiative, confidence and ability to tackle new problems
- b) Spirit of enquiry
- c) Creativity and innovativeness
- d) Planning and decision making skills
- e) Ability to work in a team and to lead a team
- f) Ability of self directed learning which is required for lifelong learning
- g) Persistence (habit of not giving up quickly and trying different solutions in case of momentary failures, till success is achieved)
- h) Resourcefulness
- i) Habit of keeping proper records of events and to present a formal comprehensive report of their work.

### 2. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Plan innovative/creative solutions independently and/or collaboratively to integrate various competencies acquired during the semesters to solve/complete the identified problems/task/shortcomings faced by industry/user related to the concerned occupation.**

### 3. COURSE OUTCOMES (COs)

The following could be some of the major course outcomes depending upon the nature of the projects undertaken. However, in case of some projects few of the following course outcomes may not be applicable.

- a) Write the problem/task specification in existing systems related to the occupation.
- b) Select, collect and use required information/knowledge to solve the problem/complete the task.
- c) Logically choose relevant possible solution(s).
- d) Consider the ethical issues related to the project (if there are any).
- e) Assess the impact of the project on society (if there is any).
- f) Prepare 'project proposals' with action plan and time duration scientifically before beginning of project.



- g) Communicate effectively and confidently as a member and leader of team.

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
L	T	P		Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
-	-	2	2	--	--	--	--	--	--	25@	10	25	10	50	20

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment

#### 5. Capstones Project

One of the dictionary meaning is the ‘crown’ or the stone placed on top of the building structure like ‘kalash on top of Temples and Mosques’ or ‘Cross on top of churches’. Capstone projects are culminating experiences in which students synthesize the competencies acquired over whole programme. In some cases they also integrate cross-disciplinary knowledge. Thus Capstone projects prepare students for entry into a career and can be described as a ‘rite of passage’ or ‘minimal threshold’ through which participants change their status from student to graduate. A capstone project therefore should serve as a synthesis — reflection and integration— to bridge the real-world preparatory experience to real life. Thus capstone project should have emphasis on integration, experiential learning, and real-world problem solving and hence these projects are very important for students. To develop the highly essential industry oriented skills and competencies in the students, the capstone projects are offered in the last two semesters to serve for following purposes:

- a) Integrate the competencies acquired by the students in the previous and current semesters.
- b) Provide opportunities for interdisciplinary work in tackling problems likely to be faced by them in industry which are exciting and challenging.

#### 6. Capstone Project Planning

Students are supposed to find out a suitable project and prepare a detailed plan in fifth semester so that it can be executed smoothly in sixth semester. The main characteristic of any project whether small or big is that it requires simultaneous application of various types of skills in the different domains of learning. Moreover, project normally do not have a predefined single solution, in other words for the same problem different students may come up with different but acceptable solutions. Further, in the process of arriving at a particular solution, the student must be required to make a number of decisions after scrutiny of the information s/he has accumulated from experiments, analysis, survey and other sources.

The projects will have a detailed project proposal, which must be executed or implemented within the time allocated, simultaneously maintaining a logbook periodically monitored by the teacher. A detailed project report is to be prepared as project progresses, which has to be submitted after the project is over. For self assessment and reflection students have to also prepare a portfolio of learning.

During the guidance and supervision of the project work, teachers’ should ensure that students acquire following *learning outcomes* (depending upon the nature of the project work some of these learning outcomes may not be applicable):

- a) Show the attitude of enquiry.
- b) Identify the problems in the area related to their programme.
- c) Identify the information suggesting the cause of the problem and possible solutions.
- d) Assess the feasibility of different solutions and the financial implications.





- e) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).
- f) Prepare required drawings and detailed plan for execution of the work.
- g) Work persistently and participate effectively in group work to achieve the targets.
- h) Work independently for the individual responsibility undertaken.
- i) Ask for help from others including guide, when required.
- j) Prepare portfolio to reflect (*chintan-manan*) on experiences during project work.
- k) Prepare seminar presentations to present findings/features of the project.
- l) Confidently answer the questions asked about the project.
- m) Acknowledge the help rendered by others in success of the project.

If students are able to acquire these *learning outcomes*, then they would be able to acquire the COs as discussed in section 3.

## 7. Scopes of Projects

Scope of the project work should be decided based on following criteria:

- a) **Relation to diploma programme curriculum:** When students intend to select topics for the project work they need to choose a project which relates well to their curriculum (It may be beyond curriculum, but it should relate to it) and requires implementation of theories already learnt and skills already possessed by them from the previous semesters.
- b) **Abilities possessed by the group of students:** Projects should be chosen so that it can be completed mainly using students' problem solving capabilities and depth of learning. It is natural that highly motivated students or high achievers may come out with projects which are more complex and challenging. Teachers should guide students to choose challenging projects according to the students' ability.
- c) **Resources Available:** Students and Guides should keep in mind the availability of resources while deciding the topic and the scope of the project. Some of the important resources which need consideration are:
  - i. Time available
  - ii. Raw Material/Components required
  - iii. Manufacturing/Fabrication equipment and tools required
  - iv. Testing/Measuring equipment and instruments required
  - v. Access to Journals (Library/Digital)
  - vi. Expertise for theoretical guidance (available in polytechnic, nearby institutes or nearby industries)
  - vii. Expertise and technology required for fabrication (if required)
  - viii. Software required.

*An important aspect to be considered is to decide who will choose a project. The best practice is that teacher should guide students about the above factors to be considered for choosing the project and based on these factors students should do the ground work and identify the possible projects and teachers should work as only facilitator and Guide in final selection of the project title and its scope.*

### d) Suggested Type of Capstone Projects

In general, the projects that the students can take up could be of the following types;

- i. Feasibility studies.
- ii. Design projects
- iii. Market surveys about raw material, components or finished products.
- iv. Prototype (design, make, test and evaluate).
- v. Advanced experimental work requiring the development of existing equipment to be used and developed.
- vi. Field works: This could include surveys, using equipment, charting data and information from visual observation.



- vii. Comparative Studies: Theoretical study of two systems/mechanisms/ processes in detail and comparing them on the basis of cost/energy conservation/impact on environment/technology used etc.
- viii. Application of Emerging technology: Theoretical study of some emerging technology and feasibility of its application in some real life situation in detail.
- ix. Fabrication of some equipment/machine etc.
- x. Construction of some structure.
- xi. Development of software or use of software for solving some broad-based problem.

## 8. GUIDELINES FOR UNDERTAKING A PROJECT

The selection of the *Capstone Project title* must have emphasis to the Elective courses/ Elective Group taken for the study and exam for 5<sup>th</sup> and 6<sup>th</sup> semester. The students will then work on the identified problem/task through a rigorous process of understanding and analyzing the problem, conducting a literature search, deriving, discussing (monitored by the guide every fortnight) and designing the *Semester V 'Project Proposal'* with the following *sub-titles*:

- a) Rationale (one page)
- b) Introduction
- c) Literature Survey
- d) Problem Definition
- e) Proposed Methodology of solving Identified problem
- f) In-case some prototype has to be fabricated then its tentative design and procedure for making it should be part of the proposal.
- g) Resources and consumables required.
- h) Action Plan (sequential list of activities with probable dates of completion)

As soon as the 'Project Proposal' is approved by the teacher, the student will begin to maintain a dated '*Project Logbook*' for the whole semester. This is a sort of a 'weekly diary' indicating all the activities conducted by the student every week in the semester to complete the project. This '*project logbook*' should be got signed by the teacher at regular intervals for progressive assessment to match the project proposal. If this is maintained sincerely and truthfully by the student, it will be very helpful in compiling the 'Project Report' at the end of the semester by him/her.

## 9. PORTFOLIO FOR SELF-DIRECTED LEARNING

To ensure that students acquire these outcomes, students should also be guided to prepare a '*Portfolio*', so that they may reflect on their weaknesses/mistakes and learn from them. *Students should also be encouraged to discuss with their guide and record not only technical problems but also problems related to group work, planning, execution, leadership in the team etc., so that students can also identify their weaknesses in affective domain and take remedial actions to overcome the same.* If they wish, the students can also show their portfolio to their teachers (whom they trust) for obtaining teachers' comments on their reflection for pointing out their mistakes so that they can improve their performance.

'*Portfolio*' is the record of the reflection (thinking or *chintan-manan*) on experiences to which students undergo during the different stages of the project. In a portfolio, students record their critical experiences and reflect (think or do *chintan-manan*) on them in writing. This process of reflecting on the experiences make them learn from their mistakes and build on their strengths. To help students in reflection, a Portfolio format with reflective prompts (simple thought provoking questions) for different stages of the project is given as annexure B.

### 12.1 Purposes of Portfolio Preparation



Reflection by self is important since group work is so complex that it is difficult for teachers to appreciate the real problems amongst the students. In a portfolio, prompts (simple thought provoking questions) are given to trigger reflection on different aspects of project work. Prompts help the students to ask questions from themselves regarding different aspects of the project work and interpersonal relationships. Process of answering these questions forces students to think about behavioral problems and possible remedies/solution to deal with those problems. Portfolio preparation therefore helps in reflection on building the strengths and elimination of the weaknesses of the students pertaining to following qualities which the industry also need.

- a) Plan properly for execution of given work.
- b) Take appropriate decisions.
- c) Arrange resources.
- d) Work as member and leader of team.
- e) Communicate properly.
- f) Resolve the conflicts.
- g) Manage the time well.
- h) Have concern for ethical, societal and environmental issues.
- i) Learn-to-learn from experiences.

It may be seen that these qualities are not directly related with the theoretical subject knowledge and can be developed only through real life experiences. Project work is one such type of experience where opportunity is available to develop all these qualities.

However, even during project work, emphasis of most of the students and teachers remains on development of the technical knowledge and skills while development of above qualities is neglected. Students can develop these qualities if they reflect (do thinking or *Chintan-Manan*) on their experiences from the point of view of these qualities and find out their own weaknesses and strengths. Because if somebody wants to improve his/her abilities then first step for that person is to have self awareness about his/her weaknesses and strengths.

Though portfolio preparation requires considerable time, it is essential, if we want to learn from the experiences and develop these qualities. Writing down reflections helps in better reflection as it is well known that when a person starts writing something he/she becomes more cautious about his/her view and evaluate those views before writing. Thus process of writing improves the quality of reflection or thinking. Moreover, if reflections on different stages of work are written down, over a period of time a large amount of reflection can be generated, and if this reflection is looked back, it may help in identifying some pattern of behaviour in individual which may be improved or rectified latter on as per requirement.

## 12.2 Guidelines for Portfolio Preparation and assessment

The main purpose of portfolio preparation is learning based on self-assessment and *portfolio is not to be used for assessment in traditional sense.*

- a) Each student has to prepare his/her portfolio separately. However, he/she can discuss with the group members about certain issues on which he/she wants to write in the portfolio.
- b) For fifth semester and sixth semester, there will be only one portfolio but it will have two separate parts, first part for project planning (having two sections A and B) second part for project execution. (having two sections C and D)
- c) Whatever is written inside the *portfolio is never to be used for assessment*, because if teachers start giving marks based on whatever is written in the portfolio, then students would hesitate in true self-assessment and would not openly describe their own mistakes or shortcomings.



- d) Some marks are allocated for portfolio, these marks are to be given based on how sincerely portfolio has been prepared and not based on what strengths and weaknesses of the students are mentioned in the portfolio.
- e) Portfolio has to be returned back to the students after assessing it (assessment is only to see that whether portfolio is completed properly or not) by teachers. Because student is the real owner of the portfolio.
- f) Students mainly learn during portfolio preparation, but they can further learn if they read it after a gap. And hence they are supposed to keep the portfolios with them even after completion of the diploma because it is record of their own experiences (it is like diary some people write about their personal experiences), because they can read it again after some time and can revise their learning (about their own qualities)

Even after completion of Diploma programme, students can continue to prepare portfolio related to different experiences in their professional and personal life and by refereeing back to old portfolios after a gap of some years, they can learn that how their personality has evolved over the years. They can also see a pattern of behaviour in their own personality which may be source of their weaknesses or strengths and they can take remedial measures based on this study of their portfolios.

#### Note

Since some sections of the portfolio are related with interpersonal relationships and student may find it difficult to write these experiences in English. Language should not be the barrier in reflection and hence students should be allowed to prepare the portfolio in their preferred language such as *Marathi* or *Hindi* if they find it difficult to write in English.

*The amount and type of mistakes identified by students would not affect the marks received by the students. The total 7 Marks allocated for portfolio (4 marks for PA and 3 for ESE) are only for proper completion of the portfolio.*

## 10. PROJECT REPORT

At the end of fifth Semester, the student will prepare a Semester V 'Project Report' with the following sub-titles:

- Certificate (in the Format given in this document as annexure A )
- Acknowledgements
- Abstract (in one paragraph not more than 150 words)
- Content Page
- Chapter-1 Introduction and background of the Industry or User based Problem
- Chapter-2 Literature Survey for Problem Identification and Specification,
- Chapter-3 Proposed Detailed Methodology of solving the identified problem with action plan
- References and Bibliography

**Note:** The report should contain relevant diagrams and figures, charts.

## 11. ASSESSMENT OF CAPSTONE PROJECT – PLANNING

Like other courses, assessment of Project work also has two components, first is progressive assessment, while another is end of the term assessment. The mentor faculty will undertake the progressive assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behaviour while guiding them on their project work every week. The following characteristics/ qualities informally or formally should be considered during different phases of the project work which will be assessed thrice as discussed in sub-section.

### (A) Initial Phase

- i. **Definition of the Problem**
  - a) Accuracy or specificity





- b) Appropriateness with reference to desired course outcomes.
- ii. **Methodology of Conduction the Project**
  - a) Appropriateness
  - b) Flexibility
  - c) Clarity
- iii. **General Behaviour**
  - a) Initiative
  - b) Resourcefulness
  - c) Reasoning ability
  - d) Imagination/creativity
  - e) Self-reliance

**(B) Intermediate Phase**

- i. **Performance of Student**
  - a) Ability to follow correct procedure
  - b) Manipulative skills
  - c) Ability to collect relevant information
  - d) Ability to observe, record & interpret
  - e) Ingenuity in the use of material and equipment
  - f) Target achievement
- ii. **General Behaviour**
  - a) Persistence
  - b) Interest
  - c) Commitment
  - d) Confidence
  - e) Problem solving ability
  - f) Decision making ability
  - g) Initiative to act
  - h) Team spirit.
  - i) Sharing of material etc.
  - j) Participation in discussion
  - k) Completion of individual responsibilities

**(C) Final Phase**

- i. **Quality of Product**
  - a) Dimensions
  - b) Shape
  - c) Tolerance limits
  - d) Cost effectiveness
  - e) Marketability
  - f) Modernity
- ii. **Quality of Report**
  - a) Clarity in presentation and organization
  - b) Styles and language
  - c) Quality of diagrams, drawings and graphs
  - d) Accuracy of conclusion drawn
  - e) Citing of cross references
  - f) Suggestion for further research/project work
- iii. **Quality of presentation**
  - a) Understanding of concepts, design, methodology, results, implications etc
  - b) Communication skills
  - c) Ability to draw conclusions and generalization



## 12. PROGRESSIVE ASSESSMENT (PA) GUIDELINES

**15 Marks are allocated for the formal progressive assessment.** However, following points need consideration during the three times of formal progressive assessment of the students at the end of 4<sup>th</sup>, 12<sup>th</sup> and 14<sup>th</sup> week.

- a) **Fortnightly monitoring** by the mentoring teachers is necessary and marks given progressively (even the gradual chapter preparation) so that that students will not copy earlier reports or get things done or reports from the market. The **students should not be awarded marks** if they have not done on their own.
- b) For progressive assessment at the end of 14<sup>th</sup> week, students should be asked to give the power point presentation before group of teachers and junior students (so that junior students may also get awareness about the capstone project work they have to carry out in future).
- c) Although marks for *portfolio preparation* is to be given at the end of 14<sup>th</sup> week, students should be asked to bring their partly prepared portfolio (relevant sections prepared) also during their assessment at the end of 4<sup>th</sup> week and 12<sup>th</sup> week.
- d) Marks for portfolio preparation should be based only on proper preparation of portfolio by writing answers to most of the prompts (self-questions to students) in the portfolio. These marks should not be based on the mistakes indicated by students in their working (while answering the prompts) and corrective actions taken by them.
- e) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks if they have done enough efforts.)
- f) **Originality of the report** (written in own words) would be given more importance rather than use of glossy paper or multi-colour printing.

### 12.1 Progressive Assessment (PA) Criteria

Allocation Criteria of the **25 marks** are for the Progressive Assessment (PA).

S. No.	Criteria	Marks
<b>First Progressive Assessment at the end of 4<sup>th</sup> week</b>		
1	<b>Problem Identification/Project Title</b> (Innovation /Utility of the Project for industry/ User/Academia) marks to be also given based on (i) Accuracy or specificity of the scope and (ii) Appropriateness of the work with reference to desired course outcomes.	02
2	<b>Industrial Survey and Literature Review:</b> marks to be given based on extent/volume and quality of the survey of Industry / Society / Institutes/Literature/Internet for Problem Identification and possible solutions	02
3	<b>General Behaviour:</b> initiative, resourcefulness, reasoning ability, imagination/creativity, self-reliance to be assessed <b>Note:</b> Oral feedback on general behaviour may also be given whenever relevant/ required during day to day guidance and supervision. <b>Only written feed-back/suggestions</b>	00
<b>Second Progressive Assessment at the end of 12<sup>th</sup> week</b>		
4	<b>Project Proposal:</b> Marks to be given also based on appropriateness, flexibility, detail and clarity in methods/planning. (In case of working models, detailed design and planning of fabrication/assembly of the prototype has to be also assessed). This proposal should include whole project including work to be done in sixth semester	03



S. No.	Criteria	Marks
5	<b>Execution of Plan in fifth semester</b> (Since project is to be fully completed in sixth semester, the part of the project which is planned to be completed in fifth semester is only to be evaluated: marks to be also given based on ability to collect relevant information, ability to follow correct procedure, manipulative skills, ability to observe, record & interpret, ingenuity in the use of material and equipment, target achievement) In case of working models, quality of workman ship (including accuracy in dimensions, shape, tolerance limits), appropriateness of raw materials/components/ technology being used, functioning of the prototype, cost effectiveness, marketability, modernity etc. has to be also assessed.	02
6	<b>Log book</b> (for work done in fifth semester, detailed and regular entry would be basis of marks)	02
7	<b>General Behaviour</b> (persistence, interest, confidence, problem solving ability, decision making ability, initiative to act, team spirit, sharing of material etc., participation in discussions, completion of individual responsibilities, leadership) <b>Note:</b> Oral feedback on general behaviour should also be given whenever relevant/ required during day to day guidance and supervision. <b>Only written feed-back./suggestions</b>	00
<b>Third Progressive Assessment at the end of 14<sup>th</sup> week</b>		
8	<b>Portfolio for Self learning and reflection</b> (marks based on amount of reflection and completion of the portfolio for work done in fifth semester)	04
9	<b>Final Report writing including documentation.</b> (marks based on: clarity in presentation and organization; styles and language; quality of diagrams, drawings and graphs; accuracy of conclusion drawn; citing of cross references; suggestion for further research/project work) Report has to be prepared for work done in fifth semester and planning for sixth semester work.	06
10	<b>Presentation</b> (presentation skills including communication skills to be assessed by observing quality of presentations and asking questions during presentation and viva/voce) Report has to be prepared for work done in fifth semester and plan for sixth semester.	02
11	<b>Defence</b> (ability to defend the methods/materials used and technical knowledge, and involvement of individual to be assessed by asking questions during presentation and viva/voce)	02
<b>Total</b>		<b>25</b>

### 13. END-SEMESTER-EXAMINATION (ESE) ASSESMENT GUIDELINES

The **remaining 25 marks** are for the end-semester-examination (ESE). And marks would be given according to following criteria. Moreover, the suggested evaluation scheme can be changed slightly by the external faculty according to nature of problem / project following University guidelines..

- a) For each project, the one or two students from the concerned group of students should be asked to present the power point presentation before the external and internal (for about 10 minutes) and then external should ask the questions from each member of the group separately to ascertain the contribution made by each student.
- b) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks commensurate with their efforts.)



- c) The students would not be awarded marks if they have completed the project by getting done the work from market or some professionals (taking help and guidance is different as compared to getting the work or maximum part of the work completed from others on payment basis).
- d) Originality of the report (written in own words, even if there are grammatical and spelling mistakes) would be given more importance rather than quality of printing and use of glossy paper (and preparing report by copy pasting from other reports).

*Note: It is very common that people are not able to complete the project in time despite best of their efforts. (Please recall that how many times people are able to complete in time, personal projects such as building own house or professional projects such as developing the lab in the institute). So if students have put in enough genuine efforts but could not complete the project in time then we should consider it sympathetically and they should be given marks based on their efforts and they should get more marks as compared to students who have got their projects completed by taking major help from others/market.*

### 13.1 End-Semester-Examination (ESE) Assessment Criteria.

Allocation Criteria of the **25 marks** are for the end-semester-examination (ESE)

S. No.	Description	Marks
1	<b>Problem Identification/Project Title</b> (innovation /utility of the project for industry/ user/academia) marks to be also given based on (i) accuracy or specificity of the scope and (ii) appropriateness of the work with reference to desired course outcomes.	02
2	<b>Industrial Survey and Literature Review</b> (marks to be given based on extent/volume and quality of the survey of industry / society / institutes/literature/internet for problem identification and possible solutions)	02
3	<b>Project Proposal:</b> Marks to be given also based on appropriateness, flexibility, detail and clarity in methods/planning. (In case of working models, detailed design and planning of fabrication/assembly of the prototype has to be also assessed). This proposal should include whole project including work to be done in sixth semester.	02
4	<b>Execution of Plan in fifth semester</b> (Since project is to be fully completed in sixth semester, the part of the project which is planned to be completed in fifth semester is only to be evaluated: marks to be also given based on ability to collect relevant information, ability to follow correct procedure, manipulative skills, ability to observe, record & interpret, ingenuity in the use of material and equipment, target achievement) In case of working models, quality of workman ship (including accuracy in dimensions, shape, tolerance limits), appropriateness of raw materials/components/ technology being used, functioning of the prototype, cost effectiveness, marketability, modernity etc. has to be also assessed.	02
5	<b>Log book</b> (for work during fifth semester, marks to be given based on detailed and regular entry)	03
6	<b>Portfolio for Self learning and reflection</b> (for work during fifth semester) Marks based on amount of reflection and completion of portfolio.	03
7	<b>Project Report including Documentation</b> (for work during fifth semester and planning for sixth semester) (marks based on: clarity in	04





S. No.	Description	Marks
	presentation and organization; styles and language; quality of diagrams, drawings and graphs; accuracy of conclusion drawn; citing of cross references; suggestion for further research/project work)	
8	<b>Presentation</b> (presentation skills including communication skills to be assessed by observing the quality of presentations and asking questions during presentation and viva/voce) Presentation should be based on work done in fifth semester and planning for sixth semester.	<b>03</b>
9	<b>Defence</b> (ability to defend the methods/materials used and technical knowledge, and involvement of individual to be assessed by asking questions during presentation and viva/voce)	<b>04</b>
<b>Total</b>		<b>25</b>

#### 14. SPECIAL TEACHING STRATEGIES (If any)

- a) Teacher's should not spoon feed the students and let them try on their own at different stages of the project work and even first let them strive hard and only when efforts of students have failed, then teacher should guide them. Guidance should be in initially in the form of clues or hints rather than complete explanation, detailed explanation should be given only when students are not able to work based on clues/hints. The role of teacher should be limited to guide and facilitator
- b) Teachers should guide students in selecting a topic which is relevant and challenging (but within capacity) for students according to their abilities.
- c) Teachers should ensure that students prepare the project plan in as much detail as possible, since this way only they would learn the importance of planning and how to do the detail planning. Teachers should allow students to proceed ahead only when they have detailed plan with them.
- d) Teachers should motivate students to maintain log book and prepare portfolio. They should explain benefits of these activities to students and also train them in these activities, because most of them may be doing this first time.
- e) Teachers should also encourage students to openly discuss their weaknesses and shortcomings in portfolio and teachers should develop confidence in students that admitting mistakes and weaknesses helps in improving them and their marks would not be affected by revealing their mistakes. Marks related to portfolio are awarded based only on the sincerity with which it is prepared and not based on strengths and weaknesses of students.
- f) Teachers should continuously discuss with students about working of group and progress in the project and from this discussion should identify their personal qualities (both strengths and weaknesses) and suggest to them ways for improving those qualities.
- g) Internal as well as external examiners should reward students for original work and efforts of students even if they are not fully successful or not able to complete the project in comparison to those students who have taken paid help from others to complete their project.



**Annexure A**

**CERTIFICATE**

This is to certify that Mr./Ms.....  
 From .....College having Enrolment No: .....  
 has completed *Report on the Problem Definition/ Semester V Project Report/ Final Project Report* having title .....  
 individually/ in a group consisting of..... persons under the guidance of the Faculty Guide.

.....  
 The mentor from the industry for the project  
 Name: .....  
 Telephone:.....

**Annexure B**

**Portfolio for Self Directed Learning for Major Project Work**

**Name of Student:**.....

**Semester:**.....**Programme/Branch:**.....

**Roll Number:**.....

**Title of the Project:**.....

**Name and Designation of Project Guide:**.....

**Name of Polytechnic:**.....

**Part A: Selecting the Project and Team (Answers to the following questions to be included in 'Portfolio' as Reflection related to formation of group and finalization of project topic).**

*Note: This section has to be prepared just after the finalization of the Project topic and formation of the Project Team .*

1. How many alternatives we thought before finalizing the project topic?
2. Did we consider all the technical fields related to branch of our diploma programme?
3. Why we found present project topic as most appropriate?
4. Whether all the group members agreed on the present project topic? If not? What were the reasons of their disagreements?
5. Whether the procedure followed in assessing alternatives and finalizing the project topic was correct? If not, discuss the reasons.
6. What were the limitations in other alternatives of project topic?
7. How we formed our team?
8. Whether we faced any problem in forming the team? If yes, then what was the problem and how was it resolved?



9. Am I the leader of our project team? If yes, then why was I chosen? If not, why I could not become the project team leader?
10. Do I feel that present team leader is the best choice available in the group? If yes, then why? If not, then why?
11. According to me who should be the leader of the team and why?
12. Can we achieve the targets set in the project work within the time and cost limits?
13. What are my significant good/ bad sharable experiences while working with my team which provoked me to think? What I learned from these experiences?
14. Any other reflection which I would like to write about formation of team and finalization of project title, if any?

**Part B: Reflection related to project planning (Answers to the following questions to be included in 'Portfolio' as reflection on planning)**

**Note: This section has to be prepared just after the finalization of the 'Project Proposal'.**

1. Which activities are having maximum risk and uncertainty in our project plan?
2. What are most important activities in our project plan?
3. Is work distribution is equal for all project group members? If not? What are the reasons? How we can improve work distribution?
4. Is it possible to complete the project in given time? If not what are the reasons for it? How can we ensure that project is completed within time.
5. What extra precaution and care should be taken in executing the activities of high risk and uncertainty? If possible, how such risks and uncertainties can be reduced?
6. Can we reduce the total cost associated with the project? If yes, then describe the ways?
7. For which activities of our project plan, arrangement of resources is not easy and convenient?
8. Did we make enough provisions of extra time/expenditure etc. to carry out such activities?
9. Did we make enough provisions for time delays in our project activity? In which activities there are more chances of delay?
10. In our project schedule, which are the days of more expenditure? What provisions we have made for availability and management of cash?
11. Any other reflection which I would like to write about project planning?



## Teacher Evaluation Sheet (ESE) for Capstone Project Planning

Name of Student: .....

Name of Programme..... Semester: .....

Course Title and Code:.....

Title of the Capstone Project: .....

**A. POs addressed by the Capstone Project (Mention only those predominant POs)**

- a) .....
- b) .....
- c) .....
- d) .....

**B. COs addressed by the Capstone Project (Mention only those predominant POs)**

- a) .....
- b) .....
- c) .....
- d) .....

**C. OTHER LEARNING OUTCOMES ACHIEVED THROUGH THIS PROJECT**

**a) Unit Outcomes (Cognitive Domain)**

- i. ....
- ii. ....
- iii. ....
- iv. ....

**b) Practical Outcomes (in Psychomotor Domain)**

- i. ....
- ii. ....
- iii. ....
- iv. ....

**c) Affective Domain Outcomes**

- i. ....
- ii. ....
- iii. ....
- iv. ....

**D. SUGGESTED RUBRIC FOR ASSESSMENT OF CAPSTONE PROJECT**

(please tick below the appropriate rating i.e. poor, average etc., for each characteristic to be assessed and give marks in the respective cell according to performance of student)

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
First Progressive Assessment (at the end of 4 <sup>th</sup> week)							





S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
1	<b>Problem/Task Identification (Project Title)</b>	Relate to very few POs Scope of Problem not clear at all	i. Related to some POs ii. Scope of Problem/Task vague	i. Take care of at-least Three POs ii. Scope of Problem/task not very specific	i. Take care of more than three POs ii. Scope of problem/task very clear	02	
2	<b>Literature Survey /Industrial Survey</b>	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At –least 15 relevant sources, most latest	About 20 relevant sources, most latest	02	
<b>Second Progressive Assessment (at the end of 12<sup>th</sup> week)</b>							
3	<b>Project proposal</b>	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable).	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed. Design of Prototype is not complete. (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)	02	
4	<b>Execution of Plan in fifth semester (please write by hand about students performance in appropriate column)</b>					02	
5	<b>Log Book</b>	Entries for most weeks are missing. There is no proper sequence and details are not correct.	Entries for some weeks are missing, details are not appropriate, not signed regularly by the guide.	Entries were made every week but are not in detail. Signed and approved by guide every week	Entries were made every week in detail, signed and approved by guide every week	03	
<b>Third progressive Assessment at the end of 14<sup>th</sup> week</b>							
6	<b>Portfolio Preparation</b>	Answer to only few of the 'questions from self' (prompts)	Answer to only about 50% of the 'questions from self'	Answer to most of the 'questions from self' (prompts) written. Some	Answer to nearly all the 'questions from self' (prompts) written in detail	03	



S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
		written. Answers are not in much detail	(prompts) written. Answers are not in much detail	answers are not in much detail			
7	<b>Final Report Preparation</b>	Very short, poor quality sketches, Details about methods, material, precaution and conclusions omitted, some details are wrong Nearly sufficient and correct details about methods, material, precautions and conclusion. but clarity is not there in presentation, not enough graphic description.	Detailed, correct and clear description of methods, materials, precautions and	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions. Enough tables, charts and sketches	<b>04</b>	
8	<b>Presentation</b>	Major information is not included, information is not well organized .	Includes major information but not well organized and not presented well	Includes major information and well organized but not presented well	Well organized, includes major information ,well presented	<b>03</b>	
9	<b>Defense</b>	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly	<b>04</b>	
<b>Total marks</b>						<b>25</b>	

**Any Other Comment:**

.....  
 .....

**Name and designation of the Faculty Member.....**

**Signature.....**



**Program Name** : Civil Engineering Program Group  
**Program Code** : CE/CR/CS  
**Semester** : Fifth  
**Course Title** : Water Resource Engineering  
**Course Code** : 22501

### 1. RATIONALE

Water is very important resource for the life of humans and plants and therefore need to be optimally used and conserved. In today's age, there is demand of water and is growing day by day, thus resulting in scarcity of water. Moreover, in India there is uncertain and inequitable rainfall. Therefore, every drop of water is required to be harnessed appropriately using the relevant technological tools and principles. Accordingly, Irrigation structures (dams, canals and allied structures etc), which basically are the backbone structures in the system used to preserve and conserve the water source. In the planning, design, construction, and maintenance of these structures, Civil engineers have a significant role to play. Thus, this course will enable the students to apply and use the basic principles and practices related to irrigation engineering at site. This will help them to implement various schemes like farm ponds, Jalayukt shivar etc. along with conventional irrigation systems.

### 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design simple irrigation systems.

### 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Estimate hydrological parameters.
- Estimate crop water requirements of a command area and capacity of canals.
- Maintain irrigation structures.
- Execute the Minor and Micro Irrigation Schemes.
- Select the relevant Diversion Head works for the specific site conditions.
- Design, construct and maintain simple Canal structures.

### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

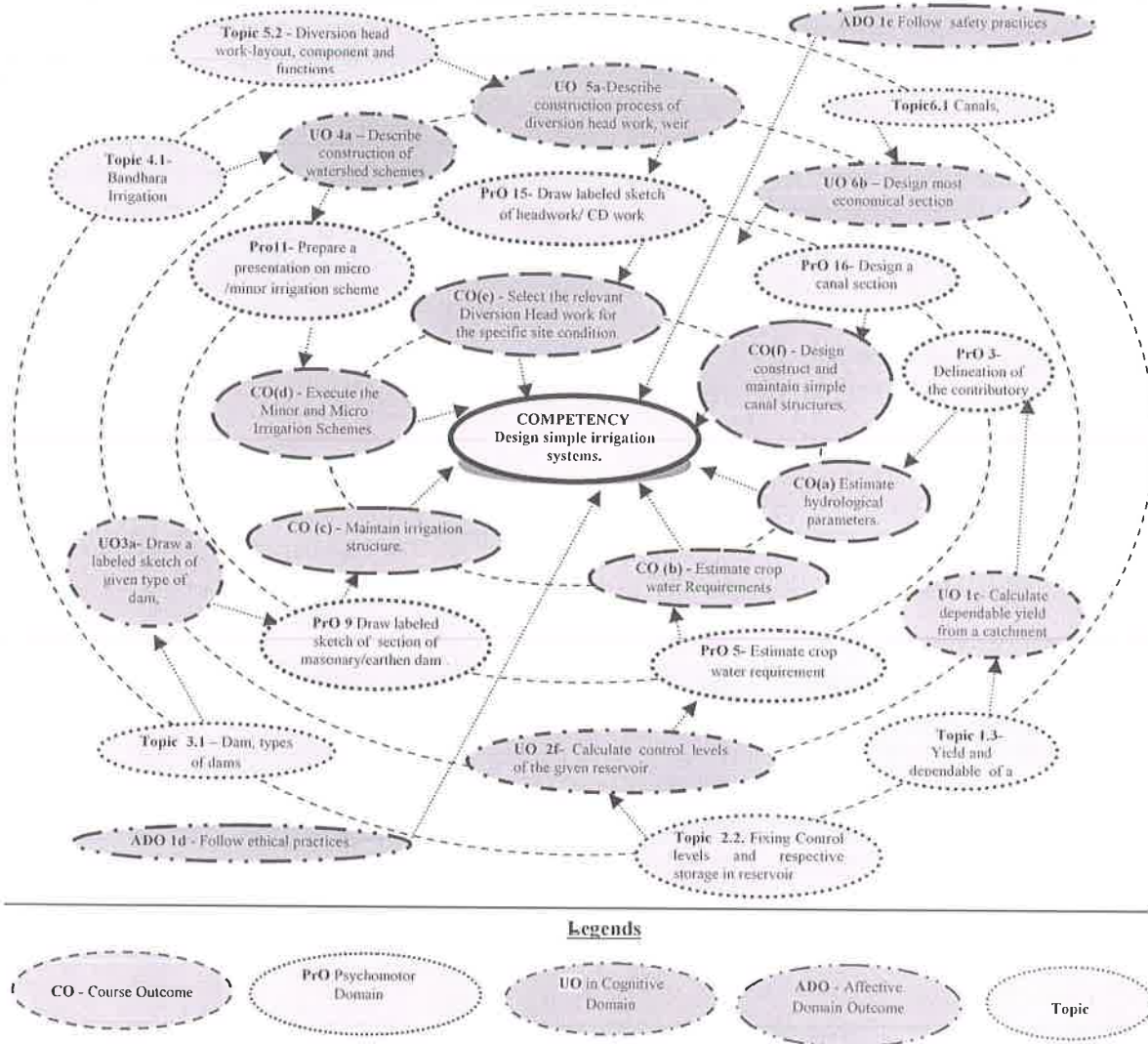
(\*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.



**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

**5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)**

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.



**Figure 1 - Course Map**

**6. SUGGESTED PRACTICALS/ EXERCISES**

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Calculate average rainfall for the given area using arithmetic mean method .	I	2*
2	Calculate average rainfall for the given area using isohyetal ,Theissen polygon method .	I	*
3	Delineation of the contributory area for the given outlet from the	I	*





S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	given topo-sheet.		
4	Compute the yield of the Catchment area demarcated in Sr.No.2.	I	2*
5	Estimate crop water requirement for the given data.	II	2*
6	Estimate capacity of the canal for the given data.	II	2*
7	Calculate reservoir capacity from the given data.	II	2*
8	Calculate control levels for the given data for the given reservoir.	II	2*
9	Draw a labeled sketch of the given masonry/earthen dam section.	III	2
10	Draw the theoretical and practical profile of the given gravity dam section.	III	2
11	Prepare a presentation on the technical details of any one micro or minor irrigation scheme.	IV	2
12	Prepare a model of any irrigation structure using suitable material.	IV	2
13	Prepare a maintenance report for any major/minor irrigation project site in the vicinity of your area, based on field visit.	I,IV	2*
14	Prepare summary of the technical details of any existing water resource project in the vicinity of your area.	III,IV	2*
15	Draw a labeled sketch of the given diversion head works and CD works.	V,VI	2*
16	Design a canal section for the given conditions with estimation of the quantity of material required for lining of the given canal.	VI	2*
	<b>Total</b>		<b>32</b>

**Note**

- i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '\*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Initiative of student in collecting data and computation.	20
2	Ability to work with the team/group.	10
3	Comprehension and presentation skill.	30
4	Correctness of design calculations and drawings.	30
5	Punctuality and neatness.	10
	<b>Total</b>	<b>100</b>

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safety practices on site.
- b. Demonstrate working as a leader/a team member.
- c. Maintain and preserve reference drawings, maps and equipment.
- d. Follow ethical practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year.
- 'Organising Level' in 2<sup>nd</sup> year.
- 'Characterising Level' in 3<sup>rd</sup> year.

### 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Technical Drawings, maps, topo-sheets	1
2	Digital planimeter.	2
3	Drawings sheet	4
4	Drawing instruments	5
5	Computing devices	6

### 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Introduction to Irrigation and Hydrology</b>	1a. Estimate average rainfall in the given situation using the given method. 1b. Estimate runoff and flood discharge in the given situation. 1c. Calculate dependable yield from the given catchment for the given data. 1d. Describe ill effects of excess irrigation in the given situation. 1e. Classify the irrigation projects on the basis of given condition. 1f. Justify the need of Irrigation for the given area. 1g. Describe the advantages and ill effects of the Irrigation in the given situation. 1h. Explain the construction and functioning of the given type of rain gauge. Compute the Maximum Flood Discharge using the relevant	1.1. Irrigation and its Classification on the basis of purpose and surface. 1.2. Hydrology : Definition and Hydrological cycle, 1.3. Rain Gauge : Symons rain gauge, automatic rain gauge, 1.4. Methods of calculating average rainfall: Arithmetic mean, Isohyetal, and Thiessen polygon method. 1.5. Runoff, Factors affecting Run off, Computation of run –off. 1.6. Maximum Flood Discharge measurement : Rational method and empirical methods. Simple numerical problems. 1.7. Yield and Dependable yield of a catchment, determination of dependable yield.



	method from the given data.	
<b>Unit – II Water Requirement of Crops and Reservoir Planning</b>	<p>2a. Estimate crop water requirement in the given situation.</p> <p>2b. Estimate capacity of canal for the given data.</p> <p>2c. Undertake/conduct survey for the given irrigation project.</p> <p>2d. Calculate reservoir capacity from the given data.</p> <p>2e. Suggest relevant measures of silt control in a given situation with justification.</p> <p>2f. Calculate control levels for the given reservoir from the given data.</p> <p>2g. Establish the relationship between duty, delta and base period.</p>	<p>2.1 Crop Water requirement : Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA, intensity of irrigation, factors affecting duty, Problems on water requirement and capacity of canal.</p> <p>2.2 Methods of application of irrigation water and its assessment.</p> <p>2.3 Surveys for irrigation project, data collection for irrigation project.</p> <p>2.4 Area capacity curve.</p> <p>2.5 Silting of reservoir : Rate of silting, factors affecting silting and control measures.</p> <p>2.6 Control levels in reservoir.</p> <p>2.7 Simple numerical problems on Fixing Control levels.</p>
<b>Unit- III Dams And Spillways</b>	<p>3a. Draw a labeled sketch of given type of dam.</p> <p>3b. Draw theoretical and practical profile of given gravity dam section.</p> <p>3c. Suggest preventive measures for the given type of dam failure with justification.</p> <p>3d. Propose the types of spillways and energy dissipaters for the given type of dam with justification.</p> <p>3e. Suggest the relevant type(s) of gate for the given type of dam(s) with justification.</p> <p>3f. Suggest suitable measures to maintain the given earthen dam with justification.</p> <p>3g. Compare the earthen dam with gravity dams with respect to the given criteria such as seepage, foundation, construction and maintenance.</p>	<p>3.1 Dam and its classification: Earthen dams and Gravity dams (masonry and concrete).</p> <p>3.2 Earthen Dams –Components with function, typical cross section, seepage through embankment and foundation and its control.</p> <p>3.3 Methods of construction of earthen dam, types of failure of earthen dam and preventive measures.</p> <p>3.4 Gravity Dams –Forces acting on dam, Theoretical and practical profile, typical cross section, drainage gallery, joints in gravity dam, concept of high dam and low dam.</p> <p>3.5 Spillways-Definition, function, location and components.</p> <p>3.6 Emergency and service spillway - ogee spillway and bar type spillway, discharge over spillway. Energy dissipation, Spillway with and without gates.</p> <p>3.7 Gates- Radial and Vertical.</p>
<b>Unit– IV Minor and Micro Irrigation</b>	<p>4a. Describe the process of construction of watershed scheme of farm pond for the given area.</p>	<p>4.1 Bandhara irrigation : Layout, components, construction and working, solid and open bandhara.</p> <p>4.2 Percolation Tanks – Need, selection</p>



	<p>4b. Explain the procedure of construction of Bandhara, Percolation tanks and any type of minor and micro irrigation schemes.</p> <p>4c. Prepare a checklist for maintenance of Bandhara irrigation, Percolation tanks and any type of minor and micro irrigation schemes.</p> <p>4d. Identify the components of Drip and Sprinkler Irrigation system in the given situation.</p> <p>4e. Identify the need for drip/sprinkler irrigation scheme for the given area.</p> <p>4f. Suggest the relevant layout for the specified crop in the given site conditions.</p>	<p>of site.</p> <p>4.3 Lift irrigation scheme-Components and their functions, lay out.</p> <p>4.4 Drip and Sprinkler Irrigation- Need, components, Layout, operation and Maintenance.</p> <p>4.5 Farm ponds, Jalayukt shivar schemes.</p> <p>4.6 Well irrigation: types of wells, yield of well, advantages and disadvantages of well irrigation.</p>
<b>Unit– V Diversion Head Works</b>	<p>5a. Describe the process of construction of diversion head work, weir and barrage in the given situation.</p> <p>5b. Prepare a checklist for maintenance of the diversion head work, weir and barrage in the given situation.</p> <p>5c. Draw a labeled sketch of the given type of diversion head work, weir and barrage.</p>	<p>5.1. Weirs – components parts, types. K.T. weir – components and construction</p> <p>5.2. Diversion head works – layout, components and their function.</p> <p>5.3. Barrages – components and their functions. Difference between weir and Barrage.</p>
<b>Unit– VI Canals</b>	<p>6a Estimate the balancing depth of the given canal(s).</p> <p>6b Design a most economical section for the designed discharge under specified condition for the given type of canal section.</p> <p>6c Prepare a checklist for the maintenance of the given type of CD work and canal regulator.</p> <p>6d Estimate the quantity of material for lining of given canal.</p> <p>6e Prepare a checklist for maintenance of the given canal.</p> <p>6f Classify the canal on the basis of alignment and position in the given canal network.</p>	<p>6.1. Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth. Design of most economical canal section.</p> <p>6.2. Canal lining - Purpose, material used and its properties, advantages.</p> <p>6.3. CD works- Aqueduct, siphon aqueduct, super passage, level crossing.</p> <p>6.4. Canal regulators- Head regulator, Cross regulator, Escape, Falls and Outlets.</p> <p>6.5. Canal maintenance.</p>

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*





## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Irrigation and Hydrology	12	4	4	6	14
II	Water Requirement of Crops and Reservoir Planning:	12	2	8	6	16
III	Dams And Spillways	14	4	4	4	12
IV	Minor and Micro Irrigation	08	-	4	6	10
V	Diversion Head Works	08	4	4	-	08
VI	Canals	10	-	4	6	10
<b>Total</b>		<b>64</b>	<b>14</b>	<b>28</b>	<b>28</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Collect data and drawings from various departments.
- Assimilate data to be used in required form.
- Interpret data.
- Prepare drawings and design calculations.
- Draw inference from designs.
- Prepare presentations.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Demonstrate thoroughly the relevant experiment to the students before they start doing the practice.



- g. Encourage students to refer different websites to have deep in-depth knowledge of the subject.
- h. Continuous observation and monitoring of the performance of students in the Laboratory.

## 12. SUGGESTED MICRO-PROJECTS

**Only one micro-project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

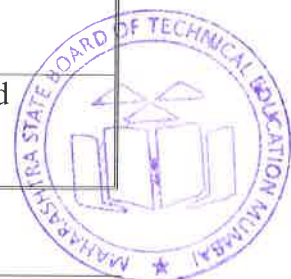
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a. Prepare a report of cropping pattern, for the given minor or major irrigation project in your area with reference to growth in yield, increase in command and culturable area and economic status of the concern people.
- b. Conduct online/internet survey for Water shed management project (s) in the Maharashtra State with a detailed report of all relevant technical inputs.
- c. Prepare a report on the executed system of rain water harvesting with reference to its necessity, broad design parameters, economics in your area along with your comments.
- d. Summarize the relevant information in the form of the report from internet regarding types of satellite imagery to capture the necessary details of the given water resource projects.
- e. Prepare a report on the on any one executed system of Farm ponds/Jalayukt shivar schemes/drip irrigation scheme with emphasis on its suitability, costing, utility and maintenance after undertaking the visit to it.

## 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Irrigation and water power Engineering	Punmia, B.C., Pande, B, Lal	Lakshmi Publications, New Delhi - 110 002. Edition 2016 ISBN 13: 9788131807637
2	Irrigation Engineering	Sharma, R.K. and Sharma, T.K.	S.Chand and Company Ltd. Delhi ISBN 13: 9788121921282 Ed. 2002
3	Irrigation Engineering	Basak, N.N.	McGraw Hill Education India Pvt. Ltd. New Delhi. Edition 1999 ISBN 13: 9780074635384
4	Irrigation and water resource Engineering	Asawa, G.L.	New Age International(P) Limited Publishers. January, 2005 ISBN (13) : 978-81-224-1673-2



S. No.	Title of Book	Author	Publication
5	Irrigation Engineering	Dahigaonkar, J.G.	Asian Book Pvt. Ltd., New Delhi ISBN 13: 9788184120080
6	Irrigation and Hydraulic structures	S.K.Garg	Khanna Publishers, Delhi. ISBN: 978-81-7409-047-9
7	Irrigation Engineering	Priyani V.B.	Charotar Book Stall, Anand.

**IS, BIS and International Codes:**

1. IS: 4410-Part-V-1982-Canals
2. IS: 4410-Part-VI-1983-Reservoirs.  
Part- VII-1968-Dams.  
Part-XVII-1977-Water Requirement of Crops
3. IS: 5477-Part-II, III and IV -1969-71-Storage zones of reservoirs.

**14. SOFTWARE/LEARNING WEBSITES/LEARNING RESOURCES**

- a. <http://nptel.ac.in/courses/105105110/>
- b. <https://wrd.maharashtra.gov.in>
- c. <http://www.imd.gov.in>
- d. <http://www.mahahp.gov.in>
- e. [http://bhuvan.nrsc.gov.in/bhuvan\\_links.php](http://bhuvan.nrsc.gov.in/bhuvan_links.php)
- f. Charts/Models/Drawings



**Program Name** : Civil Engineering Program Group  
**Program Code** : CE/CR/CS  
**Semester** : Fifth  
**Course Title** : Estimating and Costing  
**Course Code** : 22503

### 1. RATIONALE

In the construction of any civil structure, specifications of the civil work are the significant parameters in deciding the cost of the project. In construction, it is often required to use the local material for which the rates are varying in greater extent across the country. The rate analysis justifies the rates to be finalized for various items of works based on local market survey for budget provision. Therefore there emerges the need of a discipline to suggest a specific scientific technique to determine the quantities and cost of the materials along with its justification. Thus, this course provides the necessary knowledge and skills in developing the competency in the areas mentioned above in professional manner. Today being the era of technology, a provision has also been made to use the various software's for more accuracy and speedy determination of quantities.

### 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Prepare the estimate of civil engineering works.**

### 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Select the modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Justify the rate for given items of work using rate analysis techniques.
- Use relevant software for estimating the quantities and cost of items of works.

### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Credit (L+T+P)	Examination Scheme											
I.	T	P	Paper Hrs.		Theory						Practical					
					ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	4	7	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(\*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

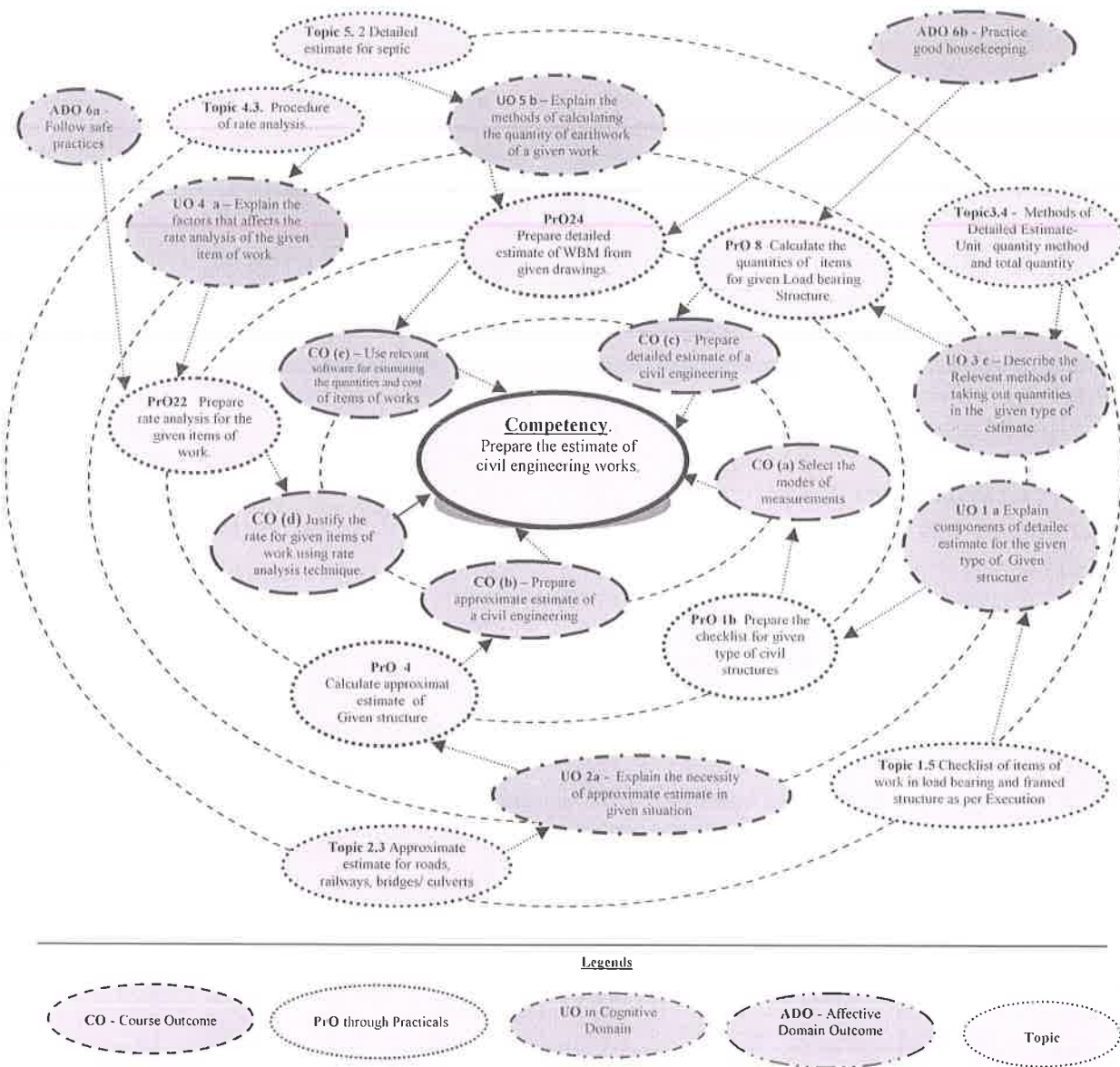
**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P – Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.





**5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)**

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.



**Figure 1 - Course Map**

**6. SUGGESTED PRACTICALS/ EXERCISES**

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare the check list of items to be executed with units for detailed estimate of the given structure from the given drawing.	I	02*
2.	Prepare a report on market rates for given material, labour wages, hire charges of tools & equipments required to construct the	IV	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	given structure as mentioned in at Serial number 1 above.		
3.	Prepare the detailed Specification for the given items using DSR ( for any ten item)	I	02*
4.	Prepare the approximate estimate for the given civil engineering works.	II	02*
5.	Prepare approximate estimate for the given civil engineering works.	II	02*
6.	Prepare bill of quantities of given item from actual measurements. (any four items).	III	02*
7.	Prepare bill of quantities of given item from actual measurements. (any four items).	III	02*
8.	Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).	III	02*
9.	Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).	III	02*
10.	Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).	III	02*
11.	Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).	III	02
12.	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart ,lead statement ( G+1 Building) .	III	02*
13.	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart ,lead statement ( G+1 Building) .	III	02*
14.	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart ,lead statement ( G+1 Building) .	III	02*
15.	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart ,lead statement ( G+1 Building).	III	02*
16.	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart ,lead statement ( G+1 Building).	III	02
17.	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule	III	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	(footing, column, beam, lintel with chajja, slab)		
18.	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)	III	02*
19.	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)	III	02*
20.	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)	III	02*
21.	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)	III	02
22.	Prepare the rate analysis for the given five item of works	IV	02*
23.	Prepare the rate analysis for the given five item of works	IV	02
24.	Prepare detailed estimate of W.B.M. Road of one kilometer length from the given drawing.	V	02*
25.	Prepare detailed estimate of W.B.M. Road one kilometer length from the given drawing.	V	02
26.	Prepare detailed estimate of small Septic tank from the given set of drawings.	V	02*
27.	Prepare detailed estimate of small Septic tank from the given set of drawings.	V	02
28.	Prepare detailed estimate of well from the given set of drawing.	V	02*
29.	Prepare detailed estimate of well from the given set of drawing.	V	02
30.	Use the relevant software to prepare detailed estimate of any one of the WBM Road/Septic Tank/ well.	V	02*
31.	Use the relevant software to prepare detailed estimate of any one of the WBM Road/Septic Tank/ well.	V	02*
32.	Use the relevant software to prepare detailed estimate of any one of the WBM Road/Septic Tank/ well.	V	02
	<b>Total</b>		<b>64</b>

**Note**

- A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '\*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- The 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Calculation of quantities.	40
b.	Preparing measurement sheet	20
c.	Preparing Abstract sheet	20
d.	Answer to sample questions	10



S. No.	Performance Indicators	Weightage in %
e.	Submit report in time	10
<b>Total</b>		<b>100</b>

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Practice good housekeeping.
- b. Follow the provisions laid in IS 1200.
- c. Practice to follow DSR.
- d. Demonstrate working as a leader/a team member.
- e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organising Level' in 2<sup>nd</sup> year and
- 'Characterising Level' in 3<sup>rd</sup> year.

#### 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1.1	Computer system (Any computer system with basic configuration)	30,31,32
1.2	Available Software of estimating and Costing.	30,31,32

#### 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
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<b>Unit – I Fundamentals of estimating and costing</b>	1a. Explain the procedure of the detailed estimate for the given structure. 1b. Prepare the checklist for the given type of the civil structure. 1c. Select the mode of measurements for given items of work as per IS: 1200. 1d. Describe the required specifications for the given item of structure. 1e. Apply the rules of deduction as per IS 1200 for calculating the quantities of a structure. 1f. Explain the salient features of the administrative and technical approval for the given project. 1g. Classify the given type of estimate on the basis of the purpose and type of work.	1.1 Estimating and Costing – Meaning, purpose, Administrative Approval, Technical Sanction and Budget provision. 1.2 Types of estimates – Approximate estimate and detailed estimate. 1.3 Detailed Estimate- of New work. 1.4 Types and Uses of Estimates: Revised estimate, supplementary estimate, revised and supplementary estimate, repair and maintenance estimate, renovation Estimate. 1.5 Roles and responsibility of Estimator. 1.6 Checklist of items of work in load bearing and framed structure as per Execution. 1.7 Modes of measurement and Desired accuracy in measurements of different items of work as per IS:1200. 1.8 Rules for deduction in Masonry work , Plastering and Pointing and Painting work as per IS:1200. 1.9 Description / specification of items of building work as per PWD /DSR. 1.10 Standard formats of Measurement sheet, Abstract sheet, Face sheet.
<b>Unit -II Approximate Estimates</b>	2a. Explain the necessity of approximate estimate in the given situation. 2b. Describe the methods used in determining the approximate estimate for the given structure. 2c. Prepare the approximate estimate for given civil engineering works. 2d. Select the relevant method of approximate estimate for the given structure. 2e. Calculate approximate cost of the given structure.	2.1 Approximate estimate- Definition, Purpose. 2.2 Methods of approximate estimate - Service unit method, Plinth area rate method, Cubical content method, Typical bay method, Approximate quantity method. 2.3 Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects. 2.4 Numericals on service unit method and Plinth area rate method.



<b>Unit-III Detailed Estimate</b>	<p>3a. Describe the procedure of preparation of detailed estimate for the given civil structure.</p> <p>3b. Identify the data required for given type of estimate.</p> <p>3c. Describe the relevant methods of taking out quantities in the given type of estimate.</p> <p>3d. Calculate the quantities of the given items for the given Load bearing structure.</p> <p>3e. Calculate the quantities of the given items (of footing, column, beam, Lintel, chajja , slab and Brickwork) for the given RCC Framed structure.</p> <p>3f. Calculate the approximate quantity of steel for the given RCC member such as footing, column, beam, Lintel, chajja and slab.</p> <p>3g. Prepare the bill of quantity for the given type of civil work.</p>	<p>3.1 Detailed Estimate- Definition and Purpose, Data required for detailed estimate, Procedure of preparation of detailed estimate- Taking out quantities and Abstracting.</p> <p>3.2 Methods of Detailed Estimate- Unit quantity method and total quantity method.</p> <p>3.3 Long wall and Short wall method (out to out and in to in method or PWD method), Centre line method.</p> <p>3.4 Bar bending schedule.</p> <p>3.5 Steel requirement for footing, column, beam, Lintel, chajja and slab.</p> <p>3.6 Provisions in detailed estimate: contingencies, work charged establishment, centage charges, water supply and sanitary Charges and electrification charges.</p> <p>3.7 Prime cost, Provisional sum, provisional Quantities, Bill of quantities, Spot items or Site items, Day work.</p>
<b>Unit –IV Rate Analysis</b>	<p>4a. Explain the factors that affect the rate analysis of the given item of work.</p> <p>4b. Describe Procedure of rate analysis for the given item of work.</p> <p>4c. Mention task work for given type of work.</p> <p>4d. Prepare rate analysis for the given items of work.</p> <p>4e. Describe the factors affecting the task work for the given situation.</p>	<p>4.1 Rate Analysis : Definition, purpose, importance and factors affecting.</p> <p>4.2 Lead ( Standard and Extra), lift, overhead charges, water charges and contractors profit,</p> <p>4.3 Procedure of rate analysis.</p> <p>4.4 Task work- Definition, factors Affecting, types. Task work of different skilled labour for different items.</p> <p>4.5 Categories of labours, their daily wages, types and number of labours for different items of work</p> <p>4.6 Load carrying capacity of different types of vehicles, transportation of materials and their hire -charges.</p> <p>4.7 Preparing rate analysis of different items of work- PCC,RCC work in (column, beam, lintel, slab), brick masonry, stone masonry, Vitriified tile flooring, plastering, , Wood work for doors.</p>
<b>Unit –V Estimate for Civil</b>	<p>5a. Calculate the earthwork quantity for the given civil engineering works.</p>	<p>5.1 Earthwork - Quantities for roads, Bunds and canal by – Mid sectional area method, mean sectional area</p>



<b>Engineering works</b>	5b. Explain the relevant method(s) of calculating the quantity of earthwork of the given work 5c. Prepare detailed estimate for given civil engineering work. 5d. Use the relevant software for preparing the detailed estimate for the given work.	method, Prismoidal formula method and trapezoidal formula method. 5.2 Detailed estimate for septic tank, Community well. 5.3 Use of computer / softwares / programmes for detailed estimate Preparation of Civil Engineering Works works. <b>(Questions on application of software from sub unit 5.3 above shall not be asked in theory exam.)</b>
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*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

### 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of estimating and costing.	08	04	04	04	12
II	Approximate Estimates	04	02	00	04	06
III	Detailed Estimate	20	02	08	18	28
IV	Rate Analysis	08	02	04	06	12
V	Estimate for Civil Engineering works	08	00	06	06	12
<b>Total</b>		<b>48</b>	<b>10</b>	<b>22</b>	<b>38</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

### 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare detailed estimate of single room of load bearing structure..
- Give seminar on relevant topic.
- Undertake micro-projects.
- Collect current DSR from PWD and prepare report on it.

### 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.



- b. '**L**' in *item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start estimating..
- g. Encourage students to refer different websites to have deeper understanding of the subject.
- h. Observe continuously and monitor the performance of students in Lab.

## 12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course.

In the first two semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here:

- a. Compare the two detailed estimates collected from professionals along with your comments in the form of a report.
- b. Prepare approximate estimate of various types of building such as school building, hospital, auditorium, Hostel, irrigation project, bridge in the immediate vicinity of your area.
- c. Prepare detailed estimate of any load bearing structure using available software.
- d. Prepare detailed estimate of the framed structure using available software.
- e. Prepare rate analysis of Painting work using OBD, Plastic emulsion, Oil paint, luster paint.
- f. Prepare detailed estimate for the proposed new Bituminous Road of 1 km length.
- g. Prepare detailed estimate for the construction of Slab Culvert.
- h. Prepare detailed estimate for the construction of Pipe Culvert.
- i. Prepare estimate for Renovation of an existing building (any five items).
- j. Prepare Rate analysis using CSR/DSR (Current/District Schedule of Rates) Items by PWD Methods.(Any Five items)
- k. Prepare the report on the salient provisions made in IS:1200 with special reference to load bearing structure.

## 13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Estimating and Costing in Civil engineering	Datta, B.N.	UBS Publishers Distributors Pvt. Ltd. New Delhi, ISBN:9788174767295



S. No.	Title of Book	Author	Publication
2	Estimating construction cost (fifth edition)	Peurifoy,Robert L. Oberlender,Garold	McGraw Hill Education, , New Delhi, 2005, ISBN-10: 0073398012 ISBN-13: 9780073398013
3	Estimating and Costing	Rangwala,S.C.	<b>Charotar Publishing</b> House PVT. LTD., Anand (Gujrat) Pin 388001 Reprint -2011
4	Estimating and Costing	Birdie,G.S.	Dhanpat Rai Publishing Company(P) Ltd.NewDelhi110002 ISBN : 978-93-84378-13-4
5	Civil Engineering Contracts and Estimates	Patil,B.S.	Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 8173715599
6	Estimating and costing, specification and valuation in civil engineering	Chakraborti,M.	Monojit Chakraborti, Kolkata (2006) ISBN-10: 818530436X ISBN-13: 978-8185304366

#### 14. SOFTWARE/LEARNING WEBSITES

- a. [www.ensoftindia.com](http://www.ensoftindia.com)
- b. [www.newtonindia.com](http://www.newtonindia.com)
- c. [www.mahapwd.com](http://www.mahapwd.com)



**Program Name** : Civil Engineering Program Group  
**Program Code** : CE/CR/CS  
**Semester** : Fifth  
**Course Title** : Design of Steel and RCC Structures  
**Course Code** : 22502

### 1. RATIONALE

For Civil Engineering technologist to understand the behaviour of various structural components for developing insight for the design concepts and will help the student in quality supervision on site. Design of steel and RCC structures is the core subject for the Civil Engineering. For the design of steel structures, the properties of steel, different steel sections, various grades and strength characteristics of steel and design of connections are required as per IS:800-2007. In the design of RCC structures Limit State Method is to be used as per IS:456-2000 for analysis and design and IS:875-1987 is to be used for Loading Standards.

### 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use the concepts of Steel and RCC structural design using Limit State Method at the site.

### 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course using Limit State Method are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Use steel table and IS code 800:2007 at work sites.
- Design the connections for the given steel joints.
- Analysis and design of singly reinforced rectangular beams.
- Design of shear reinforcement and development length for beam and slabs.
- Design various slabs for the given edge condition.
- Design of axially loaded short columns and footings.

### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
Max	Min	Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
4	1	2	7	4	70	28	30*	00	100	40	25#	10	25	10	50	20

(\*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

### 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)



This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

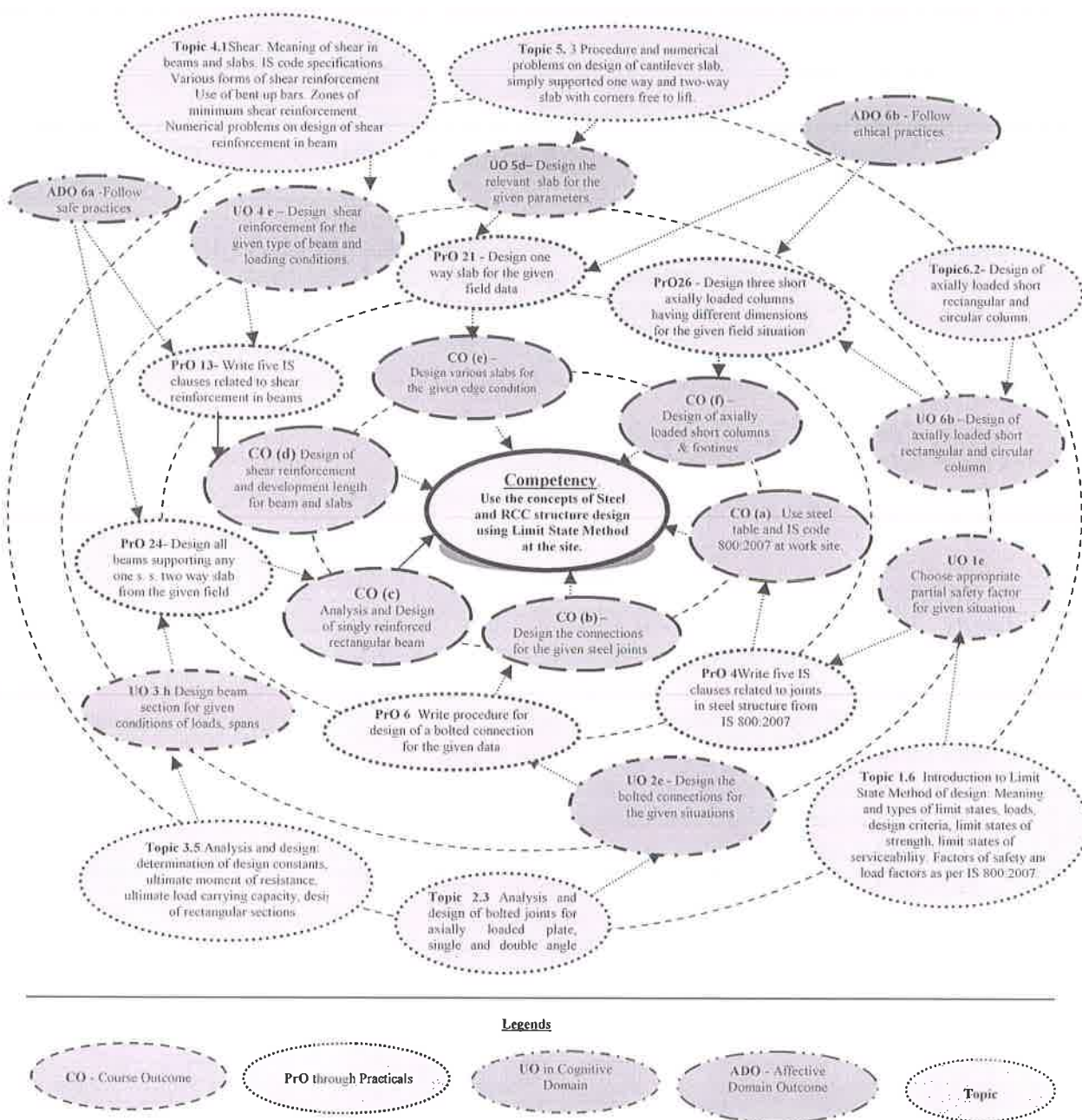


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Draw five standard rolled steel sections showing all details.	1	



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2.	Write five IS clauses related to load from IS 875:1987.	I	02
3.	Draw five commonly used built up sections.	I	
4.	Write five IS clauses related to joints in steel structure from IS 800:2007.	I	02
5.	Draw types of bolts with their modes of failure.	II	02*
6.	Design a bolted connection for the given data and compare it with design using open source software/IS code.	II	02
7.	Draw types of welds and types of welded joints.	II	02*
8.	Draw modes of failure for bolted connections.	II	02
9.	Write five IS clauses related to partial safety factors, characteristic strengths, characteristic load and design load from IS 456:2000.	III	02
10.	Draw cross section, strain –stress diagram for singly reinforced section giving design parameters and constants.	III	02*
11.	Draw stress block diagram for Under- reinforced, over-reinforced and balanced sections showing all details.	III	02
12.	Write five IS clauses related to shear reinforcement in beams and slabs from IS 456:2000.	IV	02*
13.	Write the procedure to calculate development length of main reinforcement in beams and slabs.	IV	02
14.	Write four IS clauses related to each for slab, beam and column from IS 456:2000.	III,V	
15.	Draw diagrams showing transfer of loads from one way simply supported slab and two way simply supported slab to the supporting beam as per I. S. 456:2000.	III,V	02
16.	Draw the table showing details of deflected shape along with effective length of column as per IS 456:2000.	VI	
17.	Design of a welded connection for the given data and compare it using open source software/IS code.	II	02
18.	Draw reinforcement detailing of dog legged stair.	V	02*
19.	Check the given drawing as per IS 456:2000 specifications with respect to reinforcement detailing. (Working drawing / Blue print should be collected from the suitable site.)	III, IV, V	02
20.	Design one cantilever slab from the given data.	V	02*
21.	Design a one way simply supported slab from the given data.	V	02*
22.	Design a two way simply supported slab from the given data.	V	02*
23.	Design the beam/s each supporting cantilever slab, one way simply supported slab and two way simply supported slab from the given data.	III	02*
24.	Design one axially loaded short column each supporting two given beams (corner column), three beams and four beams from the given field situation from the given data.	VI	02*
25.	Design footing for axially loaded short column designed in Sr. no.24.	VI	02*
26.	Draw the reinforcement details for cantilever slab, one way simply supported slab and two way simply supported slab designed in Sr. no. 20 to 22.	III to VI	02*





S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
27.	Draw the reinforcement details for the beam, column and footing designed in Sr. no. 23 to 25.	III to VI	02*#
28.	Prepare a report on site visit for joints in Steel structures.	II	02
29.	Prepare a report on site visit for reinforcement detailing for various structural elements.	III to VI	02*
<b>Total</b>			<b>32</b>

**Note**

- 3.1 The term work should consist of manual, A3 size sketchbook and A2 size drawing sheets.
- 3.2 A judicious mix of minimum eight (8) or more practical are to be performed from Sr. No. 1 to 18 and minimum nine (9) or more practical are to be performed from Sr. No. 19 to 29 out of which Sr. Nos. marked with ' (\*) ' are compulsory i.e. total minimum seventeen (17) practical or more.
- 3.3 Use A3 size sketchbook for Sr. No. 1,3,5,7,8,10,11,16,17,19.
- 3.4 Collect suitable working drawing /blue print from the site for the data required for the Sr.No.19 to 25 preferably separate drawing for each batch.
- 3.5 For Sr. No. 23 and 24, divide each batch into three groups. Each group will design only one type of beam and one type of column from the given types so that all types of beams and columns will get designed.
- 3.6 For Sr. No. marked with ( #), use AutoCAD software for drawing.
- 3.7 A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. All the above listed practical need to be performed compulsorily, so that the student reaches the 'Applying Level' of Blooms's 'Cognitive Domain Taxonomy' as generally required by the industry.
- 3.8 The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Interpretation of given data and its presentation.	10
2	Selection of sketches /Process of designing of the given structural components using relevant I.S. Codes /writing of visit report.	30
3	Precision in sketch book, sheets and report and its neatness, cleanliness.	30
4	Individual work and working in groups	20
5	Submission of assigned work in time	10
<b>Total</b>		<b>100</b>

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safety practices.
- b. Practice good housekeeping.
- c. Demonstrate working as a leader/a team member.
- d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of



practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organising Level' in 2<sup>nd</sup> year and
- 'Characterising Level' in 3<sup>rd</sup> year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1.1	Drawing boards and drawing equipments	1,2,5,7,11,12,17
1.2	Computers	26,27
1.3	Printers	26,27
1.4	Available CAD software.	26,27

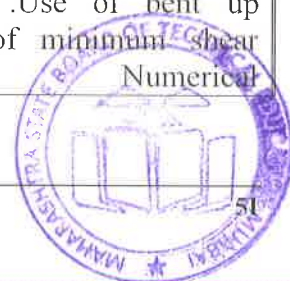
## 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Fundamental of steel structures</b>	1a. Select a relevant steel structure for the given condition. 1b. Use steel table to identify different properties of given steel sections. 1c. Explain the various type(s) of loads (Dead load, live load, impact load, seismic load, snow load etc.) acting on the given steel structures. 1d. Select the relevant factors to calculate seismic forces for given civil structure. 1e. Choose the partial safety factor as per the guidelines laid in IS for the given situation. 1f. Explain the Advantages and disadvantages of steel as construction material in the given situation. 1g. Describe the functions of the given steel structure. 1h. Identify the components of the given steel structure	1.1 Steel as construction material. 1.2 Steel structures: Towers, Roof trusses, Water Tanks, Bridges, Gantry and Crane girders, Columns, Chimney, building frames etc. 1.3 Types, grades and strength of steel sections, Steel Table, IS 808-1989. Stress Strain graph for mild steel. 1.4 Loads acting on steel structures according to IS 875-1987 part I to IV. 1.5 Limit State Method of design: Meaning and types of limit states, loads, design criteria, limit states of strength, limit states of serviceability. 1.6 Factors of safety and load factors as per IS 800:2007.
<b>Unit– II Design of</b>	2a Compute the strength of the given bolted connections	2.1 Type, uses of bolts and joints: Black bolts and High strength



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Steel Connections</b>	2b Design the bolted connections for the given situations. 2c Compute the strength of the given welded connections. 2d Design the welded connections for given situations. 2e State the Specifications for cross-sectional area, pitch, spacing, gauge, end distance, edge distance, and diameter of bolt holes for bolted connections with justification. 2f Explain the advantages and disadvantages of given welded connection.	bolts, modes of failure, 2.2 Specifications of bolt holes for bolted connections. 2.3 Strength of bolt in shear, tension, bearing and efficiency of joint. 2.4 Analysis and design of bolted joints for axially loaded plate, single and double angle members 2.5 Welded connections: Butt and Fillet welds, size of weld, throat thickness 2.6 Analysis and design of fillet welded joint for plate, single and double angle members subjected to axial load.
<b>Unit III- Analysis and Design of Singly Reinforced Sections</b>	3a. Choose partial safety factor as laid in IS provisions for the given situation 3b. Explain the different type(s) of loads acting on the given RCC structure(s). 3c. Describe the procedure used in limit state method of design a RC member for the given data. 3d. Discuss the design parameters including constants for given types of materials. 3e. Calculate ultimate moment of resistance for given type of section. 3f. Infer the stability of the given beam section by applying the various checks. 3g. Design a beam section for given conditions. 3h. Draw reinforcement detailing for a given element as per the IS provisions. 3i. Identify the given section as Under- reinforced, over-reinforced or balanced section.	3.1 RCC: functions of reinforcement, material properties, types of limit states, partial safety factors for material strength, characteristic strengths, characteristic load, design load as per IS 456:2000. 3.2 Types of loads and combinations as per IS:875:2002 3.3 Limit State of collapse (flexure) : assumptions, steel, strain diagram and stress-strain relationship for concrete and block diagram for singly reinforced section, design parameters and constants, ultimate moment of resistance 3.4 Under- reinforced, over-reinforced and balanced sections. 3.5 IS specifications regarding spacing, cover, minimum reinforcement, effective span in beams 3.6 Analysis and design: determination of design constants, ultimate moment of resistance, ultimate load carrying capacity, design of rectangular sections.
<b>Unit –IV Design of Shear reinforcement and Bond</b>	4a. Explain the pattern of shear failure for a given member in structure. 4b. Locate the zones of minimum shear reinforcement with sketch for the given loading	4.1 Shear: Meaning of shear in beams and slabs. IS code specifications. Various forms of shear reinforcement .Use of bent up bars. Zones of minimum shear reinforcement.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	<p>conditions.</p> <p>4c. Design shears reinforcement for the given conditions.</p> <p>4d. Judge the beam with given reinforcement on the basis of the shear strength.</p> <p>4e. Compute the bond length for the beam with given reinforcement.</p> <p>4f. Identify the zone of minimum shear reinforcement in the given element.</p>	<p>problems on design of shear reinforcement in beam.</p> <p>4.2 Bond: Meaning of bond as per IS code provisions. Meaning and calculation of development length in tension and compression.</p>
<b>Unit –V Design of Slabs</b>	<p>5a. Suggest the relevant type of slab for the given support condition.</p> <p>5b. Suggest relevant corresponding values of design parameters in the given situation.</p> <p>5c. Check the deflection of the given type of slab.</p> <p>5d. Design the given type of slab using the given parameters.</p> <p>5e. Check the development length of the given type of slab.</p>	<p>5.1 Slabs, support conditions, I.S. specifications regarding main steel, distribution steel, spacing and cover for reinforcement, effective span, minimum reinforcement.</p> <p>5.2 Limit state of serviceability for slabs for deflection criteria only.</p> <p>5.3 Design of one way and cantilever slab including development length check only.</p> <p>5.4 Design of two-way slab with four edges discontinuous and provision of torsion reinforcement at corners (As per IS 456:2000, table no 26 case no 9 only). Check for deflection only.</p>
<b>Unit –VI Design of axially loaded short Columns and footing</b>	<p>6a. Identify the type of column in the given situation.</p> <p>6b. Calculate the ultimate load carrying capacity of the column in the given situation.</p> <p>6c. Design the axially loaded short column for the given data.</p> <p>6d. Check the given structural drawing as per the specifications laid in relevant IS code.</p> <p>6e. Design given type of column footing for the given data.</p> <p>6f. Explain the assumptions made in the design of axially loaded short column.</p> <p>6g. Select the given type of RCC footings in the given situation.</p>	<p>6.1 Limit state of collapse in compression, assumptions, effective length, slenderness ratio, short and long columns, and minimum eccentricity.</p> <p>6.2 IS specifications for reinforcement in column.</p> <p>6.3 Load analysis for a column : load on an axially loaded column from beams at a different floor levels in a building</p> <p>6.4 Design of axially loaded short square and rectangular column.</p> <p>6.5 Various RC footings : Isolated and Sloped footings, combined footings, piles</p> <p>6.6 IS specifications for reinforcement in footing</p> <p>6.7 Design of isolated square sloped footing: Flexural design with</p>





Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		checks for one-way shear, two-way shear and bond. (Problems on design of footing for bending moment only in theory examination paper)

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamental of steel structures	04	02	04	00	06
II	Design of Steel Connections	10	02	04	08	14
III	Analysis and Design of Singly Reinforced Sections	14	02	04	06	12
IV	Design of Shear Reinforcement and Bond	10	02	02	06	10
V	Design of Slabs	14	02	06	06	14
VI	Design of axially loaded short Columns and footing	12	02	06	06	14
<b>Total</b>		<b>64</b>	<b>12</b>	<b>26</b>	<b>32</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare journals based on practical performed in laboratory.
- Give seminar on relevant topic.
- Undertake micro-projects.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.



- c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice.
- g. Encourage students to refer different websites to have deeper understanding of the subject.
- h. Observe continuously and monitor the performance of students in Lab.
- i. Demonstrate students thoroughly before they start doing the practice.
- j. Encourage students to refer different websites to have deeper understanding of the subject.

## 12. SUGGESTED MICRO-PROJECTS

**Only one micro-project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty.

- a. Collect the information of various types of connections used in actual practice.
- b. Enlist various software used for the design of steel structures and give details of any one software.
- c. Enlist various software used for the design of RCC structures and give details of any one software.
- d. Procure actual working drawing / blue print of structural design and write report after checking actual reinforcement placed at site.
- e. Collect the details of various types of the formwork used for RCC structures at site.
- f. Collect the details of safety norms followed during RCC construction at site and write a report.
- g. Collect the details of safety norms followed during Steel construction at site and write a report
- h. Visit the site and study the labor management for any one activity related to RCC component and write a report.
- i. Visit the site and study the material management for any one activity related to RCC component and write a report.
- j. Visit the site and check the level for slab, plumb of column and depth of column as per blue print and write detailed procedure of any one.
- k. Identify the various human errors occurred while placing reinforcement and suggest remedial measures.
- l. Enlist the activities during removal of formwork and precautions to be taken.



- m. Enlist all the instruments used on site along with photograph and parallel terminology used by local mason/labour/worker.

### 13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Limit State Design of Steel Structures	Shah, V. L. Gore, Veena	Structures Publications, Pune ISBN-13: 1234567170961
2	Limit State Design of Steel Structures	Shiyekar, M. R.	PHI Learning, Delhi ISBN-13: 978-8120347847
3	Design of Steel Structures	Dayarathnam, P.	S. Chand and Company, Delhi. ISBN-13: 978-8121923200
4	Analysis and Design Practices of Steel Structures	Ghosh, Moy, Karuna	PHI Learning, Delhi. ISBN-13: 978-8120349377
5	Design of Steel Structures	Sairam, K.S.	Pearson Publication, Chennai, Delhi. ISBN-13:9332516308
6	Limit State Theory and Design of Reinforced Concrete Structures	Shah, V. L. Karve, S. R.	Structures Publications, Pune. ISBN-13: 9788190371711
7	Fundamentals of Reinforced Concrete	Sinha, N.C. Roy, S.K.	S. Chand & Co., New Delhi. ISBN-13: 978-8121901277
8	Reinforced Concrete Design Principles and Practice	Krishna Raju, N. Pranesh, R.N.	New Age International, Mumbai ISBN-13: 9788122414608
9	Reinforced concrete Design	Pillai, S.U. Menon, Devdas	McGraw Hill Publications, New Delhi, ISBN-13: 978-0070141100
10	Limit State Design of Reinforced Concrete	Varghese, P. C.	PHI Learning Private Limited, Delhi. ISBN-13: 978-8120320390
11	IS:800-2007 Indian Standard code of practice for use of structural steel in general building construction	BIS New Delhi	BIS New Delhi
12	<b>IS:875-1987 Part-1 to 5: Indian Standard Code for Loading Standards</b>	BIS New Delhi	BIS New Delhi
13	IS hand book No. 1 Properties of structural steel rolled section.	BIS New Delhi	BIS New Delhi
14	IS 456:2000 - Plain and Reinforced concrete code of Practice	BIS New Delhi	BIS New Delhi



S. No.	Title of Book	Author	Publication
15	SP16- Design Aids for reinforced concrete to IS 456	BIS New Delhi	BIS New Delhi
16	I.S. 875 (Part 1-5) - 1987 code of practice of design loads for Buildings and structures.	BIS New Delhi	BIS New Delhi
17	SP 24 - Explanatory Handbook on IS 456	BIS New Delhi	BIS New Delhi
18	SP34 : 1987 - Handbook on concrete reinforcement and Detailing.	BIS New Delhi	BIS New Delhi

**Others:**

- 1 Steel tables

**14. SOFTWARE/LEARNING WEBSITES**

- a. <https://www.youtube.com/watch?v=mtRR-5fzKo8>
- b. <https://www.youtube.com/watch?v=X8WhkG70tAc>
- c. <https://www.youtube.com/watch?v=zX8HNbHmToM>
- d. <https://www.youtube.com/watch?v=-JNMIMg-CE>
- e. freevideolectures.com > Civil Engineering > IIT Guwahati
- f. [www.youtube.com/playlist?list=PLF5B83BDDBB8FCBE3](http://www.youtube.com/playlist?list=PLF5B83BDDBB8FCBE3)
- g. [nptel.ac.in/noc/individual\\_course.php?id=noc17-ce21](http://nptel.ac.in/noc/individual_course.php?id=noc17-ce21)
- h. <http://freevideolectures.com/Course/2686/Design-of-Reinforced-Concrete-Structures>
- i. <https://www.youtube.com/watch?v=hVaB0jGcyB4>
- j. <https://www.youtube.com/watch?v=AfHmpWlcqq4>
- k. <https://www.youtube.com/watch?v=PDJPcQq3PZE>
- l. <https://www.youtube.com/watch?v=GgatFNtQrBo>
- m. <https://www.youtube.com/watch?v=A9JUGWhEW5A>
- n. freevideolectures.com > Civil Engineering > IIT Madras
- o. [https://www.youtube.com/watch?v=zwtVO3-\\_iNQ](https://www.youtube.com/watch?v=zwtVO3-_iNQ)
- p. <https://www.youtube.com/watch?v=wJWt0dcgafs>
- q. <https://www.youtube.com/watch?v=csK9eNk6S1c>
- r. [au.autodesk.com/au-online/classes-on.../class...steel/msf11860](http://au.autodesk.com/au-online/classes-on.../class...steel/msf11860)

