Government Polytechnic, Mumbai
(Academically Autonoums Institute, Government of Maharashtra)

Name of the Programme: Diploma In Civil Engineering (Sandwitch Pattern)

Teaching and examination Scheme (P23) | With Effect From Academic Year : 2023-24

Duration Of Programme : 6 Semester | Duration : 16 WEEKS

Semester : Fifth | Scheme : (P23)

Sr No	Course Title	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme													
					Actual Contact Hrs. / Week			Self-Learning Hrs/ Week	Notional Learning Hrs/Week		Paper Duration (hrs.)	Theory					Based on LL & TL Practical					Based on Self Learning		Total Marks
												FA-TH		SA-TH	Total		FA-PR		SA-PR			SLA		
					CL	TL	LL					T1 Max	T2 Max	Max	Max	Min	Max	Min	Max PR	Max OR	Min	Max	Min	
1	DESIGN OF REINFORCED CONCRETE & STEEL STRUCTURES	DSC	AM23106	4	4	1	-	3	8	4	2 Hrs. 30 min.	20	20	60	100	40	25	10	-	25#	10	25	10	175
2	ESTIMATING & COSTING	DSC	CE23110	4	4	-	2	2	8	4	2 Hrs. 30 min.	20	20	60	100	40	25	10	-	50#	20	25	10	200
3	CONTRACTS, ACCOUNTS & VALUATION	DSC	CE23111	4	3	-	2	1	6	3	2 Hrs. 30 min.	20	20	60	100	40	25	10	-	-	-	25	10	150
4	IRRIGATION ENGINEERING	DSC	CE23312	4	3	-	-	3	6	3	2 Hrs. 30 min.	20	20	60	100	40	-	-	-	-	-	25	10	125
5	PROJECT	INP	CE 23401	2	-	-	4	-	4	2	-	-	-	-	-	-	50	20	-	50#	20	-	-	100
6	ELECTIVE II (ANY ONE)			3	4	-	-	4	8	4	2 Hrs. 30 min.	20	20	60	100	40	-	-	-	-	-	25	10	125
	CONSTRUCTION MAMANGEMENT	AEC	CE23502	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SOLID WASTE MANAGEMENT	AEC	CE23503	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PRESTRESSED & PRECAST CONCRETE	AEC	AM23501				-	-																
	Total			21	18	1	8	13	40	20	12	100	100	300	500	200	125	50	00	125	50	125	50	875

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment, IKS- Indian Knowledge System.

Legends :@ InternalAssessment, # ExternalAssessment, *# On Line Examination , @$ Internal Online Examination

Note :

1) FA-TH represents two class tests of 20 marks each conducted during the semester.
2) If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3) If candidate is not securing minimum passing marks in SLAof any course then the candidate shall be declared as fail and will have to repeat/re-submit/re-appear.
4) Notional Learning hours for the semester are(CL+LL+TL+SL)hrs.*15Weeks
5) 1 credit is equivalent to 30 Notional hrs.
6) *Self learning hours shall not be reflected in the Time Table.

Course Category: 1.Discipline Specific Course Core (DSC), 2.Discipline Specific Elective (DSE), 3.ValueEducation Course(VEC),4.Internship / Apprenti, Project, Community(INP), 5.Ability Enhancement Course (AEC), 6. Skill Enhancement Course (SEC), 7. Generic Elective (GE)

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CDC Co-ordinator
G. P. Mumbai

Department Coordinator, Curriculum Development,

Head of Department, Dept. of Civil Engineering

In-Charge, Curriculum Development Cell

Principal, Government Polytechnic Mumbai

Programme: Diploma in Civil Engineering (Sandwich Pattern)

Course Code: AM23106	**Course Title: Design of Reinforced Concrete and Steel Structures**

Compulsory / Optional: Compulsory

Learning Scheme and Credits						Assessment Scheme							
						FA-TH		SA-TH (2:30 Hrs.)	FA-PR	SA		SLA	Total
CL	TL	LL	SLH	NLH	Credits	TS1	TS2			PR	OR		
4	1	-	3	8	4	20	20	60	25		50#	25	200

Total IKS Hrs for Course: 04 Hrs
Abbreviations: CL- Class Room Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment.
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note:
1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. Self learning includes micro project / assignment / other activities.

I. Rationale

In this course, the student will study elements of RCC & Steel structures such as beams/tension members, columns/compression members along with the concepts of their designs. Basic Principles of designing RCC shall be helpful for students in supervising and executing construction activities effectively. Steel is commonly used as a construction material for various steel structures such as steel girders, steel bridges, steel trusses, columns, towers, railway bridges, industrial building, etc. For the design of steel structures, the properties of steel, different sections, various grades and strength characteristics of steel are required. This will be useful for developing insight for the design concepts and will help student in effective supervision and quality control on site.

II. Industry / Employer Expected Outcome

1. Understand the design philosophy and principles.
2. Solve engineering problems of RC elements subjected to flexure, shear and torsion.
3. Demonstrate the procedural knowledge in designs of RC structural elements such as slabs, columns and footings.
4. Analyze the failure modes of various types of connections.
5. Design of various elements of steel structures as per Indian Standards.
6. Apply relevant codal provisions to ensure the safety and serviceability of structural elements for the recommendation.

III. Course Outcomes

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Design of singly and doubly reinforced RCC beam.
CO2	Design of RCC beam for shear and development length.
CO3	Design of short and long RCC columns.
CO4	Design of steel tension and compression member.
CO5	Design of steel I and Channel sections.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	**TLO 1.1** Explain singly and doubly reinforced sections, IS 456, limit state and stress block diagram. **TLO 1.2** Explain design of singly reinforced beam, concept of under reinforced, over reinforced and balanced section. **TLO 1.3** Explain design of doubly reinforced sections, stress and strain diagrams and depth of neutral axis.	**Design of Reinforced Concrete Beams by Limit State Method**: 1.1 Concept of Limit state, Stress block diagram, Introduction to singly and doubly reinforced sections, IS 456. 1.2 Design of singly reinforced beam, concept of under reinforced, over reinforced and balanced section, Simple numerical problem on ultimate moment of resistance and design of beam section. 1.3 Design of doubly reinforced sections, stress and strain diagrams, depth of neutral axis, simple numerical problems on ultimate moment of resistance of reinforced beam, Calculation of Ast and Asc. **Course Outcome: CO1, Teaching Hours : 14 hrs, Marks: 14 (R-4, U-4, A-6)**
2	**TLO 2.1** Explain design of shear reinforcement, Minimum Shear Reinforcement, Provisions of IS 456, forms of shear reinforcement. **TLO 2.2** Explain determination of Development length in tension and compression members and check as per codal provisions. **TLO 2.3** Explain Shear reinforcement, Adequacy of section for shear.. **TLO 2.4** Explain serviceability limit state check	**Shear, Bond and Development length in Design of RCC member:** 2.1 Nominal shear stress in RCC section, Design shear strength of concrete, Design of shear reinforcement, Minimum Shear Reinforcement, Provisions of IS 456, forms of shear reinforcement. 2.2 Types of bond, Bond stress, check for bond stress, Determination of Development length in tension and compression members and check as per codal provisions, Anchorage value of 90 hook, Lapping of bars. 2.3 Simple numerical s on: Shear reinforcement, Adequacy of section for shear. 2.4 Introduction to serviceability limit state check **Course Outcome: CO2,Teaching Hours: 13 hrs , Marks: 12 (R-4, U-4, A-4)**

Unit No.	Theory Learning Outcomes (TLO)	Topic / Sub-topic
3	**TLO 3.1** Describe definition and classification of column, Limit state of compression members, Effective length of column. **TLO 3.2** Explain Provisions of IS 456 for minimum steel, cover, maximum steel, spacing of ties.. **TLO 3.3** Explain design of axially loaded short column - Square, Rectangular, and Circular only.	**Design of axially loaded RCC Column :** 3.1 Definition and classification of column, Limit state of compression members, Effective length of column. 3.2 Provisions of IS 456 for minimum steel, cover, maximum steel, spacing of ties etc. 3.3 Design of axially loaded short column - Square, Rectangular, and Circular only. **Course Outcome: CO3,Teaching Hours: 10 hrs., Marks: 10 (R-2, U-4, A- 4)**
4	**TLO 4.1** Describe Types of sections used for Tension members. **TLO 4.2** Explain Strength of tension member by- yielding of section, rupture of net cross-section and block shear. **TLO 4.3** Explain design of axially loaded single angle and double angle tension members with bolted and welded connections **TLO 4.4** Explain Types of sections used as compression member. **TLO 4.5** Explain built up sections, lacing and battening, Diagrams of single and double lacing and battening system. **TLO 4.6** Explain design of axially loaded single and double angle struts connected by bolted and welded connections with gusset plate.	**Design of Steel Tension and Compression Members (Limit State Method) :** 4.1 Types of sections used for Tension members. 4.2 Strength of tension member by- yielding of section, rupture of net cross-section and block shear. 4.3 Design of axially loaded single angle and double angle tension members with bolted and welded connections. 4.4 Types of sections used as compression member, Calculation of effective length, Radius of gyration and slenderness ratio, Permissible values of slenderness ratio as per IS 800, Design compressive stress. 4.5 Introduction to built up sections, lacing and battening (Meaning and purpose), Diagrams of single and double lacing and battening system. (No numerical problems). 4.6 Design of axially loaded single and double angle struts connected by bolted and welded connections with gusset plate. **Course Outcome: CO4,Teaching Hours: 15 hrs , Marks: 14 (R-4, U-4, A-6)**

Unit No.	Theory Learning Outcomes (TLO)	Topic / Sub-topic
5	**TLO 5.1** Explain Standard beam sections, Bending stress calculations . **TLO 5.2** Explain Design of simple I and channel section. **TLO 5.3** Explain Check for shear as per IS 800	**Design of Steel beams (Limit State Method) :** 5.1 Standard beam sections, Bending stress calculations. 5.2 Design of steel I and channel section. 5.3 Check for shear as per IS 800. **Course Outcome: CO5, Teaching Hours: 8 hrs , Marks: 10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Design of Reinforced Concrete Beams by Limit State Method	4	4	6	14
2	Shear, Bond and Development length in Design of RCC member	4	4	4	12
3	Design of axially loaded RCC Column	2	4	4	10
4	Design of Steel Tension and Compression Members (Limit State Method)	4	4	6	14
5	Design of Steel beams (Limit State Method)	2	4	4	10
	TOTAL	16	20	24	60

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr. No.	Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / TutorialTitles	Number of hrs.	Relevant COs
1	**LLO 1.1** Draw cross section, strain diagram & stress diagram for singly reinforced section.	Draw cross section, strain diagram & stress diagram for singly reinforced section.	04	CO1, CO2
2	**LLO 2.1** Draw cross section, strain diagram & stress diagram for doubly Reinforced section.	Draw cross section, strain diagram & stress diagram for doubly Reinforced section.	04	CO1, CO2
3	**LLO 3.1** Draw sketches of different types of column footings.	Draw sketches of different types of column footings.	02	CO3
4	**LLO 4.1** Interpret the actual RCC Structural Drawings used on site with reference to	Interpret the actual RCC Structural Drawings used on site with reference to reinforcement details of various structural elements.	02	CO1, CO2, CO3

	reinforcement details of various structural elements.			
5	**LLO 5.1** Prepare a checklist for reinforcement provided from actual drawings used on site for various structural elements.	Prepare a checklist for reinforcement provided from actual drawings used on site for various structural elements.	02	CO1, CO2, CO3
6	**LLO 6.1** Prepare a detailed report of site visit for reinforcement detailing of structural elements like beams, columns, staircase & footing.	Prepare a detailed report of site visit for reinforcement detailing of structural elements like beams, columns, staircase & footing.	08	CO1, CO2, CO3
7	**LLO 7.1** Design simply supported I section steel beam for udl.	Design simply supported I section steel beam for udl.	06	CO5
8	**LLO 8.1** Draw any five commonly used rolled steel sections and five built up sections.	Draw any five commonly used rolled steel sections and five built up sections.	02	CO4
9	**LLO 9.1** Summarize the provisions of IS 800 required for the design of tension member in report form.	Summarize the provisions of IS 800 required for the design of tension member in report form.	04	CO4, CO5
10	**LLO 10.1** Compile relevant clauses from IS 800 required for the design of a compression member and submit it in report form.	Compile relevant clauses from IS 800 required for the design of a compression member and submit it in report form.	04	CO4, CO5
11	**LLO 11.1** Draw sketches for single & double lacing of given built up 04 columns.	Draw sketches for single & double lacing of given built up 04 columns.	02	CO4
12	**LLO 12.1** Draw sketches for battening of given built up columns.	Draw sketches for battening of given built up columns.	02	CO4
13	**LLO 13.1** Prepare a report on the IS 800 provisions pertaining to design of lacing & battening along with its significance.	Prepare a report on the IS 800 provisions pertaining to design of lacing & battening along with its significance.	04	CO4, CO5

14	**LLO 14.1** Design beams section for shear as per IS 800 provisions.	Design beams section for shear as per IS 800 provisions.	06	CO4, CO5
15	**LLO 15.1** Prepare a detailed report of site visit for study of rolled steel tension & compression members used in various structures.	Prepare a detailed report of site visit for study of rolled steel tension & compression members used in various structures.	08	CO4, CO5

IV. Suggested Micro Project / Assignment / Activities for Specific Learning /Skills Development (Self Learning):

Note:

Above is just a suggestive list of micro projects and assignments; faculty must prepare their own bank ofmicro Projects, assignments, and activities in a similar way.

The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.

If a micro project is assigned, it is expected to be completed as a group activity.

SLA marks shall be awarded as per the continuous assessment record.

If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

ormative assessment (Assessment for Learning) for practical & SLA

Term work Each practical will be assessed considering - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product related performance indicators, laboratory experience. (25 Marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Lab performance, Practical Exam of 50 marks

V. Suggested COs - POs Matrix Form (CO vs PO and CO vs PSO Mapping)

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Developmentof Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO-2	PSO-3
CO1	3	3	3	--	2	2	3	3	2	--
CO2	3	3	3	--	2	2	3	3	2	--
CO3	3	3	3	--	2	2	3	3	2	--
CO4	3	3	3	--	2	2	3	3	2	--
CO5	3	3	3	--	2	2	3	3	2	--

Legends: - High: 03, Medium: 02, Low: 01, No Mapping: --

a. Suggested Learning Materials / Books:

Sr.No	Author	Title	Publisher
1	Shah, V. L., and Karve, S.R.	Limit State Theory and Design of Reinforced Concrete Structures	Structures Publications, Pune, 2014.
2	Sinha N.C., and Roy S.K.	Fundamentals of Reinforced Concrete	S. Chand & Co., New Delhi.
3	Krishna Raju, and N. Pranesh	Reinforced Concrete Design Principles and Practice	R.N., New Age International, Mumbai.
4	Shah, V. L., and Gore, V.	Limit State Design of Steel Structures	Structures Publications, Pune.
5	Subramanian N.	Design of Steel Structures	Oxford University Press.
6	--	IS 456 : 2000 Plain and Reinforced Concrete	BIS
7	--	IS 800 : 2007 Steel Code	BIS

b. Learning Websites & Portals:

Sr.No	Link / Portal	Description
1	http://www.academia.edu	-
2.	http://www.irjet.net	-
3	http://www.nitw.ac.in	-
4	http://www.slideshare.net	-
5	http://link.springer.com	-
6	http://www.nationallibrary.gov.in	-

c. **Academic Consultation Committee/Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organization
1	Mr. Dipak Kulkarni	RCC CONSULTANT	STRUCTURAL CONSULTANT
2	Mr. Neel kumar Sawant	RCC CONSULTANT AND SURVEYOR	REGIONAL HEAD, MUMBAI
3	Mrs. Nisha Wartha	SYSTEM ANALYST	R.O.MUMBAI
4	Mr. B. K. Kakad	HOD in Applied Mechanics	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Applied Mechanics Engineering

Head of Department
Department of Applied Mechanics Engineering

I/C, Curriculum Development Cell

Principal

APPROVED COPY
CDC Co-ordinator
G. P. Mumbai

Programme : Diploma in Civil Engineering (Sandwich Pattern)													
Course Code: CE 23110					Course Title: Estimating and Costing								
Compulsory / Optional: Compulsory													
Teaching Scheme and Credits						Examination Scheme							
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (2:30 Hrs.)	FA-PR	SA		SLA	Total
						T1	T2			PR	OR		
04	-	02	02	08	4	20	20	60	25	-	50 #	25	200

Total IKS Hrs. for course: 4

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents marks of two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

This is a core technology course which will enable the students to learn core facts, concepts, principles & procedures in Estimating & Costing. With this knowledge and skill, students will be able to prepare estimate before start of construction and systematically procure materials during execution using specifications for ensuring appropriate type of construction process & quality of engineering products in specialized areas in Building Construction, Irrigation, Transportation and Environmental Engineering. In absence of market rates they can prepare their own rate and thereby prepare the detailed estimate.

II. Course Outcomes:

Students should be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Select modes of measurements for different items of works.
CO2	Prepare approximate estimate of a civil engineering works.
CO3	Prepare detailed estimate of a civil engineering works.
CO4	Calculate quantity of earthwork.

CO5	Justify the rate for given items of work using Rate Analysis techniques.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	**TLO 1.1** Understand Purpose of Estimating. **TLO 1.2** Explain various types of Estimates. **TLO 1.3** Uses of Estimates. **TLO 1.4** Understanding role and responsibility of Estimator **TLO 1.5** Checklist of work items **TLO 1.6** Measurement and Abstract Sheet **TLO 1.7** Modes of measurement and its accuracy **TLO 1.8** Rules for deduction **TLO 1.9** Description of work items	**Fundamentals of Estimating and Costing:** 1.1 Estimating and Costing – Meaning, purpose, Administrative approval, Technical Sanction and Budget provision. 1.2 Types of estimates – Approximate and Detailed estimate. 1.3 Types and Uses of Estimates: Revised estimate, Supplementary estimate, Revised & Supplementary Estimate, Repair and Maintenance estimate. 1.4 Roles and responsibility of Estimator 1.5 Checklist of items in load bearing and framed structure. 1.6 Standard formats of Measurement sheet, Abstract sheet, Face sheet 1.7 Modes of measurement and desired accuracy in measurements for different items of work as per IS:1200. 1.8 Rules for deduction in different category of work as per IS 1200. 1.9 Description of items of building work as per PWD /DSR. Specifications of work items **IKS:** Understanding of work items of historical buildings. **Course Outcome: CO1** **Teaching Hours : 12** **Marks: 12** **(R- 6, U-4, A-2)**
2	**TLO** 2.1 Explain Approximate Estimate. **TLO** 2.2. Explain methods of Approximate Estimate. **TLO** 2.3 Explain Approximate estimate for Civil Engg Projects	**Approximate Estimates:** 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 (with simple numerical) 2.3 Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects. **Course Outcome: CO2** **Teaching Hours : 10** **Marks:12** **(R-2 , U- 4 , A- 6)**
3	**TLO 3.1** Understanding procedure of detailed estimate. **TLO 3.2** Explain Methods of detailed estimate **TLO 3.3** Understanding Long Wall and Short wall method Centre Line method in detailed estimate **TLO 3.4** Understanding Bar Bending Schedule **TLO 3.5** Understanding	**Detailed Estimate :** 3.1 Detailed Estimate- Definition and Purpose, Data required for detailed estimate - Civil cost, GST, Contingencies, Supervision charges, Agency charges, Procedure for preparation of detailed estimate- Taking out quantities and Abstracting. 3.2 Methods of Detailed Estimate- Unit quantity method and total quantity method (with simple numerical) 3.3 Long wall and Short wall method, Centre line method. 3.4 Bar bending schedule for footing, column, beam, Lintel, chajja and slab elements.

	different provisions in detailed estimate **TLO 3.6** Understanding Bill of Quantities	3.5 Provisions in detailed estimate: contingencies, work charged establishment, percentage charges, water supply and sanitary Charges and electrification charges etc. 3.6 Prime cost, Provisional sum, Provisional quantities, Bill of quantities. **Course Outcome: CO3** **Teaching Hours :14** **Marks:14** **(R- 2 , U- 6 , A- 6)**
4	**TLO 4.1** Explain the methods of Earthwork Calculations **TLO 4.2** Understanding detailed estimate of Septic Tank and Community Well	**Estimate for Civil Engineering Works:** 4.1 Earthwork - Quantities for roads, Embankment and canal by – Mid sectional area method, mean sectional area method, Prismoidal and Trapezoidal formula method. 4.2 Detailed estimate for septic tank, Community well. **Course Outcome: CO4** **Teaching Hours :12** **Marks:10** **(R- 2 , U- 4 , A- 4)**
5	**TLO5.1** Understanding purpose and techniques of Rate Analysis **TLO5.2** Explain terms used in Rate Analysis **TLO5.3** Explain procedure of Rate Analysis. **TLO5.4** Understanding Task Work **TLO5.5** Understanding Number of Labours required as per Task Work **TLO5.6** Understanding Lead and Lift, Hire Charges of Machineries and equipment's **TLO5.7** Preparing Rate Analysis for work items of buildings	**Rate Analysis:** 5.1 Rate Analysis: Definition, purpose and importance. 5.2 Lead (Standard and Extra), lift, overhead charges, water charges and contractors' profit. 5.3 Procedure for rate analysis. 5.4 Task work- Definition, types. Task work of different skilled labour for different items. 5.5 Categories of labours, their daily wages, types and number of labours for different items of work 5.6 Transportation charges of materials - Lead and Lift. Hire charges of machineries and equipments. 5.7 Preparing rate analysis of different items of work pertaining to buildings **Course Outcome:CO5** **Teaching Hours :12** **Marks: 12** **(R- 2 , U- 4 , A- 6)**

III. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Laboratory Learning Outcomes (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.** To prepare list of items to be executed with units	Prepare the list of items to be executed with units for detailed estimate of a given structure	02	CO1
2	**LLO2.** Understand Specifications of work items	Study of items with specification given in the DSR (for any 5 items).	04	CO1

3	**LLO 3.** Prepare Approximate Estimate	Prepare approximate estimate for the given civil engineering works.		CO2
4	**LLO 4.** Understand Measurement Sheet and prepare quantity of work items of given load bearing residential structure	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)	02	CO3
5	**LLO 5.** Understand Measurement Sheet, abstract sheet and prepare quantity of work items of given RCC framed residential structure	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.(1BHK building with staircase)	04	CO3
6	**LLO 6.** Calculate reinforcement quantities from given drawing of residential single unit	Calculate the reinforcement quantities from the given set of drawings for a room size of 3m X 4m with bar bending schedule (footing, column, beam, lintel with chajja, slab)	04	CO3
7	**LLO 7.** Prepare earthwork quantities of road	Prepare quantity of earthwork of road of 500m.	04	CO4
8	**LLO 8.** Prepare Rate Analysis for different work items.	Prepare rate analysis for the given 5 items of works.	02	CO5

IV. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

i. Select a building plan of G.F.only with sloping roof and prepare its Estimate using current SSR

ii. Select a building plan of G.F.only with flat roof (RCC) and prepare its Estimate using current SSR

iii. Work out earthwork quantity for Railway embankment for 100 m length for Broad-Gauge track in plain area.

Formative assessment (Assessment for Learning) for PR and

SLA

- Rubrics for continuous assessment based on process and product related performance indicators (___ marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (__marks)

1. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	3	2	1	1	1	1	1	--	2	1
CO2	2	3	3	3	2	2	3	--	2	1
CO3	2	3	3	3	2	3	3	--	2	1
CO4	1	3	3	3	3	2	3	--	2	1
CO5	1	3	3	2	3	3	2	--	2	1

Legends: - High:03, Medium:02, Low:01, No Mapping: --

2. Suggested Learning Materials / Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Estimating and Costing in Civil Engineering	Datta, B.N. UBS Publishers Distributors Pvt. Ltd. New Delhi.	ISBN-10: 8174767703; ISBN 13: 978-8174767707
2	Estimating and Costing	Rangwala,S.C. Charotar Publishing House PVT. LTD., Anand.	ISBN : 9789385039058 896
3	Estimating and Costing	Birdie,G.S. Dhanpat Rai Publishing Company(P) Ltd. New Delhi.	ISBN-10: 9384559512; ISBN-13: 978- 9384559519
4	Estimating and costing, specification and valuation in civil engineering	Chakraborti,M. Monojit Chakraborti, Kolkata.	ISBN-10: 818530436X ISBN-13: 978- 8185304366
5	PWD Schedule of Rates.	PWD	
6	Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.		

3. Learning Websites & Portals

Sr.No	Link / Portal	Description

1	http://www.nap.edu	
2	http://www.darshan.ac.in	
3	http://www.cmu.edu	
4	www.yb.tl	
5	http://www.nationallibrary.gov.in	

4. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Deepak Kulkarni	RCC Consultant	Structural Consultancy Organisation
2	Mr. Neelkumar Sawant	RCC Consultant and Surveyor	RCC Consultant and Surveyor Consultancy
3	Mrs. Nisha Wartha	System Analyst	R.B.T.E., Mumbai
4	Dr. D. K. Gupta	HOD Civil Engg. Dept.	Govt. Polytechnic Mumbai

Co-Ordinator,
Curriculum Development,
Department of Civil Engineering

Head of Department
Department of Civil Engineering

I/C, Curriculum Development Cell

Principal
Govt. Polytechnic, Mumbai

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CDC Co-ordinator
G. P. Mumbai

Programme : Diploma in Civil Engineering (Sandwich Pattern)													
Course Code: CE23502					Course Title : Construction Management								
Compulsory / Optional: Optional													
Teaching Scheme and Credits						Examination Scheme							
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (2.30Hrs.)	FA-PR	SA		SLA	Total
						T1	T2			PR	OR		
4	-	-	2	6	3	20	20	60	-	-	-	25	125

Total IKS Hrs. for course: 1

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents an average of two class tests of 30 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

The construction industry is in continuous need of skilled professionals, capable of managing projects efficiently in the capacity of project engineers, construction managers, site supervisors, and project coordinators, among others. It is required for a civil engineer to plan, manage and execute Civil Engineering works with utmost precision within the time frame so as to optimize the resources. Therefore, it is necessary to develop a perfect blend of knowledge, skills, and attitudes in the form of the competencies among the learners to tackle with such engineering projects effectively and efficiently leading towards sustainable development. This course will help in developing these basic competencies among the students which will enable them to get an employment in the market.

II. Industry / Employer Expected Outcome

Manage the given construction project using the relevant techniques of construction management.

Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Conduct the project feasibility analysis of the given project
CO2	Apply the relevant scheduling technique in the given situation to decide the ethical element of the project.
CO3	Manage the inventory using relevant inventory control techniques.
CO4	Execute the project as per the prevailing safety practices
CO5	Understand Various Provisions of Industrial Act

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	**TLO 1.1** Explain the term, "Project Life Cycle" with its importance. **TLO 1.2** Identify the characteristics of the given project with relevant constraints. **TLO 1.3** Select the project from the available options based on feasibility analysis. **TLO 1.4** Justify the importance of project management frameworks and standards. **TLO 1.5** Select the relevant type of equipment for the given type of activity of project.	**Unit - I Project Initiation and its feasibility** 1.1 Project: Basic Definitions, management functions, ethics, project life cycle- Project Initiation, Project Planning, Project Executing, Project Monitoring and Controlling, Project Closing. 1.2 Project Characteristics and Constraints- Scope, time, cost, Quality; Stakeholder. 1.3 Project Feasibility Analysis- Market analysis, Financial analysis- Net Present Value(NPV), Payback Period, Examine the business problem/opportunity, Identify the requirements, undertake a feasibility study, Rank the feasibility resultsDefine the criteria, give ranking scores, Identify the feasibility outcome. 1.4 Project Management Frameworks and Standards, Project Management consultant (PMC)- roles & responsibilities. 1.5 Equipment used in executing the Civil Engineering projects- •Earth moving equipment (Tractor, Bulldozer, Scrapers, Excavators), • Hauling Equipment (Drum trucks, Front end loader, Conveyor belt), • Concreting Equipment (RMC mixer, Concrete pump), • Hoisting Equipment (Lifting & lowering equipments, Cranes). 1.6. Introduction to IOT , Applications of IOT in construction Management. **Course Outcum : CO1, Teaching Hrs: 12, Marks :14 ,**

		(R:06, U:04, A:04)
2	TLO 2.1 Identify the broad activities involved in given construction project. TLO2.2 Apply the relevant technique of analysis to get the required information about the given project. TLO2.3 Explain the process of developing the critical path line in solving the given problem.	**Unit - II Project Management and Scheduling** 2.1 Broad activities in construction work – Earthwork, Foundation, RCC Work, Brick work, Scaffolding, Plastering, Painting etc & duration required for complete the activity 2.2 Methods of Scheduling-Gantt Chart, Bar chart, Development of Bar charts and Gantt chart, Merits & limitations of Bar chart & Gantt chart. 2.3 Concept of CPM & PERT: Introduction to Critical path method (CPM), Program evaluation & review techniques (PERT), Network Diagramming of Projects Activity-onarrow (AOA) Diagrams- Concept of Activity and Event, Time-Analysis of Networks- Forward Pass, Backward Pass, Probabilistic Durations- Optimistic Time, Pessimistic Time, Most Likely Time, Project Scheduling- ES and LS Schedules as Limits, Resource Scheduling, Time/Cost Trade-off **Course Outcome: CO2, Teaching Hrs: 08, Marks :12 , (R:04, U:04, A:04)**
3	TLO 3.1 Apply the relevant material management techniques in the given construction project. TLO 3.2 Apply the material management technique for rebar in the given construction project.	**Unit - III Material Management** 3.1 Material Management-Introduction, Inventory and inventory control, EOQ (Economic order of quantity), ABC technique, V-E-D analysis, Just in Time Strategy (JIT), Store management & various records related to store management 3.2 Rebar Management: Wastage of steel on site, Preventive measures to avoid the wastage of steel. Rebar, Importance of rebar, Fabrication and transportation of Rebar. Understanding rebar drawings. **Course Outcome : CO3, Teaching Hrs: 08, Marks :12 , (R:04, U:04, A:04)**

	TLO 4.1 State the general safety norms required to be taken in the given case. TLO 4.2. Suggest preventive measures of plant activities in the given situation. TLO 4.3. Describe the safe procedural steps required to be taken to prevent the given the type of accident. TLO. 4.4 Prepare a work permit in to conduct the given maintenance activity. TLO. 4.5 Explain the causes of the specified type of accident in the given situation. TLO. Prepare the specifications of the firefighting equipment required for the given type of fire.	**Unit - IV Safety Management** 4.1 Need for safety management measures. 4.2 General safety norms for an industrial unit; Preventive measures. 4.3 Defination of accidents, Types of industrial accidents. 4.4 Fire Hazards, Fire drill 4.5 Safety Procedure. 4.6 Work Permits **Course Outcome : CO4, Teaching Hrs: 08, Marks :12 , (R:04, U:04, A:04)**
5	TLO 5.1. Explain the Purpose of the act TLO 5.2. Explain the main provisions of the various acts and important definition.	**Unit – V Legislative Acts** 5.1 Necessity of acts, Important definition and Main provisions of acts. 5.2 Industrial Acts: a. Indian Factory act b. Industrial Dispute Act c. Workman Compensation Act d. Minimum Wages Act **Course Outcome : CO5, Teaching Hrs: 12, Marks :10 , (R:02, U:04, A:04)**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Laboratory Learning Outcomes (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Identify the roles and responsibilities of manpower required for a construction project	*Draw the flow chart of manpower required for a given type of project	2	CO1
2	LLO 2.1 Select the relevant resources required for foundation or RCC or Brickwork for given construction project/data	*Draw the resource allocation plan for Foundation or RCC or Brickwork activity on construction site	2	CO1
3	LLO 3.1 Select the relevant resources required for Structural members of beam or column for given construction project/data	Draw resource allocation plan for Structural members for beam or column or slab for G+5 activity on site	2	CO1
4	LLO 4.1 Select the relevant resources required for plastering or flooring for given construction project/data	Draw resource allocation plan for plastering or painting or flooring activity on site	2	CO1

	...Select different ...pments used to carry out the ...nstruction of building	Write a brief report of site inspection with special reference to construction equipments used in the project with relevant photographs, video etc	2	CO1
	LLO 6.1 Apply the concept of bar chart/Gantt chart to get the required information about the given project.	Draw the bar chart / Gantt chart for the activities of given construction project by using MS Excel/MS Project	2	CO2
7	LLO 7.1 Apply the concept of network diagram to get the required information about the given project.	Forecast the time duration required for various activities of the given construction project to represent them through a network diagram	2	CO2
8	LLO 8.1 Determine/Find the duration of the project and the sequence of critical activities.	*Solve the numerical on CPM for finding duration of project and Critical path of the any one problem for the given data	2	CO2
9	LLO 9.1 Apply the concept of PERT technique to get the required information about the given project.	*Solve the numerical on PERT to represent the sequence of activities and critical path of the any one problem for the given data.	2	CO2
10	LLO 10.1 Determine the Economic Order Quantity (EOQ) based on the given data	*Determination of EOQ (Economic order quantity) based on the given data. (Solve one Numerical)	2	CO3
11	LLO 11.1 Identify the most important product in given construction project/data	*Carry out the ABC analysis for the given problem/data (Solve one Numerical)	2	CO3
12	LLO 12.1 Apply the principles of management for rebar procurement on the given site.	Develop rebar procurement plan for the given construction site. (Manually or by using any opensource software)	2	CO3
13	LLO 13.1 Select the causes and remedial measures for given construction project/data	*Prepare a report on minimum five expected causes of accidents on construction sites with their remedial measures. (Visit any one Industrial/Residential/Public construction building)	2	CO3
14	LLO 14.1 Select the action plan measures for given construction project/data	*Prepare a brief report of the observation made on site with respect to safety on site (Visit any one Industrial/Residential/Public construction building)	2	CO3
15	LLO 15.1 Select various safety devices used at given construction site	Prepare the charts/report on various safety devices used at given construction site (Visit any one Industrial/Residential/Public construction building)	2	CO3
Total				

...e : Out of above suggestive LLOs - '*' Marked Practicals (LLOs) Are mandatory. Minimum 80% of above list of lab experiment are to be performed. Judicial mix of LLOs are to be performed to achieve desired outcomes.

V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

Assignment

- Prepare a brief report on overview of Construction Professional Practice in India.
- Solve the numerical on bar chart, CPM and cost optimization for the given data.
- Collect and interpret various store forms from PWD, WRD, MJP.
- Download the labour laws documents from internet and wrote a brief summary on it.
- Learn material management module from SAP website.

- Visit a Site to study the construction technique and use of major construction equipment.
- Student should watch any 3 learning website link given in XIII learning websites & portal and prepare a brief.
- Prepare a brief report on role of construction industry in national development.
- Compile minimum 10 safety slogans displayed at various sites with sources and write a brief summary on it.
- Prepare project cost analysis for small construction project.
- Collect & interpret bar chart/CPM network for existing construction project.

Micro project

- Prepare a report on different forms of inventory storage along with your interpretation.
- Collect the information about latest safety measures adopted at construction project.
- Collect information and prepare a report on any one top construction companies in India.
- Compare any 3 construction management software.
- Use any one free open ware software to collect information about modern techniques of material management like JIT/SAP/ERP/MSP/MSEXCEL/Primavera.
- Collect information and prepare a report on various construction equipments used in construction industry.
- Use any one free open ware software of Construction Management to prepare the scheduling of a project.
- Use any one free open ware software of Construction Management to determine the critical path for the given construction project.
- Interpret the network figures used in given civil engineering projects.

VI. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Project Initiation and its feasibility	6	4	4	14
2	Project Management and Scheduling	4	4	4	12
3	Material Management	4	4	4	12
4	Safety Management	4	4	4	12
5	Legislative Act	2	4	4	10
	Total	**20**	**20**	**20**	**60**

VII. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

Term work, Self Learning Assessment (Assignment & Microproject). Note:Each Practical will be assessed considering-60% weightage to process related and 40 % weightage to product related

...e Assessment (Assessment of Learning)

...d term examination, Viva-voce, Workshop performance (__marks)

III. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	1	2	2	2	2	2	2	3
CO2	3	3	1	2	2	2	2	3	2	3
CO3	3	3	1	2	1	2	2	2	3	2
CO4	2	1	2	2	2	2	2	3	2	2
CO5	3	3	3	2	1	2	2	2	2	2

Legends: - High:03, Medium:02, Low:01, No Mapping: --

IX. Suggested Learning Materials / Books

Sr.No	Author	Title	Publisher
1	S.C. Sharma, S.V. Deodhar	Construction Engineering and Management	Khanna Book Publishing Co (P) Ltd. ISBN 9789386173980
2	IGNOU	Project Management	Indira Gandhi National Open University(eKumbh-AICTE)
3	K. K. Chitkara	Construction Project ManagementPlanning, Scheduling & Controlling	McGraw Hill Education ISBN-10 0070680752, ISBN-13 978-0070680753
4	L. S. Srinath	PERT And CPM Principles And Applications	East-West Press (Pvt.) Ltd. ISBN-10 8185336202 ISBN-13 978-8185336206
5	Jack Gido, Jim Clements, Rose Baker	Successful Project Management	Cengage Publication ISBN: 9781337363853

X. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/105/103/105103206/	Construction Method and Equipment Management
2	https://www.youtube.com/watch? v=Cx7i2wXB0kA&list=PLWnoy5z_3B	Project Scheduling

	ObBvFtBlowxM05D-q0VAWEs&index=16	
3	https://www.youtube.com/watch? v=j6VIIlXT0Vs&list=PLWnoy5z_3B ObBvFtBlowxM05D-q0VAWEs&index=22	Accidents in Construction Industry
4	https://www.youtube.com/watch? v=EVsiIOamfU0&list=PLWnoy5z_3B ObBvFtBlowxM05D-q0VAWEs&index=26	Safety Organization and Safety Officer
5	https://www.youtube.com/watch? v=QoXvRBrEWyI&list=PLWnoy5z_3B ObBvFtBlowxM05D-q0VAWEs&index=25	Implications of Construction Accidents
6	https://archive.nptel ac.in/courses/105/104/105104161/	Introduction to planning and scheduling, resource levelling and allocation,crashing of networks
7	https://onlinecourses.nptel.ac.in/noc22_ce39/preview	Safety in Construction Industry

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr.Dipak Kulkarni	RCC CONSULTANT	STRUCTURAL CONSULTANT ORGANIZATION
2	Mr.Neel kumar sawant	RCC CONSULTANT AND SURVEYOR	REGIONAL HEAD, MUMBAI
3	Mrs. Nisha Wartha	SYSTEM ANALYST	R.O, MUMBAI
4	Dr. D.K.Gupta	HOD,CE	G.P.MUMBAI.

Coordinator,
Curriculum Development.
Department of __CIVIL_____ Engineering

Head of Department
Department of _CIVIL_____ Engineering

I/C, Curriculum Development Cell

Principal

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CDC Co-ordinator
G. P. Mumbai

Programme : Diploma in Civil Engineering	
Course Code : CE23111	Course Title : Contracts, Accounts & Valuation
Compulsory / Optional : Compulsory	

Teaching Scheme and Credits						Examination Scheme							
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (2.30 Hrs.)	FA-PR	SA		SLA	Total
						TS1	TS2			PR	OR		
03	--	02	01	06	03	20	20	60	25	--	--	25	150

Total IKS Hrs. for course:

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents marks of two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

The students will learn concepts, principles and procedures of contracts, accounts and valuation. The student will know procedure for preparing tender documents and contracts. The students will understand the procedure for execution of Civil engineering works in Government and private sectors. The student calculate rent and prepare valuation of a civil structures.

II. Industry / Employer Expected Outcome

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

- Prepare tender documents for civil engineering projects.

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Understand various types of contract and when they are used.
CO2	Suggest the relevant type of contract for the given civil engineering work.
CO3	Prepare the typical Tender document for the given civil engineering work.
CO4	Decide type of payment for the executed work.
CO5	Justify the rent fixation and valuation of given civil structure.

urse Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	**TLO1.1** Explain the functions of personnel in the given division of PWD **TLO1.2** Explain the procedureadopted by the given Government department for the construction of the given civil work **TLO1.3** Explain the specified method used in PWD to carry out the given work. **TLO1.4** Select the relevant method of contracting for the given type of work with justification.	**PWD Procedure to execute the work :** 1.1 Organization structure of Public Works Department (PWD). 1.2 Functions of their personnel, Financial powers if any. 1.3 PWD Procedure of initiating the work 1.4 Methods used in PWD for carrying out works- contract method, departmental method -rate list method, piece work method, day's work method employing labours on daily wages basis. **Course Outcome: CO1 Teaching Hours: 6 hrs Marks: 08 (R-0, U-4, A-4)**
2	**TLO2.1** Explain the requirements of valid contract in the given situation. **TLO2.2** Classify the civil engineering contracts based on the given criteria. **TLO2.3** Select the type of contract for the given type of work with justification **TLO2.4** Explain the provisions of FIDIC contract relevant to the given situation. **TLO2.5** Outline the Registration process of contractor in Public WorksDepartment (PWD) in the given type of division office. **TLO2.6** Justify the importance of Built operate transfer (BOT) contractin the given situation.	**Contracts :** 2.1 Definition of contract, Objects of contract, requirements o valid contract,Overview of Indian Contract Act 1872. 2.2 Types of engineering contract with advantages. disadvantages and their suitabilities- Lump sum contract, item rate contract, percentage rate contract, cost plus percentage, cos plus fixed fee, cost plus variable percentage and cost plus variable fee contract, labour contract, demolition contract, targe contract,negotiated contract, All in contract, Engineering Procurement Construction Contract (EPC), Annuity Contract. 2.3 Introduction of FIDIC Conditions of contract. 2.4 Classification of contractor on basis of financial limits, Requirement of documents for registration of contractor in Public Works Department (PWD). 2.5 Built operate transfer (BOT) Project:Objectives, scope, advantages, Disadvantages, Nature of agreement, mode of payment, examples, BOT Toll contract, BOT (Annuity) contrac Design, Build, Finance, Operate and Transfer (DBFOT) contract, Hybrid Annuity contract,Operate Maintain and Transfer (OMT) contract, Operation & Maintenance contract (Introduction only). **Course Outcome: CO2 Teaching Hours: 10 hrs Marks: 12 (R-4, U-4, A-4)**
3	**TLO3.1** Justify the need of the tender document for the given situation. **TLO3.2** Draft tender notice for the given type of work. **TLO3.3**Explain the relevant provision of contract in the given situation as per Contract act 1872. **TLO3.4** Justify the provision of liability period in tender document of the given work. **TLO3.5** Explain the process of arbitration	**Tender and Tender Documents :** 3.1 Definition of tender, necessity of tender, Types of tende local, Global, open Limited and negotiated tender 3.2 Notice to invite Tender (NIT)- Points to be included whil drafting tender notice, Drafting of tender notice. 3.3 Meaning of terms: Earnest money Deposit (EMD), Securit deposit, Additional Performance Security Deposit, Validit period, right to reject one or all tenders, corrigendum to tende notice and its necessity. 3.4 Tender documents- Index, tender notice, general instruction

	...ed in the given case of dispute. **TLO3.6** Justify the necessity of E-Tendering system for the given type of civil work.	special instructions,schedule A, Schedule B, schedule C, Terms related to tender documents — contract conditions- time limit, time extension, penalty, defective material and workmanship, termination of contract,suspension of work, subletting of contract, extra items,price escalation clause, defect liability period, liquidated and un-liquidated damages. 3.5 Arbitration: Meaning, qualification of arbitration award a arbitrator, appointment, Causes and Settlement of dispute Powers and duties of Arbitrator, Award of result. 3.6 Procedure of submitting filled tender Document (Tw envelope system), procedure of opening tender, comparativ statement, scrutiny of tenders ,award of contract, acceptanc letter and work order. 3.7 E -Tendering System- Online procedure of Submission Tender in PWD. 3.8 Unbalanced tender, ring formation. **Course Outcome: CO3 Teaching Hours:12 hrs Marks: 16 (R- 2, U- 6, A- 8)**
	TLO4.1 Explain the importance of nominal Muster Role (NMR) in the construction of the given structure. **TLO4.2** Record the measurements in the measurement book for the given items of works for payment. **TLO4.3** Explain the specified terms used in interim payment of the given civil work. **TLO4.4**Select the criteria for granting advances to the Contractor in the given situation with justification **TLO4.5**Select the relevant bill form in the given situation with justification.	**Accounts :** 4.1 Various account forms and their uses – Measurement Books, E- Measurement book (EMB), Nominal Muster Roll(NMR), Imprest Cash, Indent, Invoice, Bill, Vouchers, Ha receipt Cash Book, Temporary Advance. Heads of Accounts. 4.2 Mode of Payment to the contractor and its necessity - Interim Payment, Advance Payment Secured Advance, Petty advance, Mobilization advance, Running account bill, Final bi Retention money, E - payment. **Course Outcome: CO4 Teaching Hours: 8 hrs Marks: 10 (R- 2 ,U- 8, A- 0)**
5	**TL**O5.1 Explain the purpose of valuation of the given structure in the given situation. TLO5.2 .Classify the value of the given structure based on the given criteria TLO5.3 Calculate depreciation of the given structure using relevant method for the given data. TLO5.4 Calculate monthly rent of the given building from the give data	**Introduction to Valuation :** 5.1 Definition and purpose of Valuation, role of valuer. Definition - Cost, Price and Value, Characteristics of Value, Factors Affecting Value. 5.2 Types of Value - Book Value, Scrap Value, Salvage Valu Speculative Value, Distress Value, Market Value, monopoly Value, Sentimental Value, Factors affecting value. 5.3 Depreciation, Obsolescence, Sinking Fund, Methods of Calculation of Depreciation – Straight Line Method, Sinking Fund Method, Constant Percentage Method. 5.4 Fixation of rent, Lease – types of lease, lease hold propert and free hold property Mortgage – Mortgage deed, precautions to be taken while making mortgage. **Course Outcome: CO5 Teaching Hours: 12 hrs Marks: 1 (R- 2, U- 6, A- 6)**

...boratory Learning Outcome and Aligned Practical / Tutorial Experiences.

No	Laboratory Learning Outcomes (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.** Procedure of execution of construction work.	Assignment on procedure of execution of construction work.	2	CO1
2	**LLO2.** Types of contracts.	Assignment on types of contracts.	2	CO2
3	**LLO3.** Class of contractor's, procedure of registration & documents required	Assignment on class of Contractor's registration with its limits and procedure of registration, documents required and upgradation as Contractor in PWD.	6	CO2
4	**LLO 4.** BOT	Assignment on BOT	4	CO2
5	**LLO 5.** tender notices	Collection of any five tender notices.	2	CO3
6	**LLO 6.** Drafting of tender notice	Drafting of tender notice for Government and Private work.	4	CO3
7	**LLO 7** Interim payment, Secured Advance, Advance Payment, Petty Advance, Running Bill & Final Bill, Mobilization Advance	Assignment on Intrim payment, Secured Advance, Advance Payment, Petty Advance, Running Bill & Final Bill, Mobilization Advance.	2	CO4
8	**LLO 8.** Impact value of aggregate.	Numerical s on rent fixation and capitalized value of property.	6	CO5
		Total	28	

Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

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

1. Refer different websites related E- tendering and prepare report on it
2. Compare the tender documents of three different organization
3. Prepare the report on online bids/auction through internet
4. Prepare valuation report of any residential building.
5. Collect relevant information about the software used in preparation of tender documents and write report on it
6. Visit to ongoing project and study various aspects related to contracts and tender document.
7. Visit to ongoing project and study various aspects related to accounting process (MB, RA bill, various advances).
8. Give seminar on relevant topic
9. Preparing report on procedure of opening of tenders.
10. Preparing report on procedure of filling online tender.
11. Preparing report on BOT type contract works executed at nearby location.
12. Preparing report on procedure of registration as a contractor in different organizations.
13. Preparing report on procedure of Indent and Invoice at the site.

Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	PWD Procedure to execute the work	0	4	4	08
2	Contracts	4	4	4	12
3	Tender and Tender Documents	2	6	8	16
4	Accounts	2	8	0	10
5	Introduction to Valuation	2	6	6	14
	Total	**10**	**28**	**22**	**60**

VI. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

Rubrics for continuous assessment based on process and product related performance indicators (25 marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (marks)

VII. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	2	-	–	1	1	-	1	-
CO2	3	3	3	-	-	1	2	-	1	-
CO3	3	3	3	-	-	1	2	-	1	-
CO4	3	3	3	-	-	1	2	-	1	-
CO5	3	3	3	-	-	1	2	-	3	-

Legends: - High:03, Medium:02, Low:01, No Mapping: --

VIII. Suggested Learning Materials / Books

	Author	Title	Publisher
	Datta, B.N.	Estimating and Costing in Civil engineering	UBS Publishers Pvt. Ltd. New Delhi. ISBN:9788174767295
2	Construction Management and Contract Practices	Raina, V. K.	Shroff Publishers & Distributers Pvt. Ltd. New Delhi ISBN:9788184047875,
3	Rangawala, S.C.	Estimating and Costing	Charotar Publishing House PVT. LTD., Anand (Gujrat) Reprint -201
4	Birdie,G.S	Estimating and Costing	Dhanpat Rai. New Delhi 2016 ISBN : 978-93-84378-13-4
5	Patil, B.S	Civil Engineering Contracts and Estimates	Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 8173715599
6	Chakraborti, M.	Estimating and costing, specification and valuation in civil engineering	Monojit Chakraborti, Kolkata ISBN: 818530436.

IX. Learning Websites & Portals

No	Link / Portal	Description
1	www.mahapwd.com	
2	https://mahatenders.gov.in	
3	http://cpwd.gov.in/cpwde_tender.aspx	
4	https://gem.gov.in	

X. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr.Dipak Kulkarni	RCC CONSULTANT	RCC CONSULTANT ORGANIZATION
2	Mr.Neel kumar sawant	RCC CONSULTANT AND SURVEYOR	REGIONAL HEAD, MUMBAI
3	Mrs. Nisha Wartha	SYSTEM ANALYST	R.O.MUMBAI.
4	Dr.D.K.Gupta	HOD, CE.	G.P.MUMBAI.

Coordinator,
Curriculum Development,
Department of ___CIVIL_____ Engineering

I/C, Curriculum Development Cell

Head of Department
Department of __CIVIL_____ Engineering

Principal

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CDC Co-ordinator
G. P. Mumbai

Programme: Diploma in Civil Engineering (Sandwich Pattern)

Course Code: AM23501	**Course Title: Prestressed and Precast Concrete**

Compulsory / Optional: Compulsory

Learning Scheme and Credits						**Assessment Scheme**							
						FA-TH		**SA-TH (2:30 Hrs.)**	**FA-PR**	**SA**		**SLA**	**Total**
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**TS1**	**TS2**			**PR**	**OR**		
4	-	-	2	6	3	20	20	60	-	-	-	25	125

Total IKS Hrs for Course: 03 Hrs

Abbreviations: CL- Class Room Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment.

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note:

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. Self learning includes micro project / assignment / other activities.

I. Rationale

In today's system fast developing technology, use of prestressed and precast concrete is increasing with leaps and bounds. Due to several attractive and elegant features prestressed concrete and precast concrete is becoming popular in many fields, it has successfully replaced the conventional structural materials like R.C.C. and steel. All these revolution in area of structural engineering made it essential to specialize the engineering students in the subject of "Prestressed & Precast Concrete".

II. Industry / Employer Expected Outcome

1. Execute effectively the construction work involving precast and pre-stressed concrete

III. Course Outcomes

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Propose the relevant precast concrete element for a given situation
CO2	Use the relevant components for the prefabricated structure.
CO3	Justify the relevance of pre-stressed concrete in a given situation.
CO4	Suggest the relevant methods / systems for given construction work.
CO5	Evaluate losses in a given pre-stressed concrete construction and Propose a suitable cable profile.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	**TLO 1.1** Justify the necessity of the precast concrete in civil engineering. **TLO 1.2** Suggest the structural elements that can be casted in precast for the given situation. **TLO 1.3** Describe the various components for a Prefabricated building **TLO 1.4** Describe the various elements for Non structural precast concrete. **TLO 1.5** Elaborate the IS specifications and provisions for given pre cast element. **TLO 1.6** Conduct the given test on the given components of precast structure	**Precast concrete and its Elements** 1.1 Definition and necessity of precast, Advantages and disadvantages. Materials used. 1.2 Study of Structural Precast concrete elements such as fencing poles, transmission poles, paver blocks, doors and window frames, Manhole covers, precast Mesh etc. 1.3 Study of Precast Structural Building components such as slab panels, beams, columns, footings, walls, lintels and chajjas, staircase elements. 1.4 Non-structural precast concrete elements such as bridge panels, tunnel lining, cannel lining, piles, box culvert etc. 1.5 Materials required, IS specifications, casting tolerances, fabricating systems, joints, testing, storage and transportation, equipment's for elements such as PCC, RCC, PSC, SCC, Ferro-cement, Autoclaved Aerated Concrete (AAC) and Foam concrete. 1.6 Testing of Precast components. **Course Outcome: CO1, Teaching Hours : 18 hrs, Marks: 12 (R-2, U-6, A-4)**
2	**TLO 2.1** Explain the term, "Prefabricated Building Construction" **TLO 2.2** Describe modular co-ordination with standard specifications for the given prefabricated elements. **TLO 2.3** Classify different prefab systems used in civil engineering. **TLO 2.4** Explain the requirements of structural joints of the given pre fabricated elements. **TLO 2.5** Elaborate the procedure of the storage, transportation and erection for a given precast element. **TLO 2.6** Suggest the relevant combinations of mixed and composite construction for the given situation. **TLO 2.7** Evaluate the effect of Prefabricated structure on the environment.	**Prefabricated Buildings** 2.1 Concept and Benefits of Prefabricated Construction, Prefabricated Construction Process. 2.2 Precast load bearing and non-load bearing wall panels, floor systems, Material characteristics, Plans & Standard specifications, concept of modules, modular co ordination, modular grids and finishes. 2.3 Prefab systems and its classification, structural schemes. 2.4 Joints – requirements of structural joints and their design considerations for above elements 2.5 Manufacturing, storage, curing, transportation and erection of above elements, equipment needed. 2.6 Introduction to Mixed and composite construction. 2.7 Ecological aspect of use of Prefabricated building. **Course Outcome: CO2,Teaching Hours: 09 hrs , Marks: 14 (R-2, U-6, A-6)**

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
3	**TLO 3.1** Differentiate between pre stressing and post tensioning process used in civil construction **TLO 3.2** Apply the prestressing techniques in the required situation. **TLO 3.3** Distinguish the prestressed concrete material with other construction materials in given situation. **TLO 3.4** Justify the need of high strength material for prestressed concrete. **TLO 3.5** Suggest the relevant type of pre stressing steel for given structural member.	**Fundamentals of Pre-stressed Concrete** 3.1 Concept of pre stressing and post tensioning, basic terminology. 3.2 Applications of pre-stressed concrete. 3.3 Advantages and disadvantages of pre-stressed concrete with respect to other construction material. 3.4 Materials used and their properties, Necessity of high grade materials. Types of Special concrete/ High Strength concrete and requirements for precast and prestressed members 3.5 Types of Pre-stressing steel -Wire, Cable, tendon, Merits-demerits and applications. **Course Outcome: CO3,Teaching Hours: 07 hrs., Marks: 10 (R-2, U-4, A- 4)**
4	**TLO 4.1** Suggest the relevant method of pre stressing for given structural element. **TLO 4.2** Explain Hoyer system of pre-tensioning with labelled sketch. **TLO 4.3** Explain relevant system of post-tensioning based on the given criteria with labelled sketch.	**Methods and Systems of pre- stressing** 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. **Course Outcome: CO4,Teaching Hours: 06 hrs , Marks: 08 (R-0, U-4, A-4)**
5	**TLO 5.1** Identify the reasons for loss of pre-stress in the given element. **TLO 5.2** Describe the situations in which the given elements exhibit the loss of pre-stress. **TLO 5.3** Elaborate the IS specifications and provisions for losses in case of Pre and Post tensioning. **TLO 5.4** Explain the assumptions made in the analysis of pre-stressed concrete beams. **TLO 5.5** Draw the cable profiles for various load combinations in the given situation. **TLO 5.6** Evaluate the effect of the given cable profile on fiber stresses.	**Losses of pre-stress and Analysis of Pre stressed rectangular beam section** 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, Loss of pre-stress at the anchoring stage, Loss of pre-stress occurring subsequently: losses due to shrinkage of concrete, creep of concrete, elastic shortening, and creep in steel. 5.3 IS recommendations for % losses in case of Pre and Post tensioning. 5.4 Basic assumptions in analysis of pre-stressed concrete beams. 5.5 Cable Profile in simply supported rectangular beam section – concentric, eccentric straight and parabolic 5.6 Effect of cable profile on maximum stresses at mid span and at support. (No Numerical problems in theory examination) **Course Outcome: CO5, Teaching Hours: 10 hrs , Marks: 16 (R-4, U-6, A-6)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Precast concrete and its Elements	2	6	4	12
2	Prefabricated Buildings	2	6	6	14
3	Fundamentals of Pre-stressed Concrete	2	4	4	10
4	Methods and Systems of pre- stressing	0	4	4	08
5	Losses of pre-stress and Analysis of Prestressed rectangular beam section	4	6	6	16
	TOTAL	10	26	24	60

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr. No.	Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / TutorialTitles	Numbe rof hrs.	Relevan tCOs
1	**LLO 1.1** Verify the actual dimension of precast element at site with that of drawing.	Verification of the dimensions of any three precast elements mentioned in the drawing through physical inspection. (e.g. manhole covers, paver blocks, hollow blocks, solid blocks, curb stones etc)	2	CO1
2	**LLO 2.1** Prepare report of field visit or video demonstration to a manufacturing unit of precast products with reference to the points such as manufacturing process, curing, stacking, handling, in house inspec	Prepare report of field visit or by video demonstration to a manufacturing unit (of precast elements such as bridges, girders, fencing pole, transmission pole, electric pole, concrete sleepers etc.)	2	CO1
3	**LLO 3.1** Test the given solid or hollow precast blocks to determine its compressive strength and water absorption.	Determination of compressive strength and water absorption of given solid or hollow precast blocks	2	CO1
4	**LLO 4.1** Test the given Auto clave Aerated Concrete Block (AAC) to determine its compressive strength and water absorption.	Determination of compressive strength and water absorption of given Auto clave Aerated Concrete Block (AAC).	2	CO1
5	**LLO 5.1** Test the given paver blocks to determine its compressive strength and water absorption.	Determination of compressive strength and water absorption of given paver blocks	2	CO1
6	**LLO 6.1** Conduct the load test on the given manhole cover to predict its behavior after failure.	Carry out load test on given manhole cover as per IS 12592:2002 Annex C	2	CO1

Sr. No.	Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / TutorialTitles	Number of hrs.	Relevant COs
7	**LLO 7.1** Prepare a report on the basis of field visit or video demonstration of a precast manufacturing unit of building elements with reference to the points such as manufacturing process, curing, stacking.	Organize field visit or video demonstration of precast manufacturing unit (such as lintel, chajja, door frame, wall panels, stair steps etc.)	2	CO2
8	**LLO 8.1** Prepare a report on various types of pre-stressing wires / cables / strands for given situation on the basis of review of technical brochure/ specifications	Collection of samples of various types of pre stressing wires / cables / strands with their technical specifications/brochure.	2	CO3
9	**LLO 9.1** Prepare a report on different types of joints for various precast components for a given situation.	Collect information and photographs of for Various types of joints of precast members. (minimum five different type of joints)	2	CO2
10	**LLO 10.1** Draw a detailed cross section of cable profile for a given situation. (Central point load and uniformly distributed load) for eccentric prestressing force and axial force	Draw a detailed longitudinal and cross section of cable profile for different loading conditions.	2	CO5

IV. Suggested Micro Project / Assignment / Activities for Specific Learning /Skills Development (Self Learning):

Note:

Above is just a suggestive list of micro projects and assignments; faculty must prepare their own bank ofmicro Projects, assignments, and activities in a similar way.

The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.

If a micro project is assigned, it is expected to be completed as a group activity.

SLA marks shall be awarded as per the continuous assessment record.

If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

ormative assessment (Assessment for Learning) for practical & SLA

Term work Each practical will be assessed considering - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product related performance indicators, laboratory experience. (25 Marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Lab performance, Practical Exam of 00 marks

V. Suggested COs - POs Matrix Form (CO vs PO and CO vs PSO Mapping)

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Developmentof Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO-2	PSO-3
CO1	2	--	--	--	1	--	2	1	2	--
CO2	2	2	1	2	1	1	2	1	2	--
CO3	2	2	1	2	1	2	2	--	2	--
CO4	1	2	2	2	2	1	2	--	2	--
CO5	2	2	2	2	2	1	2	1	2	--

Legends: - High: 03, Medium: 02, Low: 01, No Mapping: --

a. Suggested Learning Materials / Books:

Sr.No	Author	Title	Publisher
1	Krishna Raju, N.	Pre-stressed Concrete	Pre-stressed Concrete, Tata McGraw Hill, New Delhi.
2	Shrikant B. Vanakudre	Pre-stressed Concrete	Prestressed Concrete, Khanna Publishing House, New Delhi
3	Marzuki, Nor Ashikin	Pre Cast and Pre Stress Technology: Process, Method and Future Technology	Pre Cast and Pre Stress Technology: Process, Method and Future Technology, Createspace Independent Publication.
4	--	Handbook on Precast Concrete buildings.	Indian Concrete Institute.
5	--	IS 12592 Precast Concrete Manhole Cover and Frame	BIS, New Delhi.
6	--	IS 15658 Precast concrete blocks for paving - Code of Practice	BIS, New Delhi.
7	--	IS 15916 Building Design and Erection Using Prefabricated Concrete - Code of Practice	BIS, New Delhi.
8	--	IS 15917 Building Design and Erection Using Mixed/Composite Construction - Code of Practice	BIS, New Delhi.
9	--	IS 458 Precast Concrete Pipes (with and without reinforcement) - Specification	BIS, New Delhi.

b. Learning Websites & Portals:

Sr.No	Link / Portal	Description

1	http://www.pci.org	-
2.	http://www.precast.org	-
3	http://www.indianconcrete.org	-
4	http://nitterhouseconcrete.com	-
5	http://precastblocks.com	-
6	http://www.nationallibrary.gov.in	-

c. **Academic Consultation Committee/Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organization
1	Mr. Dipak Kulkarni	RCC CONSULTANT	STRUCTURAL CONSULTANT
2	Mr. Neel kumar Sawant	RCC CONSULTANT AND SURVEYOR	REGIONAL HEAD, MUMBAI
3	Mrs. Nisha Wartha	SYSTEM ANALYST	R.O.MUMBAI
4	Mr. B. K. Kakad	HOD in Applied Mechanics	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Applied Mechanics Engineering

I/C, Curriculum Development Cell

Head of Department
Department of Applied Mechanics Engineering

Principal

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CDC ... ator
G. P. Mumbai

Programme : Diploma in Civil Engineering (Sandwich Pattern)	
Course Code: CE 23401	**Course Title:** Project
Compulsory / Optional: Compulsory	

Teaching Scheme and Credits						**Examination Scheme**									
						FA-TH			**FA- PR**			**SA**			
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**T1**	**T2**	**SA-TH (2:30 Hrs.)**	**Max**	**Min**	**PR**	**OR**		**SLA**	Total
												Max	**Min**		
-	-	4	-	4	2	-	-	-	50	20	-	50 #	20	25	125

Total IKS Hrs. for course: 2

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On- Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents marks of two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

The project work is included in the curriculum to encourage the students to undertake and tackle an independent problem related to Civil Engineering field. The project also comprises of literature survey of a problem assigned.

Course Outcomes:
Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Identify, analyze and define the problems in Civil Engineering field.
CO2	Find different solutions to the problems by collecting data and select most appropriate solution using latest practices in Civil Engineering

CO3	Use and integrate knowledge of different courses and data collected to make simple designs with the help of handbooks, standard data books, I.S. codes etc.
CO4	Work independently as a leader as well as member of a team.
CO5	Prepare and present report prepared.

Course Content Details:

Sr. No.		Topics / Sub-topics
1		Project Work: The students will select a topic related to any course in the curriculum, design various nits involved, prepare and present a Report of the work done. The project work will be done by a group of 4 to 6 students. Oral will be based on term-work. Following is the list of some Civil Engineering suggestive areas for selection of project. 1. Campus Development. 2. Bridge/Fly over/Sky walk. 3. Junction planning for city roads/planning for congested road areas/Parking studies. 4. Municipal Solid waste management. 5. Bio-Medical waste management. 6. Recycling of resources. 7. Concrete Mix design. 8. Structural audit of an existing building. 9. Manufacturing of Pre-cast concrete products. 10. Non- conventional sources of energy. 11. Transfer of technology to villages. 12. Planning and design for residential building/commercial complex. 13. Planning and design of water treatment plant for a given data. 14. Planning and design of water supply scheme for given lay-out. 15. Planning and design of sewage treatment plant for a given data. 16. Planning and design of sanitary scheme for given lay-out. 17. Lift Irrigation scheme. 18. Micro Irrigation- Drip/Sprinkler Irrigation. 19. Water shed development of small catchments. 20. Recent developments and new technologies in Civil Engg. 21. Entrepreneurship development. The project report shall contain the following as the case may be- a. Drawings b. Design c. Test results d. Detailed estimate of project e. Photographs

II. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.
- NIL-

III. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):
NIL

Formative assessment (Assessment for Learning) for PR and

SLA

- Rubrics for continuous assessment based on process and product related performance indicators (___ marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (__marks)

1. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	3	2	1	1	1	1	1	--	2	1
CO2	2	3	3	3	2	2	3	--	2	1
CO3	2	3	3	3	2	3	3	--	2	1
CO4	1	3	3	3	3	2	3	--	2	1
CO5	1	3	3	2	3	3	2	--	2	1

Legends: - High:03, Medium:02, Low:01, No Mapping: --

2. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Deepak Kulkarni	RCC Consultant	Structural Consultancy Organisation
2	Mr. Neelkumar Sawant	RCC Consultant and Surveyor	RCC Consultant and Surveyor Consultancy
3	Mrs. Nisha Wartha	System Analyst	R.B.T.E., Mumbai
4	Dr. D. K. Gupta	HOD Civil Engg. Dept.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Civil Engineering

Head of Department
Department of Civil Engineering

I/C, Curriculum Development Cell

Principal
Govt. Polytechnic Mumbai

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CDC Co-ordinator
G. P. Mumbai

Programme : Diploma in Civil Engineering													
Course Code:CE23312					Course Title : Irrigation Engineering								
Compulsory / Optional: Compulsory													
Learning Scheme						Assessment Scheme							
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (2.5 Hrs.)	FA-PR	SA		SLA	Total
						TS1	TS2			PR	OR		
3	---	-	1	4	2	20	20	60	25	---	25#	25	175

Total IKS Hrs. for course: 4 hrs /sem

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# on Line Examination, @$ Internal Online Examination

Note:

1. FA-TH represents two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale:

Water is essential resource for the entire living thing on earth, making its conservation crucial. With increasing demand and unpredictable rainfall in India, efficient water management system is more important than ever. Irrigation structures like dams, diversion head works, and canals play a key role in this effort. Water Resource Engineering deals in the planning, designing, constructing, and executing these hydraulic structures which are used to use to store, distribute and conserve the water sources. The primary goal of water resources engineering is to control and regulate water for various purposes including flood control, irrigation, hydroelectric power development etc. This course will enable the students to use and apply the basic principles and practices related to irrigation engineering and utilisation of supplied water at field.

II.

Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	State importance of irrigation, advantages, disadvantages in Indian context
CO2	Discuss methods water application to crops and types of crops in Maharashtra and evaluate duty and delta relation for crops
CO3	State types of dams, spillway structures and their suitability conditions and identify different forces acting on gravity dam and conditions of stability of dam.

CO4	Describe types of canals, canals structures and cross drainage works and functions of regulating and cross drainage
CO5	Propose the type of Diversion Headwork in the irrigation scheme

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	TLO 1.1 Classify the irrigation projects on the basis of given criteria. TLO 1.2 Explain the term "hydrological cycle". TLO 1.3 Describe the characteristics of Rain gauge station to be installed in the given location. TLO 1.4 Estimate means rainfall in the given area using the relevant method. TLO 1.5 Explain the factors affecting Runoff for given site condition. TLO 1.6 Determine the Maximum Flood Discharge using the relevant empirical method from the given data.	Unit - I Introduction to Irrigation and Hydrology 1.1 Irrigation: Definition, necessity and Classification of Irrigation projects, advantages and ill effects of excess irrigation. 1.2 Hydrology: Definition of Hydrological cycle, Rainfall, Evaporation. 1.3 Rain Gauge: Symon's rain gauge and automatic rain gauge - Tipping bucket type. 1.4 Methods of calculating mean rainfall: Arithmetic mean, Theissen polygon and Isohyetal method. 1.5 Runoff: Definition, factors affecting Runoff (No Numerical questions). 1.6 Maximum Flood Discharge measurement: Empirical methods(Simple numerical) Course Outcome: CO1Teaching Hours : 08 hrs Marks:10 (R-4 , U- 2 , A- 4)
	TLO 2.1 Explain the terms, "Cropping seasons, Crop period, Duty, Delta, base period, Culturable Command Area, Gross Command Area, intensity of irrigation." TLO 2.2 Establish the relationship between duty, delta and base period. TLO 2.3 Compute the crop water requirement and canal capacity from the given data. TLO 2.4 Propose the relevant method of supplying irrigation water in the cropping season. TLO 2.5 Suggest relevant measures of silt control in a given type of dam with justification. TLO 2.6 Compute the control levels for the given reservoir from the given data.	Unit - II Crop water requirement and Reservoir Planning 2.1 Crop Water requirement: Cropping seasons, Crop period, Duty, Delta, base period, Culturable Command Area, Gross Command Area, intensity of irrigation, factors affecting duty. 2.2 Relation between duty, delta and base period. 2.3 Numerical on water requirement and capacity of canal.. 2.4 Methods of Irrigation: Surface, subsurface and overhead irrigation. 2.5 Silting of Reservoir: Rate of silting, factors affecting silting and control measures. 2.6 Control levels in reservoir. Numerical on fixing control levels of reservoir. Course Outcome: CO2 Teaching Hours : 10 hrs Marks:14 (R-4 , U- 4 , A- 4)
	TLO 3.1 Classify the dams based on given criteria. TLO 3.2 Draw a labeled cross-sectional sketch of Earthen dam. TLO 3.3 Propose the suitable control measure to reduce the seepage through the foundation and embankment of earthen dam. TLO 3.4 Explain with the sketch the various forces acting on the gravity dam. TLO 3.5 Propose the types of spillways for given type	Unit - III Dams and Spillways 3.1 Dam and its classification based on use, materials and hydraulic design. 3.2 Earthen Dams: Components with function, typical cross section. 3.3 Methods of construction of earthen dam, seepage through embankment and foundation and its control, Types of failure of earthen dam and its preventive

of dam with justification. TLO 3.6 Propose the types of energy dissipaters for the given type of dam with justification.	measures. 3.4 Gravity Dams: Forces acting on dam, typical cross section, drainage gallery. 3.5 Spillways: Definition, function, Types. Emergency and service spillway - ogee spillway and discharge over spillway, Spillway gates. 3.6 Energy dissipation. Course Outcome:CO3 Teaching Hours :10 hrs Marks:14 (R- 4 , U- 4 , A- 4)
TLO 4.1 Explain the procedure for construction of given type of Bandhara. TLO 4.2 Propose the suitable location for construction of percolation tank. TLO 4.3 Design the typical layout of Lift Irrigation system in the given situation. TLO 4.4 Design the typical layout of Drip and Sprinkler irrigation for the given condition. TLO 4.5 Suggest the layout for the Well Irrigation scheme in the given site conditions	Unit - IV Minor and Micro Irrigation 4.1 Bandhara irrigation: Introduction, Layout, components, construction. 4.2 Percolation Tanks: Selection of site, need, construction. 4.3 Lift irrigation scheme: Components and their functions, layout. 4.4 Drip and Sprinkler Irrigation: components, layout, suitability. 4.5 Well irrigation: Introduction, types, advantages and disadvantagesA-4) Course Outcome:CO3 Teaching Hours :08 hrs Marks:10 (R- 4 , U- 4 , A- 4)
TLO 5.1 Classify the weirs based on given conditions. TLO 5.2 Suggest the suitable site for barrage construction. TLO 5.3 Draw a labeled sketch of the given type of diversion headwork. TLO 5.4 Classify the canal on the basis of alignment and position in the given canal network. TLO 5.5 Suggest the relevant type of construction material used for lining of given canal. TLO 5.6 Propose the relevant type of Cross Drainage work in given site condition. TLO 5.7 Propose the relevant types of regulators used for specific purpose in canal irrigation system	Unit - V Diversion Headwork and Canals 5.1 Weirs: Introduction, components, classification. K.T. weir: components and construction. 5.2 Barrages: Introduction, components and their functions, location. 5.3 Diversion headwork: Layout, components and their function. 5.4 Canals: Definition, classification according to alignment and position in the canal network, cross section of canal in embankment and cutting, partial embankment and cutting. 5.5 Canal lining: Purpose, construction material used, advantages. 5.6 Cross Drainage works: Aqueduct, siphon aqueduct, super passage, and level crossing. 5.7 Canal regulators: Head regulator, Cross regulator, escape, falls and outlets. Course Outcome:CO5 Teaching Hours : 08 hrs Marks: 12 (R- 4, U- 6, A- 4)

Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning): Any 10 at least

1. Estimation of crop water requirement for the given data and cropping season
2. Computation of Canal capacity from crop water requirement
3. Computation of control levels for the reservoir
4. Site visit to any nearby water resource project (Dam/Canal/Weir/diversion headwork/any other irrigation project) and prepare detailed technical report
5. Prepare detailed report on any one irrigation scheme (Micro OR Minor) by site visit or observing relevant videos
6. Collect information and Prepare a detailed report on financial assistance of central/state government schemes for the Jalayukt shivar Yojana / Farm ponds/ Drip Irrigation scheme
7. Prepare a detailed technical presentation on major dams in India. Prepare a detailed report on any two major dams in India by observing relevant videos.
8. Prepare a report of cropping pattern, for the given minor or major irrigation project in your area with reference to growth in yield
9. Prepare a report on any one executed system of rainwater harvesting with reference to its necessity, broad design parameters, and economics in your area along with your comments
10. Conduct online / internet survey for Watershed management project (s) in the Maharashtra State with a detailed report of at least five relevant technical inputs
11. 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
12. i) Prepare a report on any one

    i) Executed system of Farm ponds or Jalayukt shivar schemes or drip irrigation scheme with emphasis on its suitability, costing, utility and maintenance after undertaking the visit to it

    ii) IKS: Rahat water Irrigation system in India.
13. Visit to the nearby rain gauge station and obtain information for the average rainfall for the particular day
14. Visit to a drip irrigation installation in your area & write brief report.
15. Compare Automatic & No automatic rain gauges based on any four points.

II. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Irrigation and Hydrology	4	3	3	10
2	Crop water requirement and Reservoir Planning	6	4	4	14
3	Dams and Spillways	4	6	4	14
4	Minor and Micro Irrigation	4	4	2	10
5	Diversion Headwork and Canals	4	6	2	12
	Total				60

III. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

Rubrics for continuous assessment based on process and product related performance indicators (___ marks)

- (TH 40 marks + 25OR)

Two-unit tests of 20 marks.

For Practical learning 25 marks.

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (60 TH + 25 OR marks)

End semester assessment of 25 marks for OR (Based on Practical learning)

End semester assessment of 60 marks through end semester examination.

Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO 3
CO1	2	3	3	3	3	3	2	2	3	1
CO2	2	3	3	3	3	3	2	2	3	2
CO3	2	3	3	3	3	3	2	1	3	2
CO4	2	3	3	3	3	3	2	1	3	1
CO5	2	3	3	3	3	3	2	1	3	1

Legends: - High:03, Medium:02, Low:01, No Mapping: --

IV. Suggested Learning Materials / Books

Sr.No	Author	Title	Publisher
1	Punmia, B.C., Pande B, Lal	Irrigation and water power Engineering	Lakshmi Publications, New Delhi - 110 002. Edition2016 ISBN 13: 9788131807637
2	Dahigaonkar J.G.	Irrigation Engineering	Asian Book Pvt. Ltd., New Delhi ISBN 13: 9788184120080
3	S.K.Garg	Irrigation and Hydraulic structures	Khanna Publishers, Delhi. ISBN: 978-81-7409-047-9

4	Sharma R.K. and Sharma T.K	Irrigation Engineering	S.Chand and Company Ltd.Delhi ISBN 13: 9788121921282 Ed.2002

V. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	https://wrd.maharashtra.gov.in/	Water resource department, government of Maharashtra, India
2	https://archive.nptel.ac.in/courses/126/105/126105010/	Introduction to Irrigation Engineering and Hydrology
3	https://www.youtube.com/watch?v=fx1uUek3Iqg	Hydrological cycle and Methods of computing Average rainfall
4	https://nptel.ac.in/courses/105105110	Surface & ground water resources

VI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Dipak Kulkarni	RCC Consultant	Structural Consultant Organisation
2	Mr.Neelamkumar Sawant	State Technical Head (Trade & Institution)	JSW Cement Limited, Mumbai
3	Mrs.Nisha Wartha	System Analyst	MSBTE Mumbai
4	Smt.Meera.S Deshmukh	Sr. Lecturer in Civil Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____ Engineering

Head of Department
Department of _____ Engineering

I/C, Curriculum Development Cell

Principal

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CDC Co-ordinator
G. P. Mumbai

Programme : Diploma in Civil Engineering													
Course Code:CE23503					**Course Title :Solid Waste Management**								
Compulsory / Optional: O													
Teaching Scheme and Credits						**Examination Scheme**							
CL	**TL**	**LL**	**SLH**	**NLH**	**Credits**	**FA-TH**		**SA-TH (2.5 Hrs.)**	**FA-PR**	**SA**		**SLA**	**Total**
						TS1	**TS2**			**PR**	**OR**		
--	--	--	2	6	3	20	20	60	--	--	--	25	125

Total IKS Hrs. for course: 3

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents an average of two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale:

Effective solid waste management (SWM) is required for maintaining a healthy, sustainable environment and ensuring the well-being of human populations. With rapid urbanization, industrialization, and increased consumption, the generation of solid waste has significantly risen, leading to severe environmental and health concerns. Proper management of solid waste is essential to mitigate its negative impacts and support sustainable development. As the global population continues to grow, effective waste management is key feature for conserving landfill space, reducing waste generation, and promoting sustainability. By adopting practices such as reducing, reusing, and recycling, communities can contribute to resource conservation and climate change mitigation

II.Industry / Employer Expected Outcome

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences,Implement Solid Waste Management Techniques to reduce Environmental Footprint in Compliance with its Regulations.

I. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

...1	Classify the Solid Wastes
...O2	Decide collection method and transportation of MSW
CO3	Use best disposal method for MSW to avoid health hazards to public and people involved in process
CO4	Use best collection and disposal method for Bio-medical waste
CO5	Use best collection and disposal method for E-waste and Industrial waste.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO)	Topics / Sub-topics
1	TLO 1.1 Classify the solid waste on the basis of its source of collection. TLO 1.2 Distinguish solid waste on the basis of their characteristics. TLO 1.3 Analyze the impact of solid waste on on en environment. TLO 1.4 Draw the labeled sketch of hierarchy of waste management. TLO 1.5 Propose the organization chart required to manage solid waste for the given village / town / city of your locality	Unit - I Introduction to Solid Waste Management 1.1 Overview of Solid Waste- Definition, types and sources of– Domestic Waste, Commercial waste, Industrial waste, Market waste, Agricultural waste, Biomedical waste, E-waste, Institutional waste. 1.2 Characteristics of Solid Waste: Physical, Chemical, and Biological properties, Classification of solid waste- Hazardous waste and Non-hazardous waste. 1.3 Impact of Solid Waste on Environment and Human health. 1.4 Solid waste management hierarchy: Prevent, Reduce, Reuse, Recycle, Recover and dispose 1.5 Organization pattern of solid waste management system, and Steps involved in the development of a Solid Waste Management System. Course Outcome: CO1Teaching Hours : 06 hrs Marks:08 (R-4 , U- 2 , A- 4)
	TLO 2.1 Describe the factors affecting generation of given type of solid wastes. TLO 2.2 Suggest the relevant method of storage of solid waste for the given site conditions. TLO 2.3 Explain the relevant method of collecting the solid waste in the given situation. TLO 2.4 Suggest the relevant transportation system for transporting the municipal solid waste at the given location with justification. TLO 2.5 Justify the importance of Transfer station in collection and transportation of Solid Waste. TLO 2.6 Illustrate the different methods of segregation depending on type of solid waste. TLO 2.7 Implement the Recent techniques for segregation of solid waste in the given area. TLO 2.8 Analyze the financial requirement for solid waste management for a city or town.	Unit - II Aspects of Solid Waste Management 2.1 Waste generation, Factors Affecting Waste Generation: Population growth, urbanization, lifestyle,economicdevelopment etc. 2.2. Storage practices of solid waste generated, Tools and Equipment-Litter Bin, Broom, Shovels, Handcarts, Mechanical Road sweepers, Community bin - like movable and stationary bin. 2.3Waste Collection Systems: a) Manual: Curb system, Alley, Set out and setback system.b) Automated Collection Systems: Techniques, challenges, and innovations 2.4 Transportation of municipal waste- Importance of Efficient Transportation, Transportation vehicles- Trucks, dumpsters, and other specialized vehicles. 2.5 Transfer station- meaning, necessity, location. 2.6 Segregation of Solid waste, its importance, reducing waste, improving recycling efficiency, Methods of Segregation: Manual and automated sorting. 2.7 Recent Innovations in segregation: Robotic sorting

		systems, AI in waste management-optical sorting, and Smart bins . .2.8 Economy and financial aspects of waste management. Course Outcome: CO2 Teaching Hours : 16 hrs Marks:14 (R-4 , U- 4 , A- 4)
	TLO 3.1 Suggest a relevant method of disposal of solid waste in given situation TLO 3.2 Explain the principles of composting of SolidWaste. TLO 3.3 Describe the different steps of executing There relevant method of composting. TLO 3.4 Explain the factors considered for site selection of landfill. TLO 3.5 Explain the relevant operating method of sanitary land filling. TLO 3.6 Discuss the role of Bioreactor landfills, methane capture, leachate treatment in Municipal solid waste management system TLO 3.7 Use the relevant incineration method for disposal of given type of solid waste. TLO 3.8 Discuss the key applications of pyrolysis in solid waste management..	Unit - III Treatment and Disposal of Solid Waste 3.1 Solid waste disposal methods and its importance-Composting, Landfill, Incineration and Energy Generation 3.2 Concept, Principles, and Factors affecting the composting 3.3 Methods of composting: Manual Composting – Bangalore method, Indore Method, Vermicomposting (IKS*-Bio-fertilizers, organic farming) Mechanical Composting – Dano Process 3.4 Land filling techniques, methods and Factors to be considered for site selection of landfills. 3.5 Land filling methods :Area method, Trench method, Ramp method, Advantages and disadvantages of landfill method 3.6 Recent Developments: Bioreactor Landfills, Methane capture, Leachate treatment 3.7 Incineration of solid waste: Introduction, Types of incinerators - Flash, Multiple chamber Incinerators, Advantages and disadvantages of incineration process 3.8 Pyrolysis of waste – Purpose, process and Applications Course Outcome:CO3 Teaching Hours :20 hrs Marks:18 (R- 4 , U- 4 , A- 4)
	TLO4.1. TLO 4.1 Apply suitable management technique for safe disposal and treatment of biomedical waste. TLO4.2 Apply suitable management technique for safe disposal and treatment of Industrial waste. TLO4.3 Apply suitable management technique for safe disposal and treatment of E- waste TLO4.4 Explain various energy recovery methods, including heat recovery units, power generation from waste, and biofuels and their efficiency in sustainable waste management practices. TLO 4.5 Apply recent developments in waste-to-energy (WTE) technologies, including modern WTE plants and small-scale decentralized	Unit - IV Waste Management System 4.1 Biomedical Waste Management-Definition, Sources and generation of Biomedical waste, Classification and Management technologies for Biomedical waste. 4.2 Industrial Waste Management- Definition, Sources and generation of Industrial Waste, classification and Management technologies for Industrial Waste. 4.3 E- Waste Management - Definition, Sources and generation of E- Waste Management, Classification and Management technologies for E- Waste Management. 4.4 Energy Recovery Methods: Heat recovery Units, Power generation, Biofuels, Refuse-Derived Fuel (RDF) 4.5 Recent Developments: Modern WTE plants, small-scale decentralized systems. Course Outcome:CO3 Teaching Hours :08 hrs

	systems, and evaluate their effectiveness, scalability in sustainable waste management and energy recovery.	Marks:12 (R- 4 , U- 4 , A- 4)
	TLO5.1 Explain Role of CPCB (Central Pollution Control Board)and MPCB (Maharashtra Pollution Control Board) in managing the given type of solid waste TLO5.2 Illustrate the relevant major provisions of Municipal Solid Waste Management Rules, 2016 for disposal of the given type of solid waste. TLO5.3 Explain the different major provisions of Biomedical Waste Management Rules, 2016 for managing the given type of bio-medical waste. TLO5.4 Illustrate the relevant major provisions of E-Waste management rules 2016 TLO5.5 Explain the salient features of Hazardous and other wastes Management Rules, 2016 for the disposal of the given type of waste. TLO5.6 Illustrate the relevant major provisions of Plastic Waste management rules 2016 TLO5.7 Illustrate the relevant major provisions of Construction and Demolition Waste management Rules 2016. TLO5.8 Explain Extended Producer Responsibility (EPR) and articulate its principles, key objectives, and role in waste management TLO 5.9 Discuss the role of NGOs in social, environmental, and economic impacts of initiatives in solid waste management	Unit - V Legal Aspects of Solid Waste Management 5.1 Role of agencies in management of solid waste from various sources Central Pollution Control Board Maharashtra Pollution Control BoardMunicipal Corporations, Nagar Panchyat, Gram Panchayat etc 5.2 Municipal Solid Waste Management Rules, 2016 5.3 Biomedical Waste Management Rules, 2016 5.4 E- Waste Management Rules, 2016 5.5 Hazardous and other wastes Management Rules, 2016 5.6Plastic Waste Management Rules, 2016 5.7Construction and demolition Waste Management Rules, 2016 5.8 Extended Producer Responsibility (EPR) -The role of extended producer responsibility (EPR) in promoting, recycling, concepts, benefits of EPR 5.9 Role of NGO's and community participation in Solid waste management Course Outcome:CO5 Teaching Hours : 10 hrs Marks: 08 (R- 4, U- 6, A- 4)

Note: if any

II. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

Assignment

1. Prepare charts showing tools, equipment, vehicles and machineries used in solid waste management practices.
2. Write a report on case studies for solid waste management practices in Rural/Urban Aera
3. Prepare detailed photographic report on impact of solid waste on environment.
4. Collect information on recent developments in Solid waste management such as bioreactors, methane capture etc.
5. Write a report on the Role of NGO's and community participation in Solid waste management.
6. Write a detailed report on Energy recovery concept in solid waste management.
7. Collect the relevant technical and commercial information of minimum four tools, equipment, used for collection of solid waste with specification.

Micro project

1. Prepare compost using decomposable waste material at your home/institute adopting appropriate method.

Prepare vermicomposting using decomposable waste material and worms at your home/institute.
3. Prepare a report on route used for collection and transportation of solid waste of your city/Village.
4. Prepare a report on solid waste management practices adopted in your institute campus.
5. Develop a specific model regarding solid waste management practices

Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Solid Waste Management	2	4	0	8
2	Aspects of Solid Waste Management	4	4	6	14
3	Treatment and Disposal of Solid Waste	2	8	8	18
4	Waste Management Systems	0	8	4	12
5	Legal Aspects of Solid Waste Management	2	4	4	08
	Total	**10**	**28**	**22**	**60**

III. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

Rubrics for continuous assessment based on process and product related performance indicators(___ marks)

TH 40 marks

- Two-unit tests of 20 marks

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (60 marks)

Summative Assessment (Assessment of Learning)

End term examination, Viva-voce, Workshop performance (60 TH)

End semester assessment of 60 marks through end semester examination.

gested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	3	-			1	1	2	2	3	3
CO2	2	2	2	3	3	1	1	2	3	2
CO3	2	3	3	2	2	2	2	2	3	2
CO4	2	2	2	2	2	2	1	2	3	2
CO5	2	-	-	-	2	-	2	2	3	2

Legends: - High:03, Medium:02, Low:01, No Mapping: --

IV. Suggested Learning Materials / Books

Sr.No	Author	Title	Publisher
1	Solid Waste Management	Dr. A.D.Bhide, Indian National Scientific Documentation Centre, New Delhi	INSDOC,New Delhi (
2	Solid Waste Management	George Techobanoglous, McGraw Hill Education Private Ltd. New Delhi	ISBN:10:0071356231
3	Sasikumar K	Solid Waste Management	ISBN :9788120338692 Prentice Hall India Learning Private Limited,
4	Dr. Ranjita Roy Sarkar	Waste to Energy Efficient Municipal Solid Waste Management	ISBN :978-9392816710 Abhijeet Publications
5	Dr. Harshita Jain, Dr. Renu Dhupper	Sustainable Solid Waste Management	ISBN :978-8196358921 S.K. Kataria & Sons

V. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/105/103/105103205/	NPTEL Video Lecture on Municipal Sc Waste management by IIT
2	https://nptel.ac.in/courses/105105160	NPTEL Video Lecture on Integrated W Management for a Smart City by IIT
3.	www.mpcb.gov.in	Website of Maharashtra Pollution contr Board
4.	https://onlinecourses.swayam2.ac.in/cec20_ge34/preview	Swayam Portal Video Lecture on So and hazardous Waste Management

I.Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr.Dipak Kulkarni	RCC Consultant	Structural Consultant Organization
2	Mr.Neelamkumar Sawant	State Technical Head (Trade & Institution)	JSW Cement Limited, Mumbai
3	Mrs.Nisha Wartha	System Analyst	MSBTE Mumbai
4	Smt.Meera.S Deshmukh	Sr. Lecturer in Civil Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of _____ Engineering

Head of Department
Department of _____ Engineering

I/C, Curriculum Development Cell

Principal

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