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
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			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
	Elective (Any One)																				
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
			Total	**16**	**1**	**20**	**37**	--	**350**	--	**150**	--	**500**	--	**250**	--	**250**	--	**500**	--	**1000**

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.**
- **Evalution 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											
				Theory							Practical				
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	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 5th and 6th 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 4th, 12th and 14th 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 14th 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 14th week, students should be asked to bring their partly prepared portfolio (relevant sections prepared) also during their assessment at the end of 4th week and 12th 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
	First Progressive Assessment at the end of 4th week	
1	**Problem Identification/Project Title** (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	**Industrial Survey and Literature Review**: 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	**General Behaviour**: initiative, resourcefulness, reasoning ability, imagination/creativity, self-reliance to be assessed **Note:** Oral feedback on general behaviour may also be given whenever relevant/ required during day to day guidance and supervision. **Only written feed-back/suggestions**	**00**
	Second Progressive Assessment at the end of 12th week	
4	**Project Proposal**: 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	**Execution of Plan in fifth semester** (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	**Log book** (for work done in fifth semester, detailed and regular entry would be basis of marks)	02
7	**General Behaviour** (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) **Note:** Oral feedback on general behaviour should also be given whenever relevant/ required during day to day guidance and supervision. **Only written feed-back./suggestions**	00
	Third Progressive Assessment at the end of 14th week	
8	**Portfolio for Self learning and reflection** (marks based on amount of reflection and completion of the portfolio for work done in fifth semester)	**04**
9	**Final Report writing including documentation**. (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	**Presentation** (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	**Defence** (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**
	Total	**25**

13. END-SEMESTER-EXAMINATION (ESE) ASSESSENT 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	**Problem Identification/Project Title** (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	**Industrial Survey and Literature Review** (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	**Project Proposal**: 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	**Execution of Plan in fifth semester** (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	**Log book** (for work during fifth semester, marks to be given based on detailed and regular entry	**03**
6	**Portfolio for Self learning and reflection** (for work during fifth semester) Marks based on amount of reflection and completion of portfolio.	**03**
7	**Project Report including Documentation** (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	**Presentation** (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.	**03**
9	**Defence** (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)	**04**
	Total	**25**

14. SPECIAL TEACHING STRETAGIES (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 4th week)							

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
1	**Problem/Task Identification (Project Title)**	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	**Literature Survey /Industrial Survey**	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	
Second Progressive Assessment (at the end of 12th week)							
3	**Project proposal**	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	**Execution of Plan in fifth semester (please write by hand about students performance in appropriate column)**					02	
5	**Log Book**	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	
Third progressive Assessment at the end of 14th week							
6	Portfolio Preparation	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	**Final Report Preparation**	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	**04**	
8	**Presentation**	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	**03**	
9	**Defense**	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	**04**	
					Total marks	**25**	

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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical				
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			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.

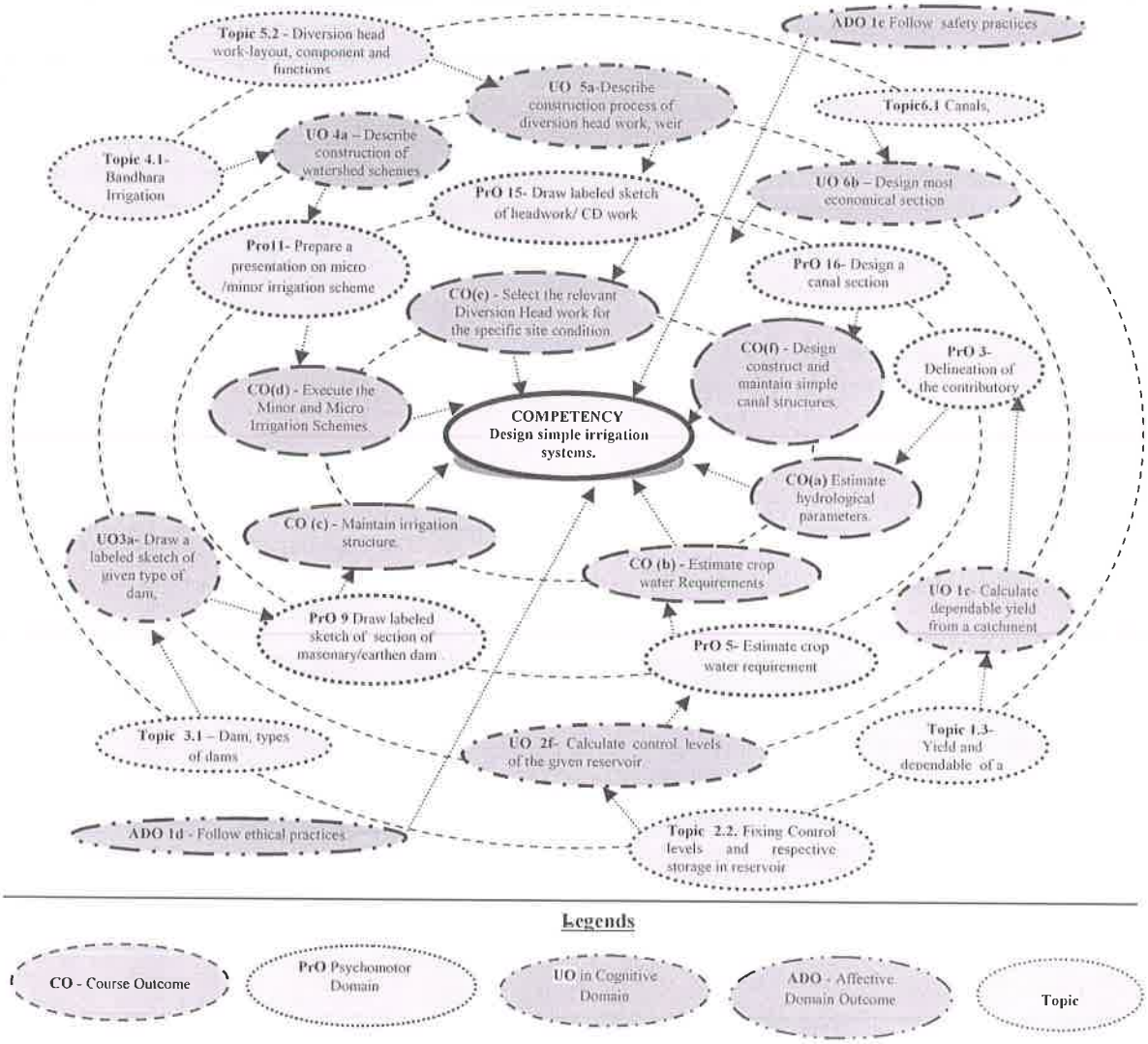

Figure 1 - Course Map

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	2*
3	Delineation of the contributory area for the given outlet from the	I	2*

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*
	Total		**32**

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 judicial 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
	Total	**100**

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 1st year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd 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
Unit – I Introduction to Irrigation and Hydrology	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 Theissen 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.	
Unit – II Water Requirement of Crops and Reservoir Planning	2a. Estimate crop water requirement in the given situation. 2b. Estimate capacity of canal for the given data. 2c. Undertake/conduct survey for the given irrigation project. 2d. Calculate reservoir capacity from the given data. 2e. Suggest relevant measures of silt control in a given situation with justification. 2f. Calculate control levels for the given reservoir from the given data. 2g. Establish the relationship between duty, delta and base period.	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. 2.2 Methods of application of irrigation water and its assessment. 2.3 Surveys for irrigation project, data collection for irrigation project. 2.4 Area capacity curve. 2.5 Silting of reservoir : Rate of silting, factors affecting silting and control measures. 2.6 Control levels in reservoir. 2.7 Simple numerical problems on Fixing Control levels.
Unit- III Dams And Spillways	3a. Draw a labeled sketch of given type of dam. 3b. Draw theoretical and practical profile of given gravity dam section. 3c. Suggest preventive measures for the given type of dam failure with justification. 3d. Propose the types of spillways and energy dissipaters for the given type of dam with justification. 3e. Suggest the relevant type(s) of gate for the given type of dam(s) with justification. 3f. Suggest suitable measures to maintain the given earthen dam with justification. 3g. Compare the earthen dam with gravity dams with respect to the given criteria such as seepage, foundation, construction and maintenance.	3.1 Dam and its classification: Earthen dams and Gravity dams (masonry and concrete). 3.2 Earthen Dams –Components with function, typical cross section, seepage through embankment and foundation and its control. 3.3 Methods of construction of earthen dam, types of failure of earthen dam and preventive measures. 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. 3.5 Spillways-Definition, function, location and components. 3.6 Emergency and service spillway - ogee spillway and bar type spillway, discharge over spillway. Energy dissipation, Spillway with and without gates. 3.7 Gates- Radial and Vertical.
Unit– IV Minor and Micro Irrigation	4a. Describe the process of construction of watershed scheme of farm pond for the given area.	4.1 Bandhara irrigation : Layout, components, construction and working, solid and open bandhara. 4.2 Percolation Tanks – Need, selection

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

***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
Total		**64**	**14**	**28**	**28**	**70**

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:

a. Collect data and drawings from various departments.
b. Assimilate data to be used in required form.
c. Interpret data.
d. Prepare drawings and design calculations.
e. Draw inference from designs.
f. 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:

a. 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 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. Edition2016 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.Edition1999 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
f. Charts/Models/Drawings

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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					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.

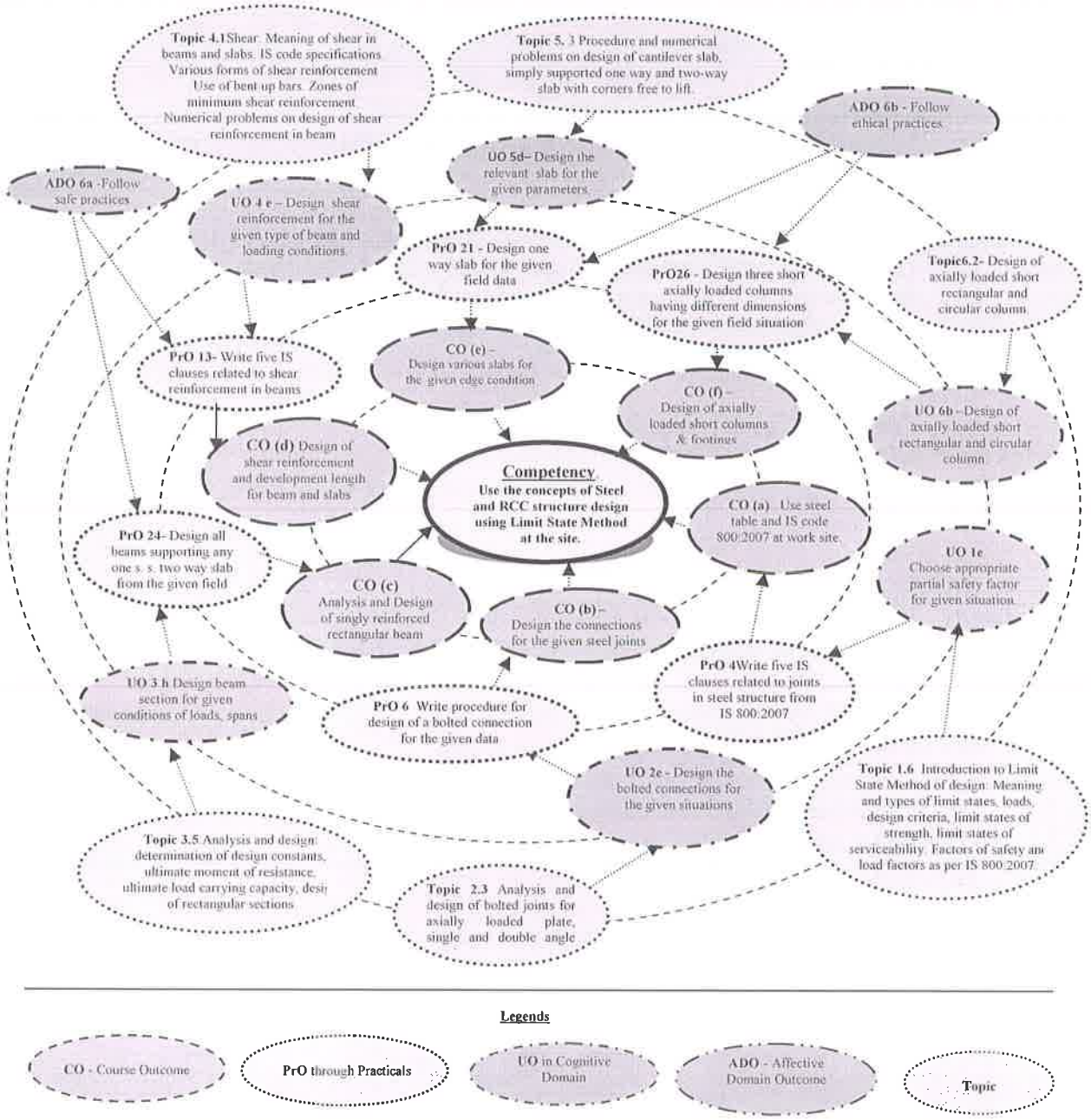

Figure 1 - Course Map

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	02
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	
16.	Draw the table showing details of deflected shape along with effective length of column as per IS 456:2000.	VI	02
17.	Design of a welded connection for the given data and compare it using open source software/IS code.	II	
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*
	Total		**32**

Note

3.1 *The term work should consist of manual, A3 size sketchbook and A2 size drawing sheets.*

3.2 *A judicial 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
	Total	**100**

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 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd 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
Unit – I Fundamental of steel structures	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.
Unit– II Design of	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
Steel Connections	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.
Unit III- Analysis and Design of Singly Reinforced Sections	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.
Unit –IV Design of Shear reinforcement and Bond	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. Numerical

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	conditions. 4c. Design shears reinforcement for the given conditions. 4d. Judge the beam with given reinforcement on the basis of the shear strength. 4e. Compute the bond length for the beam with given reinforcement. 4f. Identify the zone of minimum shear reinforcement in the given element.	problems on design of shear reinforcement in beam. 4.2 Bond: Meaning of bond as per IS code provisions. Meaning and calculation of development length in tension and compression.
Unit –V Design of Slabs	5a. Suggest the relevant type of slab for the given support condition. 5b. Suggest relevant corresponding values of design parameters in the given situation. 5c. Check the deflection of the given type of slab. 5d. Design the given type of slab using the given parameters. 5e. Check the development length of the given type of slab.	5.1 Slabs, support conditions, I.S. specifications regarding main steel, distribution steel, spacing and cover for reinforcement, effective span, minimum reinforcement. 5.2 Limit state of serviceability for slabs for deflection criteria only. 5.3 Design of one way and cantilever slab including development length check only. 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.
Unit –VI Design of axially loaded short Columns and footing	6a. Identify the type of column in the given situation. 6b. Calculate the ultimate load carrying capacity of the column in the given situation. 6c. Design the axially loaded short column for the given data. 6d. Check the given structural drawing as per the specifications laid in relevant IS code. 6e. Design given type of column footing for the given data. 6f. Explain the assumptions made in the design of axially loaded short column. 6g. Select the given type of RCC footings in the given situation.	6.1 Limit state of collapse in compression, assumptions, effective length, slenderness ratio, short and long columns, and minimum eccentricity. 6.2 IS specifications for reinforcement in column. 6.3 Load analysis for a column : load on an axially loaded column from beams at a different floor levels in a building 6.4 Design of axially loaded short square and rectangular column. 6.5 Various RC footings : Isolated and Sloped footings, combined footings, piles 6.6 IS specifications for reinforcement in footing 6.7 Design of isolated square sloped footing: Flexural design with

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
Total		**64**	**12**	**26**	**32**	**70**

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:

a. Prepare journals based on practical performed in laboratory.
b. Give seminar on relevant topic.
c. 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:

a. 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 methods 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	**IS:875-1987 Part-1 to 5: Indian Standard Code for Loading Standards**	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=-JMNMlMg-CE
e. freevideolectures.com › Civil Engineering › IIT Guwahati
f. www.youtube.com/playlist?list=PLF5B83BDDBB8FCBE3
g. 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
p. https://www.youtube.com/watch?v=wJWt0dcgafs
q. https://www.youtube.com/watch?v=csK9eNk6S1c
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MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

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:

a. Select the modes of measurements for different items of works.
b. Prepare approximate estimate of a civil engineering works.
c. Prepare detailed estimate of a civil engineering works.
d. Justify the rate for given items of work using rate analysis techniques.
e. 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											
				Theory							Practical				
L	T	P		Paper Hrs.	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.

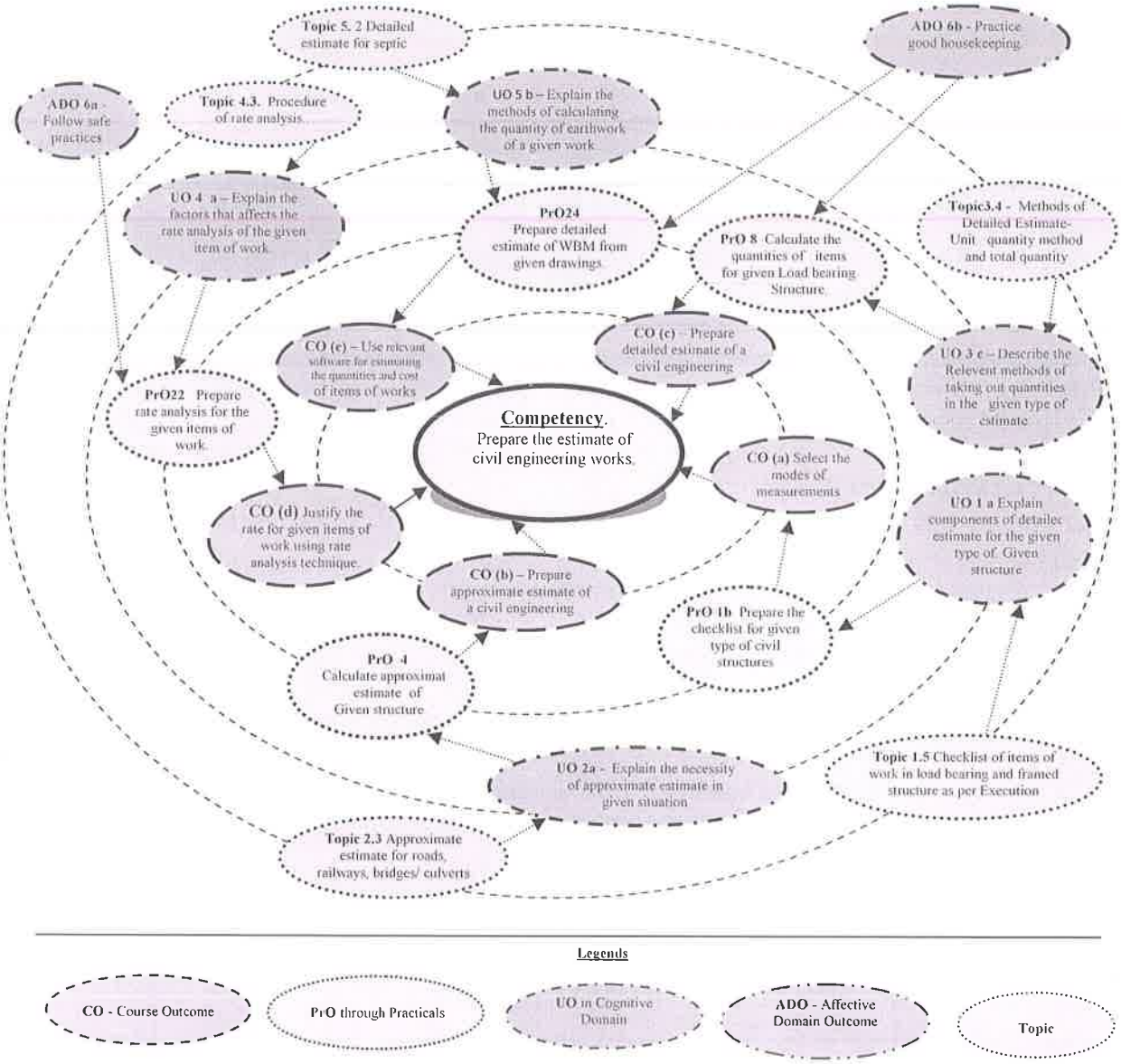

Figure 1 - Course Map

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
	Total		**64**

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 judicial 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.*

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 %
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
	Total	**100**

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 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd 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

Unit – I Fundamentals of estimating and costing	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.
Unit -II Approximate Estimates	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.

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

Engineering works	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. **(Questions on application of software from sub unit 5.3 above shall not be asked in theory exam.)**

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
Total		**48**	**10**	**22**	**38**	**70**

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:

a. Prepare detailed estimate of single room of load bearing structure..
b. Give seminar on relevant topic.
c. Undertake micro-projects.
d. 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:

a. 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.	**Charotar Publishing** 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
b. www.newtonindia.com
c. www.mahapwd.com

Program Name : **Civil Engineering Program Group**

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

Semester : **Fifth**

Course Title : **Public Health Engineering**

Course Code : **22504**

1. RATIONALE

The Environment and Public Health Engineering works for minimizing the impact of Engineering and Technology on the natural resources. Rapidly increasing urbanization, is stretching resources and infrastructure, and threatening environmental quality. To maintain better public health one must have safe quality of drinking water supply, effective methods for disposal of domestic and industrial waste and pollution free environment. The detailed knowledge about various sources of water supply, quality parameters of public water purification and conveyance of water will be useful in planning suitable water supply scheme for town/city. Topics on domestic sewage, conveyance of sewage in sewers analysis and treatment of sewage will be useful for safe disposal of this waste. Emerging trends in sanitation and water supply will provide latest know to the students. Thus the subject will be helpful in bringing up general public health to desired safe level in respect of water supply and disposal of waste.

2. COMPETENCY

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

- **Execute the efficient water supply and sanitary system.**

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:

a Identify the sources and characteristics of water and wastewater.
b Estimate the quantity of drinking water and wastewater generated.
c Draw labeled systems of plumbing for building sanitation.
d Draw the flow diagram for process of treatment of water and wastewater.
e Identify various accessories for efficient conveyance and distribution of water.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		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.

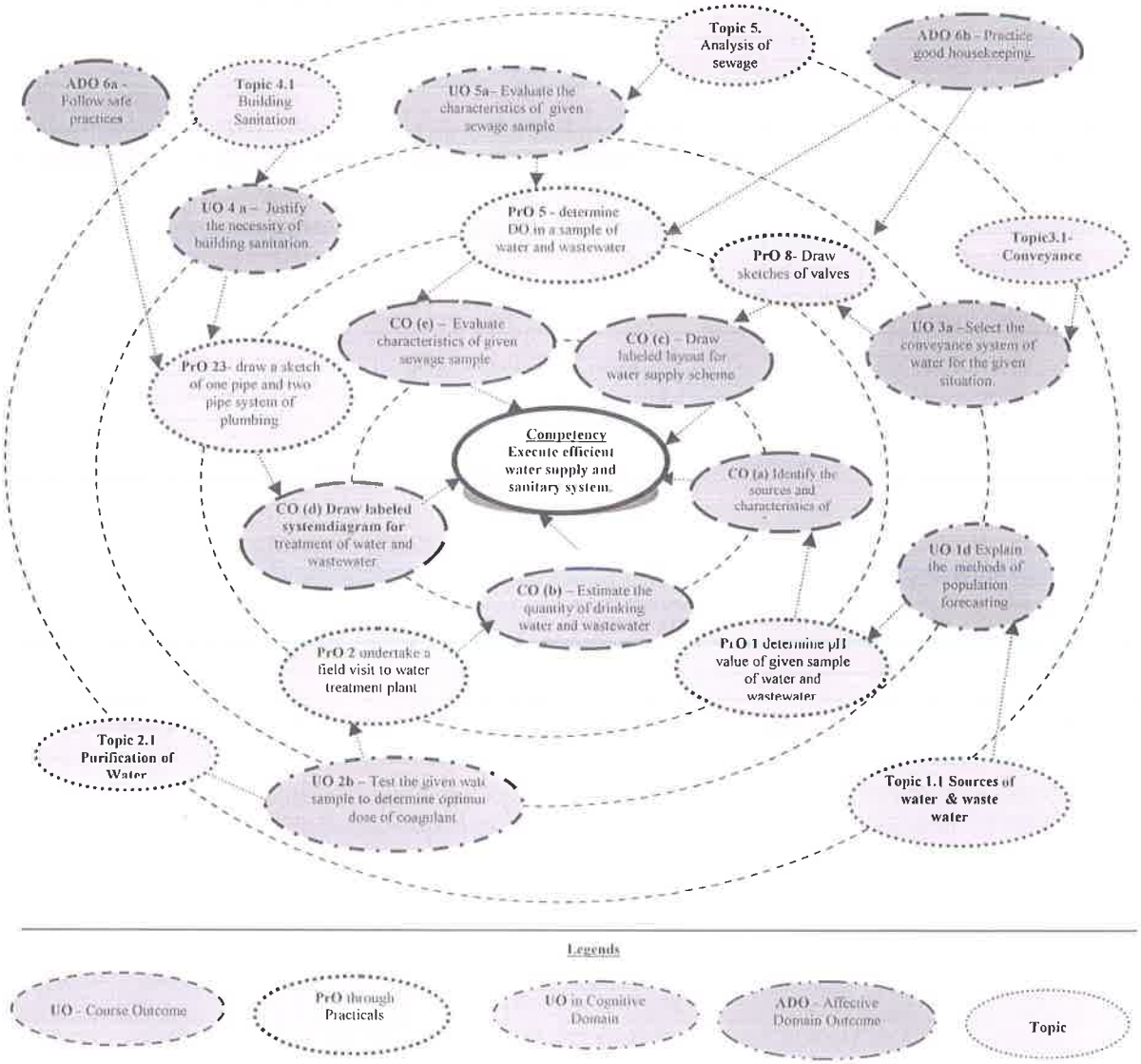

Figure 1 - Course Map

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. Require
1	Determine pH value of given sample of water.	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2	Determine the turbidity of the given sample of water.	I	02*
3	Determine residual chlorine in a given sample of water.	I	02
4	Determine suspended solids dissolved solids and total solids of given sample of water.	I	02
5	Determine the dissolved oxygen in a sample of water.	I	02*
6	Undertake a field visit to water treatment plant.	II	02*
7	Determine the optimum dose of coagulant in the given raw water sample by jar test.	II	02*
8	Draw sketches of various valves used in water supply pipe line	III	02
9	Draw a sketch of one pipe and two pipe system of plumbing	IV	02
10	Determine B.O.D. of given sample of waste water.	V	02
11	Determine pH value of given sample of wastewater.	V	02*
12	Determine suspended solids dissolved solids and total solids of given sample of wastewater.	V	02
13	Determine the dissolved oxygen in the given sample of wastewater.	V	02*
14	Determine C.O.D. of given sample of waste water.	V	02
15	Prepare a report of a field visit to wastewater treatment plant	V	02*
16	Prepare a report of the field visit to bio gas /gobar gas plant in your locality	V	02
	Total		32

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 judicial mix of minimum12 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 is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Performance of practical in the laboratory / field visit	60
b.	Observation /data collection	10
c.	Results and conclusions	10
d.	Answer to sample questions	10
e.	Submit report in time	10
Total		**100**

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. Maintain tools and equipments.
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 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd 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	Digital pH meter (4 Digit Display (LED), 0 to 1000 mV, Resolution: 0.01 pH, Manual Temp, Compensation: 0 to 80^{0}C.)	1, 11
1.2	Digital Turbidity Meter.(Range 0 to 200NTU, Resolution 1NTU, Accuracy: ± 3% FS, ± 1Digit, Display3½ Digit 7-Segment LED Light Source6V, 0.3Amp Tungsten Lamp, Detector: Photodiode, Sample System:30 mm Clear Glass Test Tubes, Power230 V ± 10% AC, 50 Hz, Accessories Test tube Set of 5, Operation Manual, Dust Cover	2
1.3	Orthotolodine test kit (free and total **chlorine testing** for EPA reporting over the range of 0-4 mg/L.)	3
1.4	Electric Oven with digital control (Temperature: 300^{0}C., 25 kg capacity)	4, 12
1.5	Digital DO meter (Range: 0 to 20 ppm, Resolution : 0.1 ppm, Temperature compensation :0 to 50 ^{0}C.)	5, 13
1.6	Jar Test Apparatus (Digital timer: 1 to 99 minutes, material: Stainless steel, Power: Electric supply, Range: 25 to 250 rpm, with 6 glass jars of 1000 mL)	7
1.7	BOD incubator with BOD bottles (Rated Voltage: AC 220V±10% 50Hz, Power: 2800W, Temperature Controlling Mode: Digital Display, Temperature Controlling Point: 24°c, 93.5°c,Temperature Controlling Precision: ±0.1°c)	10
1.8	Digital COD digester (Glassware: 15 Reaction Vessels & Air Condensers, Temperature: 150°C ± 1%, Capacity: 15 Samples at a time, Sample Size: 20 ml, Range: 0 to 500 ppm without dilution, Timer: 2 hours timer with Buzzer , Power Requirement: 230v 1000w	14

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below 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
Unit – I Sources, Quantity and Quality of water	1a. Describe various surface and sub surface sources of water in a given situation. 1b. Explain various types of intake structures for the given source of water.	1.1 **Sources of water:** Surface and Subsurface sources of water, Intake Structures, Definition and types, Factors governing the location of an intake structure, Types of intakes. 1.2 **Quantity of water:** Need to protect

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1c. Draw flow diagram of water supply scheme in the given situation. 1d. Explain the methods of forecasting population in the given situation. 1e. Undertake physical, chemical and biological tests for the given sample of water. Draw a neat labelled sketc h of cross section of "Rapid sand Gravity Filter"	water supplies, flow diagram of water supply scheme, function of units, Demands of water, Factors affecting rate of demand, Variations of water demands, Forecasting of population, Methods of forecasting of population, (Simple problems on forecasting of population), Design period, Estimating of quantity of water supply required for city or town. 1.3 **Quality of water:** Need for analysis of water, Characteristics of water- Physical, Chemical and Biological, Testing of water for Total solids, hardness, chlorides, dissolved Oxygen, pH, Fluoride, Nitrogen and its compounds, Bacteriological tests, E coli, B coli index, MPN, Sampling of water, Water quality standards as per I.S.10500.
UNIT II Purification of water	2a. Explain the term, "Aeration of water" in the given situation. 2b. Test the given water sample to determine the optimum dose of coagulant. 2c. Describe the process of filtration of water in the given situation. 2d. Differentiate between slow sand filter and rapid sand filter in the given situation. 2e. Describe different methods of disinfection for the given water sample. 2f. Explain advanced treatment methods for the water in the given situation.	**2.1 Purification of Water**: Screening- Types of screens, Aeration- objects and methods of aeration, Plain sedimentation, Sedimentation with coagulation, principles of coagulation, types of coagulants, Jar Test, process of coagulation, types of sedimentation tanks, **2.2** Clariflocculator, Filtration-theory of filtration, classification of filters: slow sand filter, rapid sand filter, pressure filter, construction and working of slow sand filter and rapid sand filter. Disinfection: Objects, methods of disinfection, Chlorination- Application of chlorine, forms of chlorination, types of chlorination practices, residual chlorine and its importance, orthotolidine test, Flow diagram of water treatment plants. **2.3 Miscellaneous water Treatments**: Water softening, Defluoridation techniques. **2.4 Advanced Water Treatments:** Electrolysis, Reverse Osmosis.
UNIT III Conveyance and Distribution of water	3a Select the conveyance system of water for the given area. 3b Select the relevant type of valve for the given pipeline of water supply. 3c Explain the methods of	3.1 **Conveyance:** Types of Pipes used for conveyance of water, choice of pipe material, Types of joints & Types of valves- their use, location and function on a pipeline. 3.2 **Distribution of water:** Methods of distribution of water- Gravity, pumping.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	distribution of water in the given situation. 3d Use the relevant method for the distribution of water in the given area. 3c Draw the layout of water distribution system in the given situation.	and combined system, Service reservoirs - functions and types , Layouts of distribution of water-Dead end system, grid iron system, circular system, radial system ; their suitability, advantages and disadvantages.
UNIT IV Domestic sewage and System of Sewerages	4a. Justify the necessity of Sanitation for the given Building. 4b. Describe the various types of traps for the given situation with sketches. 4c. Describe relevant system of plumbing in the given situation. 4d. Draw layout plan of drainage system for the given building. 4e. Describe the testing procedure for the given sewers. 4f. Explain the necessity of manhole and drop manhole in the given sewerage system.	4.1 **Building Sanitation:** Necessity of sanitation, Necessity to treat domestic sewage, Definitions - Sewage, sullage, types of sewage, Definitions of the terms related to Building Sanitation- Water pipe, Rain water pipe, Soil pipe, Sullage pipe, Vent pipe, Building Sanitary fittings-Water closet – Indian and European type, flushing cistern, wash basin, sinks, Urinals.Traps- types, qualities of good trap, Systems of plumbing - one pipe, two pipe, single stack, choice of system Principles regarding design of building drainage, layout plan for building sanitary fittings (drainage plan),inspection and junction chambers, their necessity, location, size and shape, Maintenance of sanitary units. 4.2 **Systems of Sewerage and Sewer Appurtenances**: Types of Sewers, Systems of sewerage, Design of sewers, self cleansing velocity and non scouring velocity, Laying, Testing and maintenance of sewers, Manholes and Drop Manhole-component parts, location, spacing, construction details, Sewer Inlets, Street Inlets.
UNIT V Characteristics and treatment of Sewage	5a. Evaluate the characteristics of given sewage sample. 5b. Explain the terms, "BOD and COD" for the given sample of sewage. 5c. Examine the quality of treated sewage as per given norms of MPCB. 5d. Draw flow diagram for sewage treatment plant for the given data. 5e. Select the relevant method of treatment of sewage in	5.1 **Analysis of sewage:** Characteristics of sewage, B.O.D., C.O.D. and its significance. Aerobic and anaerobic process, Maharashtra Pollution Control Board Norms for the discharge of treated sewage, Objects of sewage treatment and its flow diagram. 5.2 **Treatment of Sewage:** Screening, Grit removal, Skimming, Sedimentation of sewage, Sludge digestion, Trickling filters, Activated sludge process, Disposal of sewage, Oxidation pond, Oxidation ditch. Septic tank (details and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given situation.	design criteria), Recycling and Reuse of domestic waste.

***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	Sources, Quantity and Quality of water	08	04	08	-	12
II	Purification of water	12	04	06	08	18
III	Conveyance and Distribution of water	06	02	04	04	10
IV	Domestic sewage and System of Sewerages	12	02	04	12	18
V	Characteristics and Treatment of Sewage	10	02	04	06	12
Total		**48**	**14**	**26**	**30**	**70**

***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:

a. Prepare journals based on practical performed in laboratory.
b. Give seminar on relevant topic.
c. 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 outcomes in this course:

a. 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 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.

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. Test the water sample from locally available area to determine its characteristics..
b. Test the waste water sample from locally available area to determine its characteristics
c. Suggest the remedial measures for the control of pollution of local water source by conduct relevant study and tests.
d. Visit the site where Utilization and recycling of treated wastewater.is being implemented and prepare a detail report on it.
e. Undertake the Impact study of vehicular pollution on environment.
f. Undertake a comparative study of Solar water heater project and conventional water heater project for residential building.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Environmental Engineering Vol. I and Vol. II	Garg, S.K.	Khanna Publishers, New Delhi, 2017, ISBN-10: 8174091203; ISBN-13: 978-8174091208 ...
2	Water Supply and Sanitary Engineering	Birdie, G. S. Birdie, J. S.	Dhanpat Rai and Sons, 2011 ISBN: 81874337954,
3	Environmental Pollution Control Engineering	Rao, C.S.	New Age International Pvt Ltd Publishers . 2006, ISBN-13: 978-8122418354
4	Environmental Engineering	Tchobanoglous , George	Mcgraw Hill Publishers, 2013, ISBN 9789351340263

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.cpheeo.nic.in

b. www.mpcb.gov.in.
c. http://nptel.ac.in/courses/105106119/
d. http://nptel.ac.in/courses/105104102/
e. http://nptel.ac.in/courses/105106119/33
f. www.cpcb.nic.in
g. https://mjp.maharashtra.gov.in/
h. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-85-water-and-wastewater-treatment-engineering-spring-2006/lecture-notes/
i. http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php
j. www.IS 10500(2012): Drinking Water.
k. www.Eldo_PPT-IndianStandards_WWT%20(1).pdf


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Civil Engineering Program Group**

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

Semester : **Fifth**

Course Title : **Rural Development (Elective)**

Course Code : **22505**

1. RATIONALE

Rural development is the process of improving the quality of life and economic well being of people living in rural areas. Rural industrialization in the form of Cottage and Agro-based industries is vital for rural development. The content of this subject includes watershed management, cottage and agro-based industries, rural infrastructure development and study of various government schemes, etc. This will help the student to apply scientific knowledge in the process of sustainable development of villages through optimum utilization of both natural/man-made resources. This course has been designed so that the diploma civil engineer is able to use his knowledge for development of rural areas to make the villages a better place to live in.

2. COMPETENCY

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

- **Apply the principles of planning in rural development.**

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:

a. Undertake surveys to decide the status of socio-economic significance.
b. Identify the need of watershed management in rural areas.
c. Suggest relevant government schemes for construction of roads, housing and energy conservation.
d. Suggest the relevant cottage and agro based industries for the rural areas.
e. Select the relevant schemes of Central/State Government for the rural areas.
f. Apply the principles of rural development in rural areas.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		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 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.

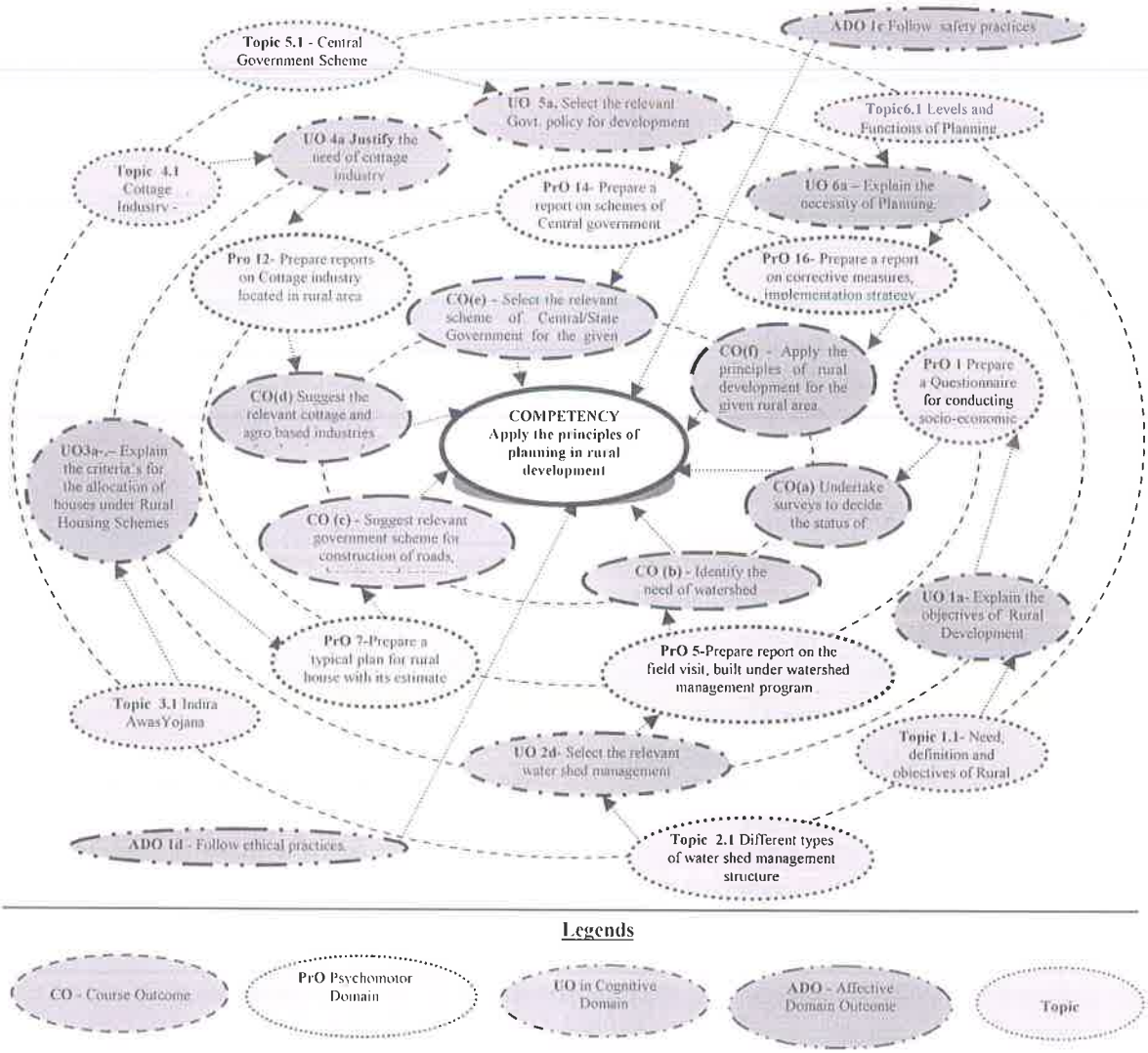

Figure 1 - Course Map

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 a Questionnaire for conducting socio-economic survey	I	02*
2	Undertake Socio-economic survey of a small nearby village-Part-I	I	02*
3	Undertake Socio-economic survey of a small nearby village-Part-II	I	02*
4	Analyze the data and prepare a report based on socio-economic survey which includes the list of available natural resources.	I	02*

S.No	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
5	Prepare the report on youth and woman empowerment on the basis of socio-economic survey and suggest a suitable solution with regard to education, training and employment.	I	02
6	Prepare the report on the field visit to the any one structure (K. T. weir, Gabian Structure, Cement Plug,) built under watershed management program.	II	02*
7	Prepare the report on the field visit to the any one structure (Contour Bunding, Farm pond, Underground Bandhara) built under watershed management program.	II	02*
8	Prepare the report on the field visit to the nearby Drip/Sprinkler /Lift Irrigation System with neat labeled sketch/layout along with the details of calculations for capacity, head, discharge and power for pump and pressure calculations for pipe.	II	02*
9	Prepare the typical plan for rural housing for, considering low cost housing/local material for construction.	III	02*
10	Prepare the estimate for the rural house having typical plan as mentioned in above practical no 7	III	02*
11	Suggest a typical cross section for the proposed new village road with justification and detailed note on its construction procedure with required specifications recommended by IRC.	III	02
12	Prepare the report of your recommendations of various schemes of State government regarding village development required to be implemented on the basis of socio-economic survey.	III	02*
13	Prepare the report, including your comments, on construction and working of Gobar gas/ Biogas plant with subsidies available, if any after undertaking the visit to the plant.	III	02
14	Prepare the report, including your comments, on construction and working of solar power panel with subsidies available, if any after undertaking the visit to the site.	III	02
15	Prepare a report on Cottage industry located in nearby rural area (Report should consist of raw material required, process, equipments required and area required) with layout and location plan for it.(on the basis of suitability and scope of that particular village)	IV	02*
16	Prepare a report on schemes of Central Government regarding village development, that are required to be implemented on the basis of socio-economic survey	V	02*
	Total		**32**

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 judicial 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 %
a.	Collection and Analysis of data	40
b.	Preparation of report /drawing	30
c.	Interpretation of result and conclusion	10
d.	Answer sample questions	10
e.	Submission of report in time	10
Total		**100**

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 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd 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	NIL	

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
Unit – I Overview of Rural Development :	1a. Suggest Modifications and improvements required for the development of the given rural area. 1b. Describe the social, economic and political significance of rural development for the given area. 1c. Describe the role of CAPART (Council for advancement of people's action and rural technology) in the development of	1.1 Rural Development :Need, definition, objectives. • Rural development as a phenomenon • Rural development as a strategy 1.2 Significance Of Rural Development • Social significance- Rural problems, social change, resource utilization, infrastructure etc.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given type of rural area. 1d. Describe the procedure for Socio-Economic survey for the given village. 1e. Explain the Role of Civil Engineer in the development of given rural area.	• Economic significance-- National income, employment, food and fodder, industrial development, internal trade and transport, capital formation, etc. • political significance- Political stability, 1.3 Rural Development Environment • Panchayat raj institution • CAPART (Council for advancement of people's action and rural technology)- Organizational set up, purposes, objectives, activities. 1.4 Socio-Economic survey 1.5 Role of Civil Engineer in Rural Development.
Unit– II Water Resource Management and Sanitation	2a. Select the relevant Water shed management structure in the given site condition. 2b. Describe the procedure of the construction of farm Pond in the given site condition. 2c. Explain the advantages and Disadvantages of Water shed management Structure for the given site condition. 2d. Calculate the rain water harvesting potential for the given area. 2e. Use the relevant method of Rainwater Harvesting suiting to the given site condition. 2f. Draw the Layout of given type of irrigation system(s) showing its component parts for the given site condition. 2g. Select the Irrigation System relevant to the given site condition.	2.1 Water shed management Structure (K. T. weir, Gabian Structure, Cement Plug, Contour Bunding, Farm pond, Underground Bandhara.): Uses ,Importance, Advantages and Disadvantages 2.2 Rain Water Harvesting and Recharging of sources 2.3 Irrigation System- purpose and Type 2.4 Layout and component parts of Drip Irrigation, Sprinkler Irrigation and lift Irrigation 2.5 Design parameter for laying Drip, Sprinkler and Lift Irrigation System 2.6 Rural Water Supply – Sources, Low cost technique of treatment, Protection of Bore hole. 2.7 Rural Sanitation- Low cost W.C., Readymade Toilet, Soak Pit , techniques for constructing W. C. requiring less quantity of water.
Unit III- Rural Roads, Housing and Energy	3a Explain the criteria's for the allocation of house under Rural Housing Schemes for the given location. 3b Describe the credit-cum-Subsidy scheme for rural housing for the given locality. 3c Apply the principles of Rural	3.1 Indira Awas Yojana – Salient features, beneficiary people, Conversion of Unserviceable Houses into Pucca/Semi-Pucca houses. 3.2 Credit-cum- Subsidy scheme of rural housing- Salient features, share of Central and State

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Housing in Habitat Development in the given rural area. 3d Summarize the salient features of Pradhan Mantri Gram Sadak Yojna of Govt.of India. 3e Set up Rural Building Center for the given purpose in the given situation. 3f Calculate the minimum amount of energy, required to cater the need for domestic cooking, heating and lighting in the given rural area. 3g Identify the sources of renewable energy for the given site conditions.	Government, 3.3 Rural Building Centers-Purpose, technology transfer, skill development, training, eco-friendly materials 3.4 Pradhan Mantri Gram Sadak Yojna(PMGSY)- Key elements, concept of rural road connectivity. 3.5 Low Cost Housing- Principles, purposes, use of Local Material for construction 3.6 Rural Roads- Type, Specifications, Construction Techniques and Road Drainage 3.7 Bio mass – Types of fuel such as Firewood, agricultural residues, dung cakes 3.8 Renewable energy and Integrated Rural Energy Programme – Objectives, key elements, implementation, financial provisions, sources of renewable energy 3.9 Working of Gobar gas and Biogas plant, National project on biogas development-technology, performance and implementation, financial assistance, involvement of Panchayat and local bodies.
Unit-IV Rural Industry and Finance	4a. Justify the need of cottage industry for the rural people in the given rural area. 4b. Classify the cottage industry on the basis of given criteria for the given rural area. 4c. Classify the agro based industry based on the given criteria. 4d. Suggest the criteria with justification for setting the agro based industry for the given rural area. 4e. Identify the sources of funds for the development of the given rural area.	4.1 Cottage Industry- Brick Manufacturing, Concrete hollow Block, Artificial Sandstone crushing plant. 4.2 Agro based Industry- Dairy, Animal Husbandry, Horticulture, Sericulture, and Fishery 4.3 sources of funds for rural development • Domestic (institutional and non –institutional) • foreign institutional and non – institutional)
Unit –V Government Policies Pertaining to	5a. Select the relevant Government policy for the development of the given rural area. 5b. Compare the different Government	5.1 Central & State Government Schemes 5.1..1 Prime Minister Rural 5.1..2 Development Fellows Scheme

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Rural Development	schemes of Rural development available for the given area. 5c. Explain the salient feature of National Rural Employment Guarantee Act,2005 for the development of given rural area. 5d. Describe the procedure mentioned in Prime Minister Rural Development Fellows Scheme for the given rural area. 5e. Execute the Deen Dayal Upadhyaya Grameen Kaushalya Yojana for the development of the given rural area.	5.1..3 National Rural Employment 5.1..4 Guarantee Act, 2005, NREGA 5.1..5 Swarnjayanti Gram Swarozgar Yojana (SGSY). 5.1..6 The Sampoorna Grameen Rozgar Yojna. 5.1..7 Deen Dayal Upadhyaya 5.1..8 Grameen Kaushalya Yojana.
Unit – VI Planning for Rural Development	6a. Justify the necessity of planning for the development of the given rural area. 6b. Execute the relevant plan at the specified level of the given rural area. 6c. Describe the functions of planning at micro, meso and macro levels for the given rural area.. 6d. Describe the process of micro level planning w.r.t.agriculture. 6e. Describe the methodology used for executing the block and district level planning for the given rural area. 6f. Identify the components of an ideal development project for the given rural area.	6.1 Plan and planning for rural development. 6.2 Levels and Functions of Planning. 6.3.1 Micro-level Planning 6.3.2 meso-level Planning 6.3.3 macro-level Planning 6.3 Decentralization policy of Planning. 6.4 Block and District Level Planning.

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
1	Overview of Rural Development	04	02	04	-	06
2	Water Resource Management and Sanitation	10	02	04	10	16
3	Rural Roads. Housing and Energy	12	02	08	10	20
4	Rural Industry and Finance	08	02	04	04	10
5	Government Policies Pertaining to Rural Development	06	02	-	06	08

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
6	Planning for Rural Development	08	-	04	06	10
Total		**48**	**10**	**24**	**36**	**70**

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:

a. Prepare journals based on practical performed in laboratory.
b. Give seminar on relevant topic.
c. 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:

a. 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 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 class and Lab.

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. Prepare a report on implementation of Prime Minister Rural Development Fellows Scheme for the nearby Village after undertaking the visit to that village.
b. Collect the detailed information on Pradhan Mantri Gram Sadak Yojana (PMGSY) that has been executed successfully for the given rural area and present the same in the form of the report.
c. Summarize the salient features of the National Rural Employment Guarantee Act, 2005 (NREGA) that has been executed successfully for the given rural area and present the same in the form of the report.
d. Prepare the report on the executed scheme under the banner of "Swarnjayanti Gram Swarozgar Yojana (SGSY)" to assist the poor families living below the poverty line in the given rural areas for taking up self employment.
e. Prepare the report on the executed scheme under the banner of, "The Sampoorna Grameen Rozgar Yojna" to provide additional wage employment in the given rural areas with its impact on food security, improvement in nutritional levels.
f. Analyze the E-Book released by the Ministry of Rural Development downloaded through internet with special reference to its initiatives and achievements.
g. Collect the information of, "Deen Dayal Upadhyaya Grameen Kaushalya Yojana" and prepare a report on it with reference to the nearby village or rural settlement.
h. Visit to - Ralegan Siddhi, Hiware Bazar, Chitrakut, Vanrai and prepare a report on it.

13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Rural Development in India: Past, Present and Future : a Challenge in the Crisis	Desai,Vasant	Himalaya Publishing House, Delhi ISBN 8183181929 ISBN 9788183181921
2	Rural Development Strategy	Rastogi , A.K.	Wide Vision, Jaipur ISBN -81-8068-000-2
3	Rural Development Principles, Policies and Management	Singh, Katar	Sage Publications India Pvt Ltd ISBN- 978-81-7829-926-6 (PB)
4	Dynamics Of Rural Development	Gaur, Keshav Dev	Mittal Publications, 1992,Delhi ISBN:81-7099-396-2 ISBN-13:978-8170993964
5	Document Published by Ministry of Rural development	Govt. of India	Ministry of Rural development,

14. SOFTWARE/LEARNING WEBSITES

a. http://rural.nic.in/
b. http://www.panchayat.gov.in/
c. https://www.india.gov.in/topics/rural


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : Civil Engineering Program Group

Program Code : CE/CR/CS

Semester : Fifth

Course Title : Energy Conservation and Green Building (Elective)

Course Code : 22506

1. RATIONALE

Today's homebuyers are increasingly interested in green building as it improve the way homes use energy, water, and materials, to reduce negative impacts on human health and the overall environment-both during construction and over its lifetime. Building heating and cooling are the most energy-intensive activities, followed by electricity use for lighting and appliances. Rising standards of living result in more energy services required for heating, cooling, lighting and communicating. Energy being in limited quantum as on date is a very scarce resource nowadays and need to be used optimally. Higher levels of energy efficiency reduce carbon emissions from the home's own energy systems. Therefore, it becomes necessary to be energy--conscious and make every effort for the conservation of energy. The environmental management and audit is necessary to study the impact of various industries on natural resources. Green building use the resources optimally, reduce waste and reduce the cost of life cycle and provide healthy indoor environment for its occupants through restoring/improving the natural environment. Therefore this course will enable the students to face these challenges of today's era in most effective way to build the structures as green one to improve the quality of environment significantly.

2. COMPETENCY

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

- **Implement concept of energy conservation in construction practises.**

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:

a. Identify various sources of environmental pollution.
b. Implement the different steps in environmental impact assessment.
c. Relate the construction of green building with the prevailing energy conservation policy and regulations.
d. Construct the building using the principles of Green building and the relevant materials.
e. Select the relevant rating system for assessment of given Green building

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		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.

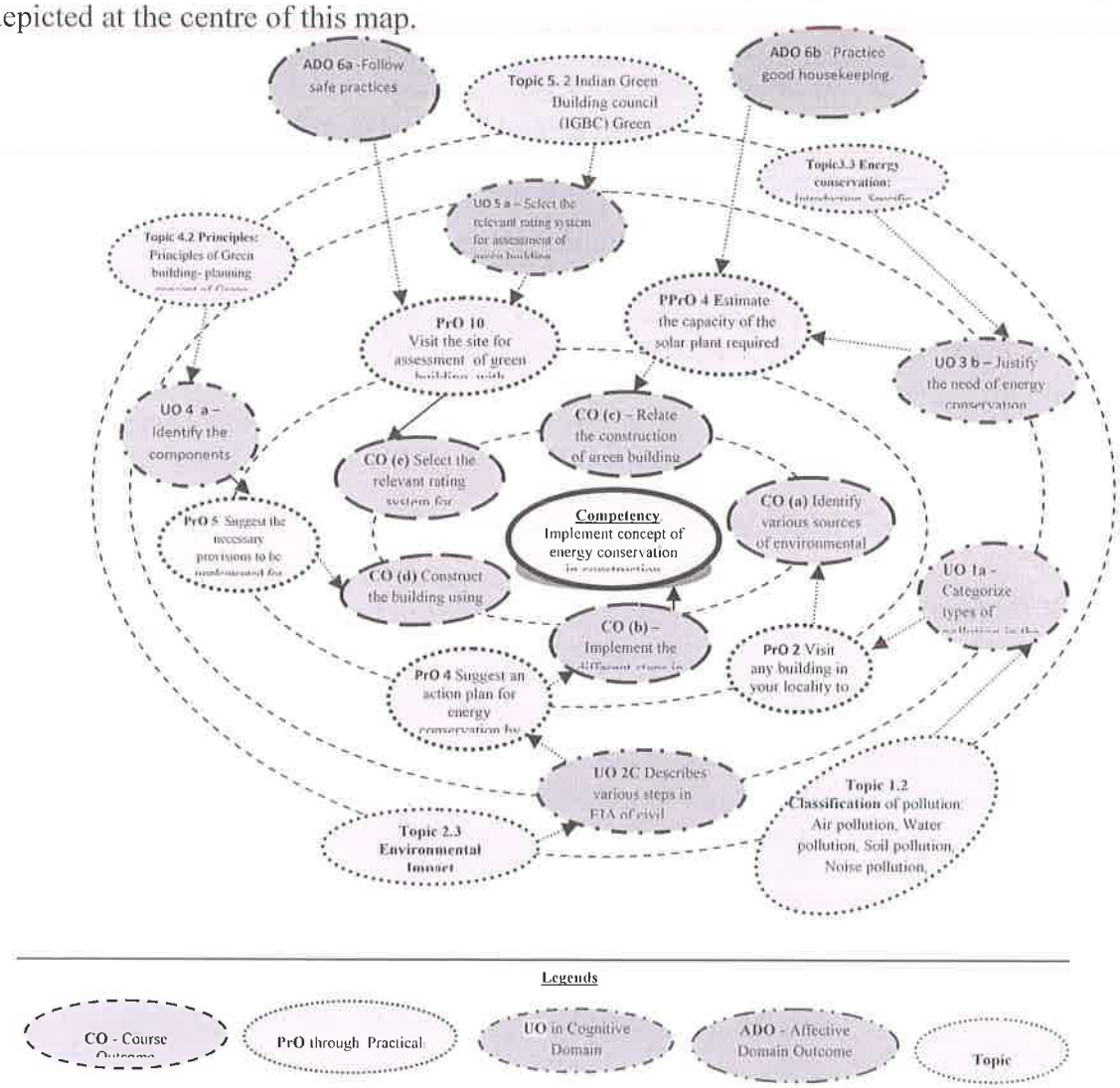

Figure 1 - Course Map

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	Prepare a report on noise levels in various area of your city by	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	collecting the relevant data from the concern department with your comments.		
2	Visit any building in your locality to identify the relevant legal provisions followed for control of pollution and submit your observations-cum-findings in the form of a report.	I	02*
3	Inspect your institute building and submit an action plan for improving the indoor and outdoor environmental quality	II	02*
4	Estimate the capacity of the solar plant required for your institute building on the basis of the total electricity consumption data available from concern department.	II	02*
5	Identify the impact of number of trees , green belt on the energy level of the building. (By physical verification)	III	02*
6	Prepare an action plan for energy conservation by inspecting an existing structure to explore its potential in it.	III	02*
7	Conduct the energy audit of your institute building using any rating system.	III	02
8	Visit to the nearby wind mill and prepare a report on your observations w.r.t. generation of energy with relevant sketches wherever required.	III	02
9	Visit to the nearby Hydroelectric power plant and prepare a report on your observations w.r.t. generation of energy with relevant sketches wherever required.	III	02
10	Visit to the nearby solar energy plant and prepare a report on your observations w.r.t. generation of energy with relevant sketches wherever required.	III	02*
11	Inspect any conventional building in your area to suggest the action plan for converting it into green building with necessary legal provisions to be followed.	IV	02*
12	Visit the site of green building to identify the components of HVAC unit with space calculation and submit the visit report.	IV	02
13	Visit the site for assessment of green building with relevant rating system and submit your findings in the form of a report. (Part 1)	V	02*
14	Visit the site for assessment of green building with relevant rating system and submit your findings in the form of a report. (Part 2)	V	02*
15	Visit the site for assessment of green building with relevant rating system and submit your findings in the form of a report. (Part 3)	V	02*
16	Visit a site for suggesting necessary modifications required for improving green rating and energy conservation in the given building in Local area	V	02*
	Total		**32**

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 judicial mix of minimum 12 or more practical*

LOs/tutorials 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. *Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

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. Maintain tools and equipment.
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 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd 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	All practicals are based on Field visits, survey, and report writing. No specific equipments are required.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below 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

Unit – I Environmental Pollution	1a.Categorize types of pollution in the given situation. 1b.Explain the term, "air pollution" in the given context. 1c.Justify the need to control environmental pollution of the given area. 1d.Describe the relevant process of reducing noise pollution in the given situation. 1e.Use the different legal provisions pertaining to environmental and pollution in the given situation.	1.1**Introduction:** Definition of Environment and environmental pollution, Ecology, control of environmental pollution. 1.2 **Classification** of pollution: Air pollution, Water pollution, Soil pollution, Noise pollution, Environmental laws for controlling pollution.
Unit – II Environmental Audit and Environmental Impact Assessment (EIA)	2a.Justify the necessity of Environmental audit for the given purposes. 2b.Set the norms for Environmental audit of the given building. 2c.Describes various steps in EIA of the given civil engineering projects. 2d.Relate the findings of EIAfor reducing the Pollution in the given situation.	**2.1 Environmental Audit :** Meaning, Necessity, Norms **2.2 Types:** Objective-based types: Liabilities audit, Management audit, Activities audit Client-driven types: Regulatory external audit, Independent external audit, Internal environmental audit, Third party audit **2.3 Environmental Impact Assessment(EIA):**Introduction, EIA regulations, Steps in environmental impact assessment process, Benefits of EIA, Limitations of EIA, Environmental clearance for the civil engineering projects.
Unit– III Energy and Energy conservation	3a.Use the given source of renewable and Non-renewable energy for energy conservation. 3b.Justify the need of energy conservation in the given civil project. 3c.Describe present practices adopted in energy conservation in the country. 3d.Justify the role of MEDA in energy conservation in the given city/town. 3e. Implement the relevant provisions of Energy conservation act 2001 for the purpose of energy conservation in the given project.	3.1 **Renewable Energy Resources :** Solar Energy, wind Energy, Ocean Energy, Hydro Energy, Biomass Energy **3.2 Non-renewable Energy Resources:** Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical Sources of Energy, Fuel Cells, Hydrogen, Biofuels **3.3 Energy conservation:** Introduction, Specific objectives, present scenario, Need of energy conservation, LEED India Rating System and Energy Efficiency. **3.4 Functions** of Government organization working for Energy conservation and Audit(ECA)- •National Productivity council(NPC) •Ministry of New and Renewable Energy (MNRE)

		•Bureau of Energy efficiency (BEE) • Maharashtra Energy Development Agency (MEDA) 3.5 Salient features of Energy Conservation Act – 2001
Unit– IV Green Building	4a.Identify the components of the given green building. 4b. Explain the principles of green building used in the given building. 4c.Improve the quality of environment in the given civil structure. 4d. Suggest the strategies for design of the given building to have green building construction. 4e.Identify the relevant Materials required for the given building to have green building construction.	**4.1 Introduction:** Definition of Green building, Benefits of Green building, **4.2 Principles:** Principles of Green building- planning concept of Green Building 4.3 **Features:** Salient features of Green Building, Environmental design (ED) strategies for building construction **4.4 Process:** Improvement in environmental quality in civil structure **4.5 Materials:** Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. reuse of waste material-Plastic, rubber, Newspaper wood, Non toxic paint, Green roofing,
Unit– V Rating System for Green Building	5a. Select the relevant rating system for assessment of given green building 5b. Compare the different rating systems such as GRIHA , IGBC, EDGE, BEE adopted in the country. 5c.Explain salient provisions used in IGBC green rating system for the given building. 5d. Explain the role of HVAC unit in the given type of green building.	5.1 Leadership in Energy and Environmental Design (LEED) criteria, 5.2 Indian Green Building council (IGBC) Green rating, 5.3 Green Rating for Integrated Habitat Assessment. (GRIHA) criteria, 5.4 HVAC unit in green Building

***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	Environmental Pollution	4	--	4	4	08
II	Environmental Audit and Environmental Impact Assessment	8	2	4	6	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	(EIA)					
III	Energy and Energy conservation	10	4	6	6	16
IV	Green Building	14	2	8	6	16
V	Rating System for Green Building	12	2	4	12	18
Total		48	**10**	**26**	**34**	**70**

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:

a. Identify renewable and non renewable energy sources
b. Identify the sources of pollution in your area
c. Visit to construction site to identify energy resources
d. Make a model of solar energy plant.
e. Search software/freeware for the course content and write the report stating their applications.

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:

a. 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. Procure various materials required for practical exercises.
g. Arrange visit to nearby industries and workshops for understanding various construction materials.
h. Use video/animation films to explain various processes like Manufacturing of construction materials, concrete mixing, and base preparation for painting, mortar laying, carpentry work, false ceiling.
i. Use different instructional strategies in classroom teaching.

j. Demonstrate different samples of various construction materials like Stone, aggregate of different sizes, timber, lime, bitumen, Bricks, tiles, precast concrete products, Water proofing material, Termite proofing material, Thermal insulating material, plaster of Paris, paints, distemper, and varnishes.
k. Display various technical brochures of recent building materials.

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. Prepare a report by taking case study to classify the terms and the construction methodologies between Traditional building and Green building.
b. Collect the relevant information of recent technologies in green building construction and prepare a report on it.
c. Make a model of hydroelectric power plant and prepare a report.
d. Prepare a questionnaires for environmental audit
e. Prepare questionnaires for assessment of environmental impact

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Sustainable construction: Green Building design and Delivery.	Kibert, C.J.	John Wiley Hoboken, New Jersey, Nov. 2007, ISBN: 978-0-470-11421-6.
2.	Non conventional Energy Resources–	Chauhan, D S Sreevasthava, S K	New Age International Publishers, New Delhi 2014 ISBM13 : 9788122433999
3.	Alternative Building Materials and Technologies – –	Jagadeesh, K S, Reddy Venkatta Rama Nanjunda Rao, K S	New Age International Publishers, Delhi, 2008 ISBN 8122420370, 9788122420371
4.	Handbook of Green Building Design and Construction	Sam Kubba	Butterworth-Heinemann,2012 **eBook ISBN:**9780123851291

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.moef.nic.in/environmental_clearancegeneralhttp://www.sustainable.doe.gov
b. https://www.mahaurja.com/
c. https://mnre.gov.in/
d. https://www.mahaurja.com/meda/energy_conservation/energy_conservation_program
e. http://web.ccsu.edu/faculty/kyem/GEOG473/10TheWeek/IMPACT%20ASSESSMENT.htm

Program Name : **Civil Engineering Program Group**

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

Semester : **Fifth**

Course Title : **Traffic Engineering (Elective)**

Course Code : **22507**

1. RATIONALE

Traffic engineering is an important aspect of all modes of transportation. Due to the abundant growth in population and infrastructure development, there is urgent need to pay the immediate attention to the certain issues like designing traffic control device installations and modifications, including traffic signals, signs, and pavement markings. Also it is important for safety of vehicle users as well as pedestrians. This course is expected to develop knowledge of performing various traffic surveys, analyze and interpret the data and provide the solutions in the form of traffic controlling devices. The civil engineering diploma holders have to do the related construction and maintenance activities of the structures made for guiding the traffic.

2. COMPETENCY

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

- **Execute the working and control of traffic engineering elements.**

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:

a. Analyze the road traffic characteristics.
b. Undertake various types of road traffic studies.
c. Use the relevant road traffic signs and markings.
d. Select the relevant road signals for the given traffic islands
e. Maintain the road environment.
f. Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		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 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.

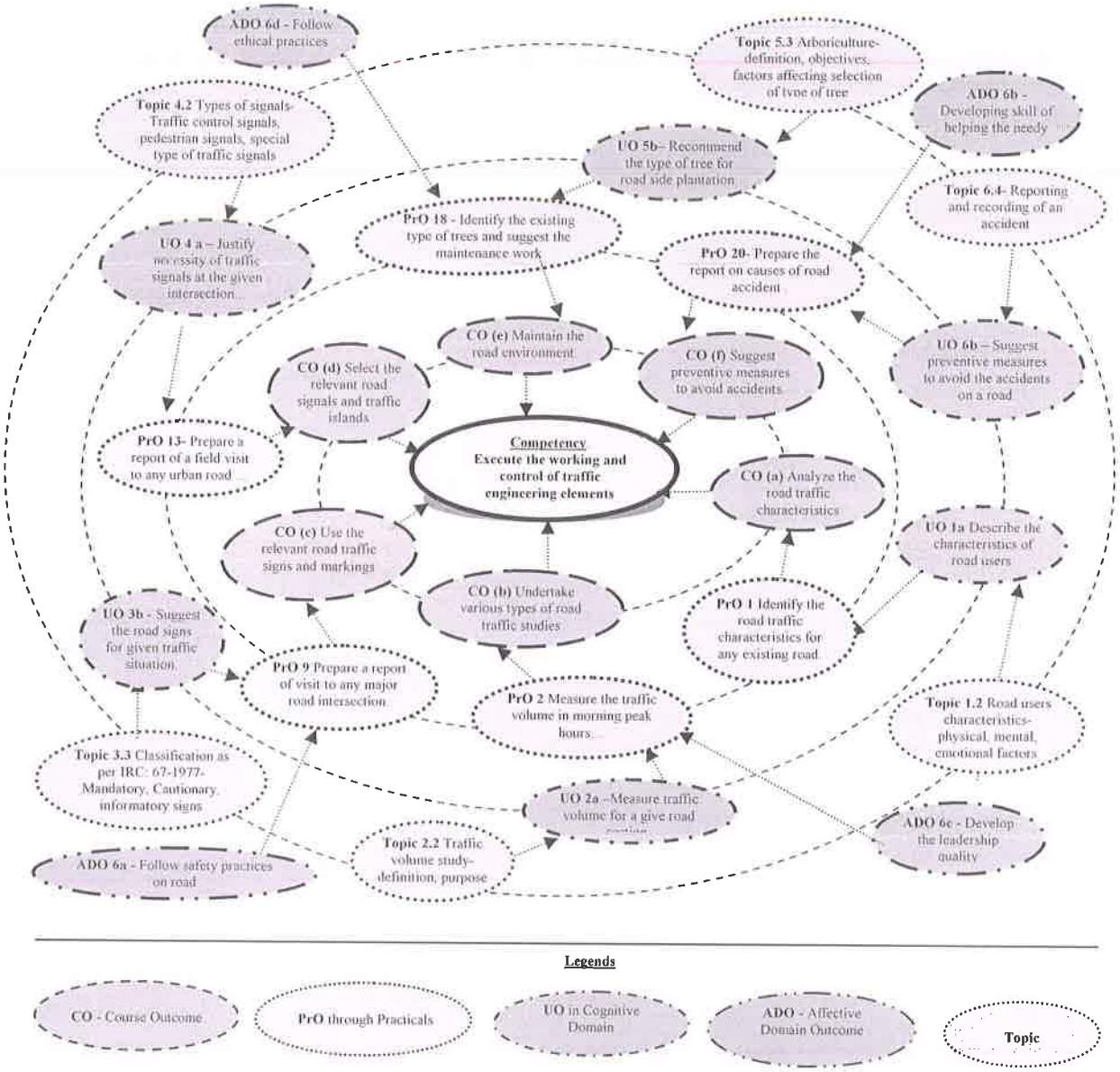

Figure 1 - Course Map

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.	Identify the road traffic characteristics for any existing road.	I	02
2.	Measure the traffic volume in morning peak hours to analyze traffic composition on road way.	II	02*
3.	Measure the traffic volume in evening peak hours to analyze traffic composition on road way.	II	02
4.	Measure the traffic volume in non peak hours to analyze traffic composition on road way.	II	02
5.	Measure the traffic volume in morning peak hours to analyze traffic composition at Intersection.	II	02*
6.	Measure the traffic volume in evening peak hours to analyze traffic composition at Intersection.	II	02
7.	Measure the traffic volume in non peak hours to analyze traffic composition at Intersection.	II	02*
8.	Prepare a report of trip generation and trip attraction between two zones on the basis of origin-destination study within area of your town/city.	II	02*
9.	Measure the spot speed on corridor of road way to analyze the percentile speed graphically.	II	02*
10.	Prepare a report of a field visit to any major road intersection in your locality to identify the type, working of traffic signals along with your recommendations if any.	III	02*
11.	Prepare a report of a field visit to any minor road intersection in your locality to identify the type, working of traffic signals along with your recommendations if any.	III	02
12.	Suggest the relevant vehicle parking system for your campus along with your recommendations if any in the form of a report.	III	02*
13.	Prepare a report of a field visit to any urban road way to identify the road signs and corresponding markings on road.	III	02
14.	Prepare a report of a field visit to any urban road to identify the traffic island along with its sketch.	III	02
15.	Prepare a report of a field visit to any road intersection in your locality to identify its type along with its sketch.	IV	02*
16.	Identify the existing street lighting system of any two types of roads.	IV	02
17.	Locate the points of conflicts in the diagram of a busy intersection on a major urban road in your locality.	IV	02
18.	Identify the existing type of trees to suggest any relevant maintenance required.	V	02
19.	Draw the collision diagram for any case study of road accident.	VI	02*
20.	Prepare the report on the causes of accidents and preventive measures suggested by you for the situation in practical no 18.	VI	02*
	Total		**32**

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 judicial 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 are to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
a.	Observation	40
b.	Following safety measures during work	10
c.	Active participation in team work	10
d.	Interpretation of observations and suggestions given	30
e.	Report submission in time	10
Total		**100**

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 road.
b. Developing skill of helping the needy.
c. Develop the leadership quality.
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 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd 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)	All
1.2	Drawing board with accessories	All
1.3	LCD Projector with accessories	All
1.4	Measuring tape.	13,14, 15
1.5	Line dori, white wash, brush	13,14, 15

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
Unit – I Fundamentals of Traffic Engineering.	1a. Describe the characteristics of road users in the given situation.. 1b. Describe the vehicular characteristics for the given situation. 1c. Calculate reaction time of driver in the given situation. 1d. Explain the factors affecting the reaction time for the given situation.	1.1 Traffic engineering- Definition, objects, scope 1.2 Road user's characteristics-physical, mental, emotional factors. 1.3 Vehicular characteristics-width, length, height, weight, speed, efficiency of breaks. 1.4 Road characteristics-gradient, curve of a road, design speed, friction between road and tyre surface. 1.5 Reaction time-factors affecting reaction time. PIEV Theory.
Unit– II Traffic Studies	2a Measure the traffic volume for the given section of road. 2b Analyze origin-destination studies data collected for the given road. 2c Analyze spot speed study data collected for the given road. 2d Design and develop the parking system for the given situation. 2e Suggest the improvement in road geometrics for the given road based on traffic volume count with justification.	2.1 Traffic Studies –types, purpose, Information required for traffic studies. 2.2 Traffic volume study-definition, purpose. 2.3 Methods of collection of traffic volume count data-manual, automatic recorders, moving car method 2.4 Traffic volume count data-representation and analysis of data. 2.5 Necessity of Origin and Destination study and its methods. 2.6 Speed studies-spot speed studies, and its presentation 2.7 Need and method of parking study.
Unit III- Road Signs and Traffic Markings	3a. Interpret the traffic signs at the given road intersection or road. 3b. Suggest the road signs for given traffic situation with justification. 3c. Explain the necessity of pavement markings for given road and road intersection. 3d. Draw the relevant markings on the given pavement.	3.1 Traffic control devices –definition, necessity, types. 3.2 Road signs-definition, objects of road signs. 3.3 Classification as per IRC: 67-1977-Mandatory or Regulatory, Cautionary or warning, informatory signs, Location of cautionary or warning sign in urban and non-urban areas, Points to be considered while designing the road signs. Points to be considered while erecting the road signs. 3.4 Traffic markings- definition 3.5 Classification of traffic markings-carriage way, kerb, object marking and reflector markers

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-IV Traffic Signals and Traffic Islands.	4a Justify the necessity of given traffic signal at the inter section of a road. 4b Explain the principle of coordinated signals on the given road section. 4c Categorize the existing traffic island at the given road intersection. 4d Suggest the relevant measures to guide the traffic in the given situation with justification..	4.1 Traffic signals- Definition, 4.2 Types of signals-Traffic control signals, pedestrian signals, special type of traffic signals, 4.3 Types of traffic control signals.-Fixed time, manually operated, traffic actuated signals 4.4 Location of signals 4.5 Compute signal time by fix time cycle, trail cycle, approximate, Webster's and IRC method and sketch timing diagram for each face. 4.6 Traffic islands –Definition, advantages and disadvantages of providing islands. 4.7 Types of traffic islands-rotary or central, channelizing or Refuge Island. 4.8 Road intersections or junctions-Definition, Types of road intersection. 4.9 Intersection at grade- Types, basic requirements of good intersection at grade. 4.10 Grade separated intersection-advantages and disadvantages, types-over pass or flyovers-Cloverleaf pattern, Trumpet type, underpass 4.11 Segregation of traffic-Definition, purpose, types.
Unit –V Road Environment and Arboriculture	5a. Suggest the street lighting system for the given road section. 5b. Recommend the relevant type of trees for road side plantation. 5c. Justify the need of protecting the road side plantation. 5d. Describe the methods of protecting the road side plantation.	5.1 Street lighting –definition, sources necessity, types-luminaire, foot candle, lumen, factors affecting their utilization and maintenance. 5.2 Factors affecting visibility at night. 5.3 Arboriculture- definition, objectives, factors affecting selection of type of trees. 5.4 Maintenance of trees-protection and care of road side trees
Unit –VI Road Accident Studies	6a. Analyze the causes of accident occurred on the given road section. 6b. Suggest preventive measures to avoid the accidents on the given road section. 6c. Create awareness about the traffic rules and laws at selected location.	6.1 Road accidents-Definition, types-Collision and non-collision accidents 6.2 Causes of accidents 6.3 Measures to prevent road accidents 6.4 Reporting and recording of an accident 6.5 Collision and condition diagram 6.6 Considerations regarding road safety 6.7 Legislation and law enforcement, education and propaganda

***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 Traffic Engineering	02	04	--	--	04
II	Traffic Studies	08	02	04	06	12
III	Road Signs and Traffic Markings	12	02	08	06	16
IV	Traffic Signals and Traffic Islands.	12	02	08	06	16
V	Road Environment and Arboriculture	06	--	08	--	08
VI	Road Accident Studies	08	--	08	06	14
Total		**48**	**10**	**36**	**24**	**70**

***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:

a. Prepare journals based on practical performed in laboratory.
b. Group discussion on traffic jams and related probable solutions in the city.
c. 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:

a. 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 the particular situation before undertaking the task in practice.

g. Train the students to help competent authority for guiding the traffic movements at an intersection.
h. Show video clips of nearby road with traffic movements and discuss the shortcomings in the road design
i. Show picture clips/photographs of Road accidents and discuss the features of road system design which could have prevented such accidents.
j. Arrange expert lectures by traffic system designers.
k. Arrange the brain storming sessions for suggesting the viable solution for a specific traffic problem.

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. Prepare a model of traffic controlling devices.
b. Make posters showing traffic safety and awareness.
c. Perform traffic survey of busy road junction of city in groups and to suggest measures for improvement.
d. Prepare a report on advanced road marking machinery and materials.
e. Undertake the process of planting, protecting and maintaining the trees along the road.
f. Prepare the charts showing different types of road signs.

13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Transportation Engineering	Arora, N. L.	Khanna Publishers, Delhi, 1996, ISBN: 81-7319-0933,
2	Traffic Engineering and Transport Planning	Kadiyali, L.R.	Khanna Publishers, Delhi, 2001, ISBN:10: 8185240779;
3	Transportation Engineering Vol. I & II	Vazirani, V N Chaondola, S P	Khanna Publishers. Delhi, 2016 ISBN: 9780128038185; 9780128038895
4	Traffic planning and design	Saxsena, S C	Dhanpat Rai & Sons Delhi, 2016 ISBN-10: 8123915500
5	Indian Highways- IRC Journal	Journal-monthly issue	IRC (Indian Road Congress), India, 1973, ISSN: 0376-7256

14. SOFTWARE/LEARNING WEBSITES

a. http://www.sanfoundry.com/highway-engineering-questions-answers-traffic-engineering/
b. https://www.youtube.com/watch?v=G7qU7HOw9QA
c. http://freevideolectures.com/Course/91/Introduction-to-Transportation-Engineering/4
d. https://www.slideshare.net/AtifKhan178/road-arboriculture
e. https://www.youtube.com/playlist?list=PLCC59953860B62145
f. http://nptel.ac.in/downloads/105101008/
g. http://nptel.ac.in/courses/105101008/downloads/cete_29.pdf
h. http://nptel.ac.in/courses/105101008/downloads/cete_38.pdf

Program Name : **Civil Engineering Program Group**

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

Semester : **Fifth**

Course Title : **Precast and Pre-stressed Concrete (Elective)**

Course Code : **22508**

1. RATIONALE

Precast and Pre-stressed Concrete construction technology is widely used across the globe for its inherent advantages. It has been adopted in India from past many years, but was mostly limited to civil structures such as tunnels, bridges, flyovers and underpasses. Today, with critical housing shortages, rising labour and input costs and an increased emphasis on quality and timely delivery, more and more developers are opting for innovative construction practices like precast and pre-stressed concrete. Hence it is essential to make upcoming engineering community aware about this. This course is designed to provide basic knowledge of precast and pre-stressed elements, their design aspects, pre-stressing techniques, methods and basic design principles.

2. COMPETENCY

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

a) Execute effectively construction work involving precast and pre-stressed concrete

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 will be able to demonstrate the following ***industry oriented*** COs associated with the above mentioned competency:

a. Select the relevant precast concrete element for a given type of construction.
b. Use the relevant components for the prefabricated structure .
c. Justify the relevance of pre-stressed element in a given situation.
d. Select the relevant methods / systems for given construction work.
e. Evaluate losses in a given pre-stressed concrete construction.
f. Propose a suitable cable profile for the given pre-stressed concrete member.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical				
L	T	P		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.

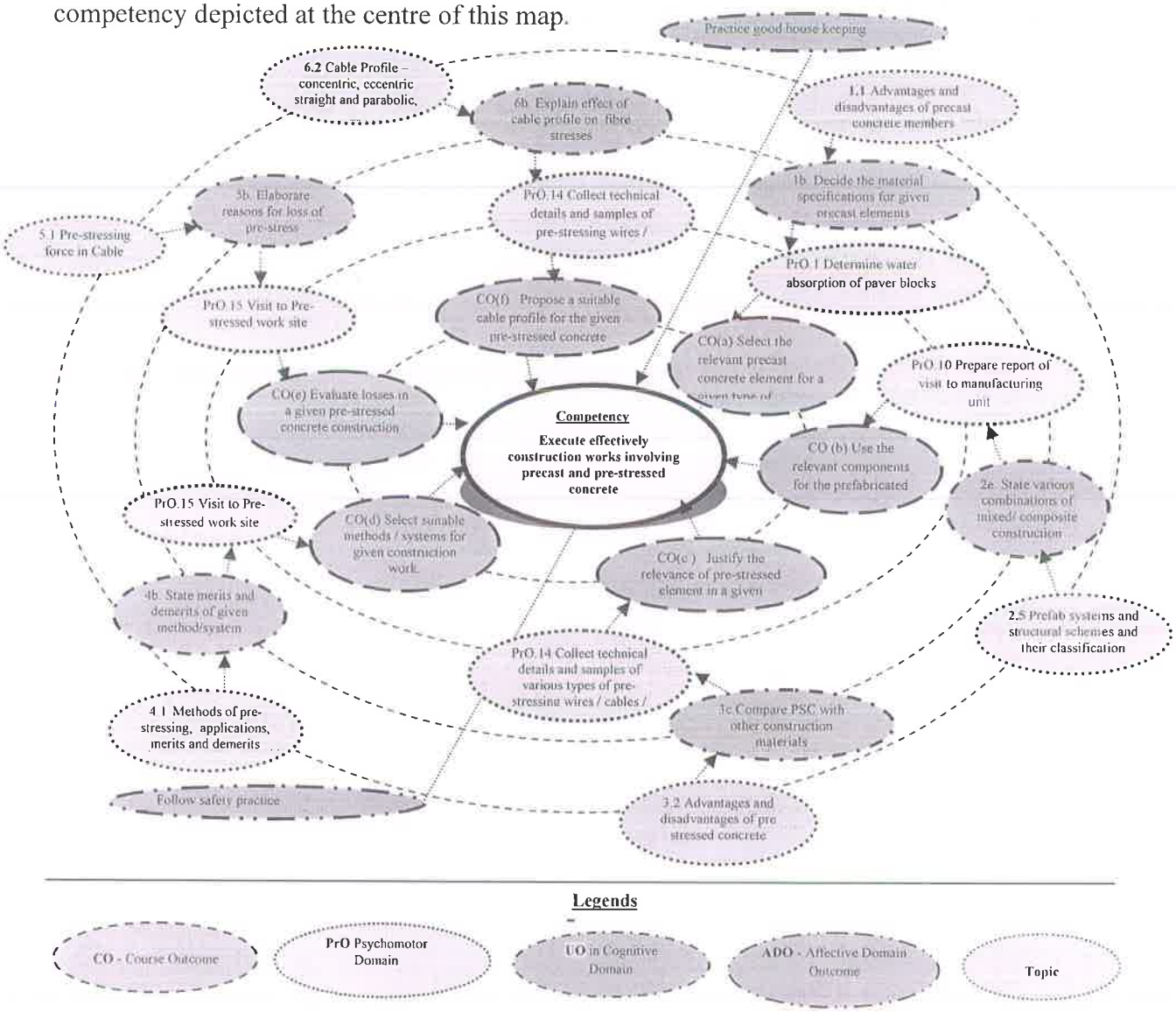

Figure 1 - Course Map

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) Ten compulsory* + any other two	Unit No.	Approx. Hrs. required
1	Determine water absorption of paver blocks of three different shapes of three different make and size.	I	02*
2	Determine water absorption of solid / hollow building blocks of three different sizes of three different make and size.	I	02*
3	Inspect any three elements (e.g. manhole covers, paver blocks, hollow blocks, solid blocks, curb stones etc) for dimension checking.	I	04*

S. No.	Practical Outcomes (PrOs) Ten compulsory* + any other two	Unit No.	Approx. Hrs. required
4	Prepare report of field visit to a manufacturing unit (of precast elements such as fencing pole, transmission pole, electric pole) with reference to the points such as manufacturing process, curing, stacking, handling, in-house inspection and testing.	I	04*
5	Determine compressive strength of given solid precast blocks	I	02*
6	Determine compressive strength of given hollow precast blocks	I	02*
7	Determine compressive strength of given paver blocks	I	02*
8	Perform load test on given manhole cover as per IS 12592:2002 Annex C	I	02
9	Observe Pressure Testing of given precast pre-stressed pipes	I	04
10	Prepare report of field visit to manufacturing unit (of precast elements such as lintel, chajja, door frame, wall panels, stair steps) with reference to the points such as manufacturing process, curing, stacking, handling, in-house inspection and testing.	II	04*
11	Determine flexural strength on given wall panels on site	II	04
12	Test in-situ the given prefabricated wall panel to judge its resistance against impact.	II	04
13	Test in-situ the given prefabricated wall panel to judge its resistance against flexure (holding the panel simply supported and applying impact force at centre till collapse)	II	02
14	Determine flexural strength of the given precast joists	II	02
15	Prepare the report, collect the samples of various types of pre-stressing wires / cables / strands along with their technical specifications/brochure.	III	02*
16	Prepare report of field visit to bridge site regarding pre-stressed member with reference to the points such as shape, dimensions, cable/ tendon, anchor block, method of pre-stressing, transfer of pre-stress, equipment used, etc.	III to VI	04*
	Total		**32**

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 judicial mix of minimum 12 or more practicals 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 is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10

S.No.	Performance Indicators	Weightage in %
7	Submission of report in time	10
	Total	**100**

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. Maintain tools and equipment.
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:

1. 'Valuing Level' in 1st year.
2. 'Organising Level' in 2nd year.
3. 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Hot air electric oven having temperature range 5^0 C to 250^0 C, removable 2-3 stainless steel shelves, thermostat, digital temp controller, with mineral wool insulation, door walls with silicon rubber gasket and lock	1,2
2	Digital display balance of capacity 10 kg having LC 10 gm and of capacity 30 kg having LC 10 gm	1,2
3	Test frame for load test for manhole covers	9
4	Universal Testing Machine: Capacity – 1000 kN. Type: Mechanical type / digital, electrically Operated with accessories such as (1) Tensile test attachment for wire specimen, (2) Compression test attachment, (3) Transverse test attachment with bending Punch, along with service tools and operation manual	10, 13
5	Compression Testing Machine: Digital display manual control compression testing; machine; Max. Capacity (KN): 2000 ; Measuring range: 4%-100% of FS; Max. distance between two platen (mm): 330; Compression plate size (mm): 220×220; Max. piston stroke (mm): 0-20; Max. piston speed (mm/min): Approx. 30; Column clearance 300×200; Oil pump motor power (KW): 1.5	6, 7, 8

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.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Precast concrete Elements	1a. Explain the concepts of precast concrete in the given situation. 1b. Select the material of relevant specifications for the given pre-cast elements. 1c. Describe the design considerations and IS provisions for given pre-cast element. 1d. Classify the joints of the given pre-cast elements. 1e. Recommend the precast element in the given situation on the basis of different test carried on it. 1f. Justify the need of different tests to decide the relevance of precast element in the given situation.	1.1. Advantages and disadvantages of precast concrete members, 1.2. Materials used- PCC, RCC, PSC, SCC, Ferro-cement, Aerated and Foam concrete 1.3. Non-structural Precast elements - Paver blocks, Fencing Poles, Transmission Poles, Manhole Covers, Hollow and Solid Blocks, Door & Window frames, curb stones. 1.4. Structural Precast elements – tunnel linings, Canal lining, Box culvert, bridge panels, foundation, sheet piles 1.5. Materials required, IS specifications, casting tolerances, fabricating systems, design considerations, joints, testing, storage and transportation, equipment ; for elements mentioned above 1.6. Testing of Precast components
Unit – II Prefabricated building	2a. Describe the various elements for a Prefabricated building 2b. Describe modular co-ordination design considerations with IS provisions for prefabricated elements. 2c. Explain the requirements of structural joints of the given pre-fabricated element. 2d. Describe the procedure of the storage, transportation and erection for a given precast element. 2e. Suggest the various combinations for mixed / composite construction. 2f. Recommend the relevant equipment required for the construction of given Prefabricated element with justification. 2g. Depict the effect of	2.1 Precast Structural Building components such as slab panels, beams, columns, footings, walls, lintels and chajjas, staircase elements, 2.2 Prefabricated building using precast load bearing and non load bearing wall panels, floor systems, 2.3 Material characteristics, Plans & Standard specifications 2.4 Modules, modular co-ordination, modular grid, finishes 2.5 Casting tolerances for above elements 2.6 Prefab systems and structural schemes and their classification 2.7 Design considerations and requirements 2.8 Joints – requirements of structural joints and their design considerations for above elements 2.9 Manufacturing, storage, curing, transportation and erection of above elements, equipment needed 2.10 Introduction to Mixed and composite construction 2.11 Ecological aspect of use of Prefabricated building

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Prefabricated building on the surrounding environment of the given building.	
Unit– III Introduction to Pre-stressed Concrete	3a. Explain the principle of pre-stressing the given element. 3b. Describe the applications of pre-stressed concrete elements in the given situation. 3c. Distinguish the PSC with other construction materials in given situation. 3d. Justify the need of high strength material for PSC. 3e. Select relevant type of pre-stressing steel for given member.	3.1 Principle of pre-stressed concrete and basic terminology. 3.2 Applications of pre-stressed concrete 3.3 Advantages and disadvantages of pre-stressed concrete 3.4 Materials used and their properties, Necessity of high-grade materials 3.5 Types of Pre-stressing steel -Wire, Cable, tendon, Merits-demerits and applications
Unit– IV Methods and systems of pre-stressing	4a. Select the relevant method of pre-stressing for given structural element. 4b. Illustrate the merits and demerits for given method/system of pre-stressing. 4c. Explain Hoyer system of pre-tensioning with diagram. 4d. Explain relevant system of post- tensioning based on the given criteria with diagram.	4.1 Methods of pre-stressing – Internal and External pre-stressing, Pre and Post tensioning- applications, merits and demerits 4.2 Systems for pre tensioning – process, applications, merits and demerits - Hoyer system 4.3 Systems for post-tensioning - process, applications, merits and demerits - Freyssinet system, Magnel Blaton system, Gifford Udall system. 4.4 Cover requirement for tendons
Unit– V Losses of pre-stress	5a. Identify the reasons for loss of pre-stress in the given element. 5b. Describe the situations in which the given elements exhibit the loss of pre-stress. 5c. Calculate the loss of pre-stress during anchoring in the given situation. 5d. Calculate the loss of pre-stress occurring in the	5.1. Pre-stressing force in Cable, Meaning of Loss of Pre-stress 5.2. Loss of pre-stress during the tensioning process - loss due to friction, length effect, wobbling effect and curvature effect. (Simple Numerical problems to determine loss of pre-stress) 5.3. Loss of pre-stress at the anchoring stage, 5.4. Loss of pre-stress occurring subsequently: losses due to shrinkage of concrete, creep of concrete, elastic shortening, and creep in steel. (Simple

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	given situation. 5e. Compile the IS recommendations for percentage loss in the given pre-stressing method.	Numerical problems to determine loss of pre-stress) 5.5. IS recommendations for % loss in case of Pre and Post tensioning
Unit– VI Analysis and design of Pre-stressed rectangular beam section	6a. Explain the assumptions made in the analysis of pre-stressed concrete beams 6b. Outline the cable profiles in the given situation. 6c. Predict the effect of the given cable profile on fiber stresses. 6d. Calculate maximum stresses induced in given beam 6e. Describe the steps adopted in the design of given pre-stressed beam element.	6.1 Basic assumptions in analysis of pre-stressed concrete beams. 6.2 Cable Profile in simply supported rectangular beam section – concentric, eccentric straight and parabolic, 6.3 Effect of cable profile on maximum stresses at mid span and at support. 6.4 Numerical problems on determination of maximum stresses at mid spans with linear (concentric and eccentric) cable profiles only. 6.5 Simple steps involved in Design of simply supported rectangular beam section (No numerical Problems)

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	Precast concrete Elements	08	02	04	06	12
II	Prefabricated building	10	02	06	08	16
III	Introduction to Pre-stressed Concrete	06	02	02	04	08
IV	Methods and systems of pre-stressing	06	00	04	04	08
V	Losses of pre-stress	08	02	04	06	12
VI	Analysis and design of Pre-stressed rectangular beam section	10	02	04	08	14
Total		**48**	**10**	**24**	**36**	**70**

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:

a. Undertake micro-projects.
b. Prepare journals based on practical performed in laboratory.
c. Poster presentation on any one topic.
d. Prepare short film related to manufacturing process of precast units.
e. Prepare short film related to pre-stressing process adopted on site.
f. Market survey specific to properties of various type of materials used in Precast and Pre-stressed concrete.

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:

a. 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***.
a. Guide student(s) in undertaking micro-projects.

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 four 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. Similar micro-projects could be added by the concerned faculty:

a. Collect pictorial information about pre-stressing jobs
b. Collect data of pre-stressed components manufactured in your vicinity.
c. Write a detailed report of visit to any one prefabricated unit.
d. Collect data for materials required for precast elements, with their suppliers, sale price etc.
e. Prepare a power point presentation on systems of pre-stressing
f. Present a seminar on testing of precast units.
g. Collect samples of at least five precast elements from your area.
h. Prepare a report on comparison of cast in situ and precast elements with respect to time required, quality and cost.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Pre Cast and Pre Stress Technology: Process, Method and Future Technology	Marzuki , Nor Ashikin	Createspace Independent Pub ISBN 10: 1499353391 ISBN 13: 978-1499353396
2	Handbook on Precast Concrete buildings	--	Indian Concrete Institute
3	Precast Concrete Structures	Elliott, Kim S.	CRC Press, New York, 2011 ISBN- 13: 9781498723992
4	Design Of Pre-stressed Concrete Structures	Lin, T.Y.	John Wiley and Sons, New York, 2014 ISBN- 8: 0471018988
5	Pre-stressed Concrete	Krishna Raju, N.	Tata McGraw Hill, New Delhi, 2012 ISBN 10: 1259003361 ISBN 13: 9781259003363
6	Pre-stressed Concrete Structures	Nagarajan, Pravin	Pearson Education India ISBN 9332517614, 9789332517615
7	IS 12592: 2002Precast Concrete Manhole Cover and Frame	BIS, New Delhi	BIS, New Delhi
8	IS 15658: Precast concrete blocks for paving - Code of Practice	BIS, New Delhi	BIS, New Delhi
9	IS 15916: 2011 Building Design and Erection Using Prefabricated Concrete - Code of Practice	BIS, New Delhi	BIS, New Delhi
10	IS 15917: 2011 Building Design and Erection Using Mixed/Composite Construction - Code of Practice	BIS, New Delhi	BIS, New Delhi
11	IS 458 - 2003 Precast Concrete Pipes (with and without reinforcement) — Specification	BIS, New Delhi	BIS, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. www.youtube.com for videos regarding precast and prestressing procedures.
c. www.nptel.ac.in
d. www.discoveryforengineers.com
e. Website of Precast Concrete Engineers Society (PSEI)
f. Website of Masterbuilder (Precast Concrete Structures-Design aspects and its implementation in India)