GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMAIN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**Design of Steel and RCC Structure**
COURSE CODE	**AM41202**
PREREQUISITE COURSE CODE & TITLE	**AM31204 - Mechanics of Structure**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
AM41202	**Design of Steel and RCC Structure**	**DSC**	**4**	**-**	**2**	**0**	**6**	**3**	**4**	**30**	**70**	**100**	**40**	**25**	**10**	**25#**	**10**	**0**	**0**	**150**

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.

1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

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

III.INDUSTRY EXPECTED OUTCOME

To help the student to attain the following industry identified competency through various teaching learning experiences**: ' Use the concepts of Steel and RCC structural design using Limit State Method at the site.'**

IV. COURSE-LEVEL LEARNING OUTCOMES (COs)

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

CO1: Use steel table and IS code 800:2007 at work sites.
CO2: Design the connections for the given steel joints.
CO3: Analysis and design of singly reinforced rectangular beams.
CO4: Design of shear reinforcement and development length for beams.
CO5: Design various slabs for the given edge condition.
CO6: Design of axially loaded short column and footings.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

SECTION I

Sr. No	Theory Learning Outcomes (TLOs) aligned to COs.	Learning content mapped with TLOs.	Suggested Learning Pedagogies	Relevant COs
UNIT I- FUNDAMENTAL OF STEEL STRUCTURES (CL Hrs-4, Marks-7)				
1.	TLO 1.1: Select a relevant steel Structure for the given condition. TLO 1.2: Use steel table to identify different properties of given steel sections. TLO 1.3: Explain the various type(s) of loads (Dead load, live load, impact load, seismic load, snow load etc.) acting on the given steel structures. TLO 1.4: Select the relevant factors to calculate seismic forces for given civil structure. TLO 1.5: Choose the partial safety factor as per the guidelines laid in IS for the given situation. TLO1.6: Explain the Advantages and disadvantages of steel as construction material in the given situation. TLO 1.7: Describe the functions of the given steel structure. TLO 1.8: Identify the components of the given steel structure.	1.1 Steel as a construction material. 1.2 Steel Structures: Roof trusses, Water Tanks, Bridges, Gantry and Crane girders, Columns, Chimney, building frames etc. 1.3 Types, grades and strength of steel sections, Steel Table, IS 808-1989. Stress Strain graph for mild steel. 1.4 Loads acting on steel structures according to IS 875-1987 part I to IV. 1.5 Limit State Method of design: Meaning and types of limit states, loads, design criteria, limit states of strength, limit states of serviceability. 1.6 Factors of safety and load factors as per IS 800:2007	Chalk-Board Demonstration Presentations, Hands-on	**CO1**

UNIT-II DESIGN OF STEEL CONNECTIONS (CL Hrs-12, Marks-14)				
2	TLO 2.1: Compute the strength of the given bolt (bolt value) TLO 2.2: Calculate strength of Bolted connection. TLO 2.3: Design of the bolted connection for given axial force. TLO 2.4: Compute the strength of given welded connection. TLO 2.5: Design of Welded connection for given axial force. TLO 2.5: Explain the advantages and disadvantages of given welded connection.	2.1 Types and uses of black bolts of grade 4.6. 2.2 Specifications of bolt holes for bolted connections. 2.3 Strength of bolt in shear, tension, bearing. 2.4 Analysis and design of bolted joints for axially loaded plate, single angle members. 2.5 Welded connections: Butt and Fillet welds, size of weld, throat thickness. 2.6 Analysis and design of fillet weld joint for plate (ISF); single angle (ISA) members subjected to axial load.	Chalk-Board Demonstration Presentations	**CO2**
Unit- III ANALYSIS AND DESIGN OF SINGLY REINFORCED RECTANGULAR BEAMS (CL Hrs-12, Marks-14)				
3	TLO 3.1: Explain the different types of loads acting on the given RCC structures. TLO 3.2: Describe the procedure used in limit state method of design a RC member for the given data. TLO 3.3: Discuss the design parameters including constants for given types of materials. TLO 3.4: Calculate ultimate moment of resistance for given type of RC beam section. TLO 3.5: Design a beam section for given conditions. TLO 3.6: Draw reinforcement detailing for a RC beam as per the IS provisions. TLO 3.7: Identify the given section as Under-reinforced, over- reinforced or balanced section.	3.1 Functions of reinforcement, material properties, types of limit states, partial safety factors for Steel and concrete, characteristic strengths, characteristic load, design load as per IS 456:2000. 3.2 Limit State of collapse (flexure): assumptions, strain diagram and stress-strain relationship for concrete and stress block diagram for singly reinforced section, design parameters and constants, ultimate moment of resistance 3.3 Under-reinforced, over-reinforced and balanced sections. 3.4 IS specifications regarding spacing, cover, minimum reinforcement, effective span in beam. 3.5 Analysis of RC section – Determination of design constant ultimate moment of resistance and load carrying capacity etc. 3.6 Design of RC beam – Find Depth of RC section, Main steel calculation and provision, Percent Steel Calculation.	Chalk-Board Demonstration Presentations	**CO3**

SECTION II

UNIT-IV DESIGN OF BOND AND SHEAR REINFORCEMENT (CL Hrs-10, Marks-10)				
4	TLO 4.1: Explain the pattern of shear failure for a given RC member. TLO 4.2: Locate the zones of minimum shear reinforcement with sketch for the given loading. TLO 4.3: Design shear reinforcement by using Vertical Stirrups. TLO 4.4: Compute the bond length for the beam with given reinforcement. TLO 4.5: Identify the zone of minimum shear reinforcement in the given element.	4.1 Bond: Meaning of bond as per IS code provisions. Meaning and calculation of development length in tension and compression. 4.2 Various forms of shear reinforcement, IS code specification, Zones of minimum shear reinforcement, Design of shear reinforcement for RC beam by using vertical stirrups.	Chalk-Board Demonstration Presentations	**CO4**
UNIT-IVDESIGN OF SLAB (CL Hrs-12, Marks-12)				
5	TLO 5.1: Suggest the relevant type of slab for the given support condition. TLO 5.2: Suggest relevant corresponding values of design parameters in the given situation. TLO 5.3: Check the deflection of the given type of slab. TLO 5.4: Design the given type of slab using the given parameters. TLO 5.5: Check the development length of the given type of slab.	5.1 Slabs, support conditions, I.S. specifications regarding main steel, distribution steel, spacing and cover for reinforcement, effective span, minimum reinforcement. 5.2 Limit state of serviceability for slabs for deflection criteria only. 5.3 Design of one-way end cantilever slab including development length check only. 5.4 Design of two-way simply supported slab with four edges discontinuous. (As per IS 456:2000, table no 26 case no 9 only). Check for deflection only.	Chalk-Board Demonstration Presentations	**CO5**
UNIT –VI DESIGN OF AXIALLY LOADED SHORT COLUMN AND SQUARE FOOTING (CL Hrs-10, Marks-13)				
	TLO 6.1: Identify the type of column in the given situation. TLO 6.2: Calculate the ultimate load carrying capacity of the column in the given situation. TLO 6.3: Design the axially	6.1 Limit state of collapse in compression, assumptions, effective length, slenderness ratio, short and long columns, and minimum eccentricity. 6.2 IS specifications for main reinforcement and lateral reinforcement in column. 6.3 To calculate loading for axially loaded short column for given data.	Chalk-Board Demonstration Presentations	**CO6**

	loaded short column for the given data. TLO 6.4: Design square footing for axially loaded square column TLO 6.5: Explain the assumptions made in the design of axially loaded short column. TLO 6.5: Select the given type of RCC footings in the given situation.	6.4 Design of axially loaded short square and rectangular column. 6.5 Various RC footings: Isolated and Sloped footings, combined footings. 6.6 IS specifications for reinforcement in footing 6.7 Design of isolated square footing for square column with given data. 6.8 Check for one way shear and two-way shear (problems on design of footing for bending moment only in theory examination paper)		

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles (Any 10)	Number of hrs.	Relevant COs
1	I	Write five IS clauses related to load from IS 875:1987.	2	CO1
2	I	Draw five commonly used built up sections.	2	CO1
3	I	Write five IS clauses related to joints in steel structure from IS 800:2007.	2	CO1
4	II	Draw types of bolts with their modes of failure.	2	CO2
5	II	Draw types of welds and types of welded joints.	2	CO2
6	II	Draw modes of failure for bolted connections.	2	CO2
7	III	Write five IS clauses related to partial safety factors, characteristic strengths, characteristic load and design load from IS 456:2000.	2	CO3
8	III	Draw cross section, strain —stress diagram for singly reinforced section giving design parameters and constants.	2	CO3
9	III	Draw stress block diagram for Under- reinforced, over-reinforced and balanced sections showing all details.	2	CO3
10	III V	Write four IS clauses related to each for slab, beam and column from IS 456:2000.	2	CO3, CO5
12	III V	Draw diagrams showing transfer of loads from one way simply supported slab and two-way simply supported slab to the supporting beam as per I. S. 456:2000.	2	CO3, CO5
13	V	Draw reinforcement detailing of dog legged stair	2	CO5
14	VI	Introduction to ‘coupler’ for Lap length used in multistoried buildings	2	CO6

VII. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Only one micro-project is planned to be undertaken by a student individually (or in a group of 3) that needs to be assigned beginning of the semester.

The micro-project could be industry application based, internet-based, workshop- based, laboratory-based or field-based. Each micro-project should include two or more COs which are in fact, an integration of POs, UOs and ADOs. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed five.

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

a.Collect the information of various types of connections used in actual practice.
b.Enlist various software used for the design of steel structures end give details of any one software.
c.Enlist various software used for the design of RCC structures and give details of any one software.
d.Collect the details of various types of the formwork used for RCC structures at site.
f.Collect the details of safety norms followed during RCC construction at site and write brief report.
g. Collect the details of safety norms followed during Steel construction at site and write brief report.
h. Visit the site and study the labor management for any one activity related to RCC component.
i. Visit the site and study the material management for any one activity related to RCC component.
j. Visit the site and check the level for slab, plumb of column and depth of column as per blue print and write detailed procedure of anyone.
k. Identify the various human errors occurred while placing reinforcement remedial measures.
l. Enlist the activities during removal of formwork and precautions.
m. Enlist all the instruments used on site along with photograph and parallel terminology used by local mason/labor/worker

VIII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED :NA

IX. SUGGESTEDFOR WEIGHTAGE TOLEARNING EFFORTS& ASSESSMENTPURPOSE (Specification Table)

Unit	Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamental of steel structures	4	5	2	00	7
II	Design of Steel Connections	12	2	2	10	14
III	Analysis and Design of SinglyReinforced Rectangular Beams	12	2	2	10	14
IV	Design of Shear Reinforcement and Bond	10	2	2	6	10
V	Design of Slabs	12	2	4	6	12
VI	Design of axially loaded short Columns and footing	10	2	3	8	13
	Total	60	15	15	40	70

X. ASSESSMENTMETHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning, test exam 30 marks.	Final exam70 marks.

XI. SUGGESTED CO- PO 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
CO1	2	2	2	3	2	2	2	1	2
CO2	2	2	2	3	2	2	2	1	2
CO3	2	2	2	3	2	2	2	1	2
CO4	2	2	2	3	2	1	2	1	2
CO5	2	2	2	3	2	1	2	1	2
CO6	2	2	2	3	2	1	2	1	2

Legends: -High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XII. SUGGESTED LEARNINGMATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Dr. V.L. Shah, Prof. Veena Gore	Limit State Design of Steel Structures	Structures Publications, Pune ISBN-81-903717-5-4
2	Prof. S K DUGGAL	Limit State Design of Steel Structures	3rd, Edition, McGraw Hill Publication, New Delhi ISDN-I3:978-93-5316-488-1
3	Dr. V.L. Shah, Late Dr. S.R. Karve,	Limit State Theory and Design of Reinforced Concrete Structures (IS: 456 - 2000)	8th Edition, Structures Publications, Pune. ISBN-13:978-8190371711
4	Pillar, S.U. Memon, Devdas	Reinforced concrete Design	McGaaw Hill Publications, New Delhi.ISDN-I3:978-0070141100
5	Varghese, P.C.	Limit State Design of Reinforced Concrete	PHI Learning Private Limited, Delhi.lSBN-13: 978-8120320390
6	BIS New Delhi	IS: 800 - 2007 Indian Standard Code of Practice for use of structural steel in general building construction	BIS New Delhi
7	BIS New Delhi	IS: 875 - 1987 Part 1-5: Indian Standard code for Loading Standard.	BIS New Delhi
8	BIS New Delhi	IS: 456 – 2000, Plain and reinforced cement concrete code of practice	BIS New Delhi

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.youtube.com/watch?v=mtRR-5fzKo8	Introduction to Design of Steel Structures
2	https://www.youtube.com/watch?v=X8WhkG70tAc	Design of Steel Structures
3	https://www.youtube.com/watch?v=-JMNMlMg-CE	Bolt Connections
4	freevideo1ectures.com › Civil Engineering › IIT Guwahati	Design of Steel Structures, RCC Structures
5	nptel. ac,in/noc/individual course.php?id =noc17-ce21	NPTEL Courses
6	http://freevideolectures.com/Course/2686/Design-of-Reinforced-Concrete-Structures	RCC Structures
7	https://www.youtube.com/watch?v=hVaB0jGcyB4	Design of Singly Reinforced Concrete Beams

Name & Signature: **K. P. Bagade** Lecturer in Applied Mechanics	**S. V. Khadake** Lecturer in Applied Mechanics
(Course Experts)	
Name & Signature: **V. B.Kondawar** (Programme Head)	Name & Signature: **S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**ESTIMATING AND COSTING**
COURSE CODE	**CE41201**
PREREQUISITE COURSE CODE & TITLE	**-**
CLASS DECLARATION COURSE	**YES**

I. LEARNING&ASSESSMENTSCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE41201	ESTIMATING AND COSTING	DSC	4	-	2	-	6	3	4	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Term: 00Hrs

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Note:

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2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

A civil engineer mainly is involved in planning, designing and construction of civil engineering projects. Estimating and costing is widely required in all civil engineering projects. The course enables the student to I) calculate the quantities of materials II)Prepare approximate estimate of civil engineering project, III) Prepare detailed estimate of civil engineering project , IV) Prepare rate analysis of civil engineering project V)Draft specifications of items of construction.

III. COURSE-LEVELLEARNINGOUTCOMES(CO'S)

After completing the course, student will be able to

CO1. Select Mode of Measurements of different items of Work.

CO2. Prepare Approximate Estimates of Civil Engineering Work.

CO3. Prepare detailed estimate of Civil Engineering work.

CO4. Draft specification for Civil engineering item of Work.

CO5. Calculate Rate of an item of Civil Engineering Works.

IV. THEORYLEARNINGOUTCOMESANDALIGNEDCOURSECONTENT:

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learningcontentmappedwith TLO's.	Suggested Learning Pedagogies	Relevant CO's
		SECTION I		
		UNIT-I Introduction to Estimation and costing (CL Hrs-5, Marks-5)		
1.	TLO 1.1 Explain the purposes of estimation and costing. TLO 1.2 Explain the technical terms involved for preparing different types of Estimate. TLO 1.3 Prepare check list of items for the given type of civil engineering structure. TLO 1.4 .Select the mode of Measurements for a given item asper IS: 1200. TLO 1.5 Apply the rules for deductions in Masonry work ,Plastering, Pointing and Painting work as per IS:1200.	1.1 Estimation and Costing—Meaning, purpose, Administrative Approval, Technical Sanction and Budget. 1.2 Types of Estimates—Approximate estimate and detailed estimate. 1.3Types and Uses of Estimates: Revised estimate, supplementary estimate, revised and supplementary estimate, repair and maintenance estimate, renovation Estimate. 1.4 Roles and responsibility of Estimator. 1.5 Checklist of items of work in load bearing and framed structure as per Execution. 1.6 Modes of measurement and Desired accuracy in measurements of different items of work as per IS:1200. Principles behind fixing units of measurements. 1.7 Rules for deductlon in Masonry work ,Plastering and Pointing and Painting work as per IS:1200. 1.8 Standard formats of Measurement sheet, Abstract sheet, Face sheet.	Site visit Video Simulation Chalk-Board	CO1
		UNIT-II Approximate Estimate (CL Hrs-04, Marks-6)		
2	TLO 2.1- Explain necessity of approximate estimate. TLO 2.2- Describe the methods used in determining the approximate estimate for the given structure. TLO2.3- Prepare the approximate estimate for the given civil engineering works. TLO 2.4- Select relevant method of approximate estimate.	2.1 Approximate estimates, -Definition and purpose 2.2- Methods of approximate Estimate- Service unit method, Plinth area rate method, Cubical content method, Typical bay method. 2.3- Approximate method for-roads, Railways Bridges, irrigation projects, water supply and sanitary works. 2.4- Numerical examples on approximate estimate.	Site Visit Video Demonstrations Presentations Chalk-Board	CO2

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learningcontentmappedwith TLO's.	Suggested Learning Pedagogies	Relevant CO's
	UNIT-III Detailed Estimates (CL Hrs-21, Marks-24)			
3	TLO 3.1 Describe the procedure of preparation of detailed estimate for given type of structure. TLO 3.2 Describe methods for determining quantities of items of structure. TLO 3.3 Calculate quantities of items of construction of a load bearing structure and frame structure. TLO 3.4 - Prepare bar bending schedule for a given RCC item of construction. TLO 3.5.- Prepare detailed estimate of a load bearing structure. TLO 3.6.– Prepare detailed estimate of a frame structure. TLO 3.7 -Prepare the bill of quantity for the given type of civil work.	3.1 Detailed estimate:-Defination,Purpose**,** Data required for preparing detailed estimate, Procedure of preparationof detailed estimate- Taking out quantities and Abstracting. 3.2 Methods of Detailed Estimate-Unit quantity method and total quantity method. 3.3 Long wall and Short wall method (out to out and in to in method or PWD method), Centre line method. 3.4Provisions in detailed estimate: contingencies, work charged establishment, centagecharges, watersupply and sanitary Charges and electrification charges, Tools and plant, Quality control charges. 3.5Prime cost, Provisional sum, provisional Quantities, Bill of quantities, Spot items or Site items, Day work. 3.6 Steel requirement of RCC components like-Footing, column, beam, lintel, chajja,slab. 3.7Prepare Bar bending schedule.	Site Visit Video Demonstrations Presentations Chalk-Board	CO3
	SECTION II			
	UNIT- IV Estimate for Civil Engineering works **(CL Hrs-12, Marks-16)**			
4	TLO 4.1- Calculate the earthwork quantity for the given civil engineering works. TLO 4.2 – Explain the relevant Methods of calculatlng the quantity of earthwork for the given work. TLO 4.3 -Prepare detailed estimate for given civil engineering work. TLO 4.4 – Use the relevant software for prepaiing the detailed estimate for the given work.	4.1 Detailed estimate for septic tank, Community well,under ground water tank, sump well. 4.2 Quantity of Earth work required in roads, dams, canals,by mid sectional area method, mean area method, trapezoidal method, prismoidal formula method. 4.3 Use of computer / softwares / programmes for detailed estimate Preparation of Civil Engineering Works.(Questions on application of software from sub unit 4.3 above shall not be asked in theory exam.)	Site visit Video DSR ,SSR Chalk-Board	CO4

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learningcontentmappedwith TLO's.	Suggested Learning Pedagogies	Relevant CO's
UNIT –V Specifications (CL Hrs-04, Marks-5)				
5	TLO 5.1 Justify the importance of specification for construction work. TLO 5.2 Classify the specifications based on the given criteria. TLO 5.3 Explain the provisions made in specifications for given condition. TLO 5.4 Draft a detailed specification for a given items of engineering structure. TLO 5.5 Explain legal aspects related to specification of items of construction work.	5.1 Specification- Definition,Necessity and importance, points to be observed in framing specifications of an item. 5.2 Types of specification - Brief and Detailed, Standard and Manufacturers Specification 5.3 Preparing Detailed Specifications of items such as Excavation, PCC, Brick work, Internal and external plastering work, RCC work of Building construction, Canal lining, reinforcement, waterproofing of Irrigation Structures, WBM road, Bituminous road of transportation structures and Cast iron water pipes used in Public health structures. 5.5 Legal aspects of Specification.	Site visit Video DSR ,SSR Chalk-Board,simulation	CO5
UNIT- VI Rate Analysis (CL Hrs-14, Marks-14)				
6	TLO 6.1 Explain the factors affecting rate analysis of item of construction. TLO 6.2 -Calculate the quantity of material required for different items of civil engineering work. TLO 6.3 Describe the procedure of rate analysis of item of construction. TLO 6.4. Explain task work and factors affecting task work TLO 6.5. Prepare rate analysis of item of construction.	6.1 Rate Analysis- Definition,purpose, importance and factors affecting rate of an item. 6.2 Important technical terms-Lead (standard and extra) , overheadcharges, watercharges and contractors profit, 6.3 Task work-Definition, factors affecting task work, types of labors,number of labors required for different type of work.DSR,SSR 6.4 Working the quantities of materials required for different items of civil engineering works for example PCC, RCC, Brickwork, Stone Masonary, Flooring, Plastering,Painting etc. 6.5 Preparing rate analysis for items of civil Engineeringworks.-excavation,PCC,RCC work in (colulnn, beam, lintel, slab),brick masonry, stone masonry, tile flooring,plastering, white washing,painting etc.	Site Visit Video Demonstrations Presentations Chalk-Board	CO6

V. LABORATORYLEARNINGOUTCOMEANDALIGNEDPRACTICAL/TUTORIALEXPERIENCES.

Sr. No	Practical /Tutorial /Laboratory Learning Outcome(LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1:-Study drawings to prepare check list of items.	Prepare a check list of items of the following types of civil engineering works. (a) Load Bearing Building. b) Bituminous Road c) Septic tank (d) Community well	1	1
2	LLO2:-Apply concept of preparation of approximate estimate.	Prepare approximate estimate from the given data.	2	1
3	LLO3:- Apply knowledge of preparation of detailed estimate of load bearing building.	Prepare detailed estimate of a load bearing structure of single storied residential building for all items of works , considering quantity of reinforcement in percentage.	4	2
4	LLO4:- Apply knowledge of preparation of detailed estimate of RCC Hall.	Prepare detailed estimate of small R.C.C. hall by considering following items of works. - I)R.C.C.Column footing, II) R.C.C.Column, III)R.C.C.Beam, IV)R.C.C.Slab, V)PCC foundation bed, VI)Excavation for column footing (Quantities of concrete, reinforcement and formwork shall be calculated for the above items.)	4	2,
5	LLO5:- Apply knowledge of preparation of detailed estimate of civil engineering structure.	Prepare detailed Estimate of any **one** of the following works. i) Septic Tank ii) Sump well iii) Community well	2	2,3
6	LLO6:- To understand calculation of quantities of materials for item of construction.	Calculate quantity of earthwork from the given data for road work.	2	4
7	LLO7:- Apply knowledge of preparation of detailed estimate of civil engineering structure.	Prepare detailed Estimate of Bitumen Road with Earth work.	2	2,3
8	LLO8:-To understand preparation of rate analysis of item of construction of civil engineering structure.	Prepare Rate Analysis for any five civil engineering items.	4	4
9	LLO9:- To understand measurement and recording of items of construction.	Measurement of any five completed items of construction and recording them in measurement book.	4	2,3
10	LLO10:-To understand the material, quality of material, ,sequential stpes to be followed in the construction.	Draft general and detailed specification for an item of civil engineering work.	2	3,5
11	LLO11:-To know use of softwares in preparation of estimate.	Prepare report on use of softwares in estimating and costing.	1	4

Sr. No	Practical /Tutorial /Laboratory Learning Outcome(LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
12	LLO12:- To understand calculation of quantities of materials for item of construction.	Calculate material requirements for following items whose estimate is prepared in Sr.No.3 I) PCC foundation Bed, II) BB masonry in ground floor, III) Internal plaster, IV) Flooring, V) RCC slab (Steel on % basis)	2	3
All practical titles are compulsory.				

VI. SUGGESTEDMICROPROJECT/ASSIGNMENT/ACTIVITIESFORSPECIFICLEARNING/SKILLSDEVELOPMENT(SELF-LEARNING)

Microproject:

NA

Assignment: -

NA

VII. LABORATORY EQUIPMENT/ INSTRUMENTS/ TOOLS/ SOFTWARE REQUIRED

Sr.No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	NA	NA

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr.No	Unit	Unit Title	Aligned CO's	LearningHours	R-Level	U-Level	A-Level	TotalMarks
		SECTION I						
1	I	Introduction to Estimation and Costing	1	5	1	2	2	5
2	II	Approximate Estimate	2	4	2	--	4	6
3	III	Detailed Estimates	3	21	4	4	16	24
		SECTION II						
4	IV	Estimate for Civil Engineering works	4	12	2	2	12	16
5	V	Specification	5	4	1	2	2	5
6	VI	**Rate Analysis**	6	14	4	2	8	14
Grand Total				**60**	**14**	**12**	**44**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two unit tests of 30 marks and an average of two unit tests. For laboratory learning 25 marks.	End semester assessment of 25 marks for external assessment. End semester assessment of 70 marks theory examination.

X. SUGGESTED COS- PO'sMATRIXFORM

Course Outcomes (COs)	Programme Outcomes(PO's)							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	3	2	2	2	3	2	2	2
CO2	3	3	3	3	2	2	2	2	2	2
CO3	3	2	3	2	2	2	3	2	2	2
CO4	3	2	3	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2
CO6	3	2	3	2	2	2	2	2	2	2

Legends:-High:03, **Medium:**02, **Low:**01, **No Mapping:**-
*PSOsare to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No.	Author	Title	Publisher with ISB Number
1	Datta B.N.	Estimating and Costing	UBS Publishers,DistributorsPvt.Ltd.New Delhi 9788174767295
2	Rangwala S.C.	Estimating and Costing	charotar Publishing House Pvt.Ltd.,Anand
3	Birdie G.S.	Estimating and Costing	Dhanparai Publication,New Delhi 978-93-84378-13-4
4	Chakarborti M. Monoj It Chakarborti, Kolkatta	Estimating and Costing,Specification and valuation in civil engineering	M.Chakraborty,kolkatta, ISBN - 13:978-8185304366

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.ensoftindia.com	Construction softwares
2	www.newtonindia.com	Construction softwares
3	www.mahapwd.com	DSR ,Estimates

Name & Signature: **SEEMA V. KOLHE** Lecturer in Civil Engineering (Course Expert)	**Dr.R MAGHAV** Lecturer in Civil Engineering (Course Expert)
Name &Signature: **V.B.Kondawar** (Programme Head)	Name &Signature: **S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**IRRIGATION ENGINEERING**
COURSE CODE	**CE41205**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory Practical				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE41205	IRRIGATION ENGINEERING	DSC	3	--	2	1	6	3	3	30	70	100	40	25	10	--	--	25	10	150

Total IKS Hrs. for Term: 1 Hrs.

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

1. **FA-TH** represents an average of two class tests of 15 marks each conducted during the semester.
2. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
3. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Water is essential resource for all the 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 headworks, 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 used 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 utilization of supplied water at field.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1 - Evaluate the hydrological parameters of the given site.

CO2 - Compute the Canal capacity for the crop water requirement of the given command area.

CO3 - Compute Control levels in reservoir.

CO4 - Suggest the suitable type of dam for the given site condition.

CO5 - Execute the Minor and Micro Irrigation Schemes.
CO6 - Propose the type of Diversion Headwork in the irrigation scheme.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
SECTION – I				
Unit - I Introduction to Irrigation and Hydrology (CL Hrs-07, Marks-12)				
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 mean 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.	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 measurements: Empirical methods.	Video Demonstrations Lecture Using Chalk-Board Presentations Site/Industry Visit Collaborative learning	**CO1**
Unit - II Crop water requirement and Reservoir Planning (CL Hrs-08, Marks-12)				
2	**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.	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. **IKS:** Rahat water Irrigation system in India. 2.4 Methods of Irrigation: Surface, subsurface and overhead irrigation. levels of reservoir.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Collaborative learning	**CO2**
Unit - III Reservoir Planning (CL Hrs-06, Marks-11)				
3	**TLO3.1** Classify surveys for reservoir planning. **TLO 3.2** Suggest relevant measures	3.1 Different surveys for reservoir planning. 3.2 Silting of Reservoir: Rate of		**CO3**

	of silt control in a given type of dam with justification. **TLO 3.3** Compute the control levels for the given reservoir from the given data.	silting, factors affecting silting and control measures. 3.3 Control levels in reservoir. Numerical on fixing control.		
SECTION – II				
Unit - IV Dams and Spillways (CL Hrs-11, Marks-15)				
3	**TLO 4.1** Classify the dams based on given criteria. **TLO 4.2** Draw a labeled cross-sectional sketch of Earthen dam. **TLO 4.3** Propose the suitable control measure to reduce the seepage through the foundation and embankment of earthen dam. **TLO 4.4** Explain with the sketch the various forces acting on the gravity dam. **TLO 4.5** Propose the types of spillways for given type of dam with justification. **TLO 4.6** Propose the types of energy dissipaters for the given type of dam with justification.	4.1 Dam and its classification based on use, materials and hydraulic design. 4.2 Earthen Dams: Components with function, typical cross section. 4.3 Methods of construction of earthen dam, seepage through embankment and foundation and its control, Types of failure of earthen dam and its preventive measures. 4.4 Gravity Dams: Forces acting on dam, typical cross section, drainage gallery. 4.5 Spillways: Definition, function, Types. Emergency and service spillway - ogee spillway and discharge over spillway, Spillway gates. 4.6 Energy dissipation.	Video Demonstrations Lecture Using Chalk-Board Presentations Site/Industry Visit Collaborative learning	**CO4**
Unit - V Minor and Micro Irrigation (CL Hrs-05, Marks-10)				
5	**TLO 5.1** Explain the procedure for construction of given type of Bandhara. **TLO 5.2** Propose the suitable location for construction of percolation tank. **TLO 5.3** Design the typical layout of Lift Irrigation system in the given situation. **TLO 5.4** Design the typical layout of Drip and Sprinkler irrigation for the given condition. **TLO 5.5** Suggest the layout for the Well Irrigation scheme in the given site conditions. **TLO 5.6** Purpose of farmpond.	5.1 Bandhara irrigation: Introduction, Layout, Components, construction. 5.2 Percolation Tanks: Selection of site, need, construction. 5.3 Lift irrigation scheme: Components and their functions, layout. 5.4 Drip and Sprinkler Irrigation: components, layout, Suitability. 5.5 Well irrigation: Introduction, types, advantages and disadvantages. 5.6 Introduction to farm pond.	Lecture Using Chalk-Board Video Demonstrations Case Study Presentations Site/Industry Visit Collaborative Learning	**CO5**
Unit - VI Diversion Headwork and Canals (CL Hrs-08, Marks-10)				
6	**TLO 6.1** Classify the weirs based on given conditions. **TLO 6.2** Suggest the suitable site for barrage construction.	6.1 Weirs: Introduction, components, classification. K.T. weir: components and construction. 6.2 Barrages: Introduction, components and their	Lecture Using Chalk-Board Model Demonstration	**CO6**

	TLO 6.3 Draw a labeled sketch of the given type of diversion headwork. **TLO 6.4** Classify the canal on the basis of alignment and position in the given canal network. **TLO 6.5** Suggest the relevant type of construction material used for lining of given canal. **TLO 6.6** Propose the relevant type of Cross Drainage work in given site condition. **TLO 6.7** Propose the relevant types of regulators used for specific purpose in canal irrigation system. **TLO 6.8** Operation and maintenance of canal.	functions, location. 6.3 Diversion headwork: Layout, components and their function. 6.4 Canals: Definition, classification according to alignment and position in the canal network, cross section of canal in embankment and cutting, partial embankment and cutting. 6.5 Canal lining: Purpose, construction material used, advantages. 6.6 Cross Drainage works: Aqueduct, siphon aqueduct, super passage, level crossing. 6.7 Canal regulators: Head regulator, Cross regulator, escape, falls and outlets. 6.8Operational maintenance of canal structure.	Video Demonstrations Case Study Presentations Site/Industry Visit Collaborative Learning	

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles/Tutorial Titles	No. Of Hrs.	Relevant Cos
1	LLO1.1 Estimate average rainfall or Runoff from the given data.	*Estimation of average rainfall OR Runoff using relevant method.	02	CO1
2	LLO 2.1 Estimate the water requirement for the cropping season for given area.	*Estimation of crop water requirement for the given data and cropping season.	02	CO2
3	LLO 3.1 Estimate Canal capacity based on the given data.	Computation of Canal capacity from crop water Requirement.	04	CO2
4	LLO 4.1 Compute the control levels for the reservoir from given data.	*Computation of control levels for the reservoir.	02	CO3
5	LLO 5.1 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.	02	CO4
6	LLO 6.1 Prepare detailed technical report for the identified water resource project.	Site visit to any nearby water resource project (Dam/Canal/Weir/diversion headwork/any other irrigation project) and prepare detailed technical report.	04	CO4
7	LLO 7.1 Prepare detailed technical presentation on any one micro or minor irrigation scheme.	*Prepare detailed report on any one irrigation Scheme (Micro OR Minor) by site visit or observing relevant videos.	02	CO5
8	LLO 8.1 Prepare a detailed report	Collect information and prepare a detailed report	04	CO5

	on financial assistance of central/state government schemes for the Jalayukt shivar Yojana / Farm ponds / Drip Irrigation scheme.	on financial assistance of central/state government schemes for the Jalayukt shivar Yojana / Farm ponds / Drip Irrigation scheme.		
9	LLO 9.1 Draw a labeled sketch of existing Cross section of canal in filling OR cutting OR partial cutting and filling	*Sketch the existing Cross section of canal in filling OR in cutting OR in partial cutting and filling, nearby area by measuring actual dimensions.	02	CO6
10	LLO 10.1 Draw a labeled sketch of Cross Drainage works using actual measurements.	Sketch any one existing Cross Drainage works in nearby area by measuring the actual dimensions.	02	CO6
11	LLO 11.1 Visit to Lift Irrigation Scheme.	Arrange a Site Visit to study Lift Irrigation Scheme and prepare a report on it.	04	CO5
All are compulsory practical's to be performed.				

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Assignment

Student should maintain a separate full-size book to solve the assignment given by course teacher. Course teacher can assign following type of assignments to students. Assignments should be solved by individual students and corrective actions should be given by course teacher.

Microproject:

Student should prepare 10-15 pages microproject on any topic in a group of 4 students only. Course teacher can allot following topics to microproject group. Microproject report should be prepared with new information other than classroom teaching. The necessary guidance for the microproject work should be provided by course teacher.

1. Prepare a report of cropping pattern, for the given minor or major irrigation project in your area with reference to growth in yield.
2. 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.
3. Conduct online / internet survey for Watershed management project (s) in the Maharashtra State with a detailed report of at least five relevant technical inputs.
4. 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.
5. Prepare a report on any one 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.
6. Visit to the nearby rain gauge station and obtain information for the average rainfall for the particular day.
7. Best practices in Irrigation Engineering.
8. Automation in lift tank irrigation.

NOTE: "These are the optional activities for extra learning of students".

Assignment:

1. Compare Automatic & Nonautomatic rain gauges based on any four points.
2. Prepare details report of IMD rain gauge stations in your locality.
3. Visit to a drip irrigation installation in your area & write brief report.
4. Prepare a short report on well irrigation based on yield & season wise crops grown.
5. Prepare a model of dam by using locally available material.
6. Write the initiatives taken by state government for drip irrigation & sprinkler irrigation.
7. Write a short report on cooperative equal water distribution system in your area.
8. Measure evaporation of water in summer season by using available vessels

Note:

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, 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 microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with broad specifications	Relevant LLO
1	N.A	All

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Irrigation and Hydrology	CO1	07	04	04	04	12
2	II	Crop water requirement	CO2	08	02	04	06	12
3	III	Reservoir Planning	CO3	06	02	04	05	11
4	IV	Dams and Spillways	CO4	11	04	04	07	15
5	V	Minor and Micro Irrigation	CO5	05	02	04	04	10
6	VI	Diversion Headwork and Canals	CO6	08	02	04	04	10
Grand Total				45	**16**	**24**	**30**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered. For formative assessment of laboratory learning 50 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.	Pen and Paper Test (Written Test), Term Work.

X. 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	3	3	2
CO2	3	2	2	1	2	2	1	3	3	2
CO3	3	3	3	3	2	3	3	3	3	3
CO4	2	2	3	2	2	2	3	3	3	3
CO5	3	2	3	2	2	3	2	3	3	3

Legends: - High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. 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 – 110002. Edition2016 ISBN 13: 9788131807637
2	Sharma R.K. and Sharma T.K	Irrigation Engineering	S.Chand and Company Ltd.Delhi ISBN 13: 9788121921282 Ed.2002
3	Basak N.N.	Irrigation Engineering	McGraw Hill Education India Pvt. Ltd. New Delhi.Edition1999 ISBN 13: 9780074635384
4	Dahigaonkar J.G.	Irrigation Engineering	Asian Book Pvt. Ltd., New Delhi ISBN 13: 978818412008
5	S.K.Garg	Irrigation and Hydraulic structures	Khanna Publishers, Delhi. ISBN: 978-81-7409-047-9

XII. LEARNING WEBSITES & PORTALS

Sr. No.	Link/Software	Description
1	https://www.engineeringcivil.com/softwares.	Softwares used in Civil Engineering
2	https://www.nbmcw.com/tech-articles/concrete/3725-new-construction-materials-for-modern-projects.html	Building materials, new construction materials
3	https://geniebelt.com/blog/10-innovative-construction-materials	Innovative construction materials
4	https://www.viatechnik.com/blog/modern-construction-machines-theyre-used/	Modern construction machines
5	https://www.academia.edu/28172313/ADVANCED_BUILDING_CONSTRUCTION_EQUIPMENT	Advanced Building Construction Equipment
6	https://theconstructor.org/construction/sustainability-construction-civil-engineering/9492/	Sustainability in Construction
7	https://www.designingbuildings.co.uk/wiki/Advanced_construction_technology	Advanced Construction Technology
8	https://www.constructionjunkie.com/blog/2018/1/7/the-16-most-interesting-advances-in-construction-technology-of-2017	Emerging Trends in Civil Engineering
9	https://mysubs.in/buy/recent-trends-in-civil-engineering-and-technology-journal-subscription?gclid=Cj0KCQjw6IfoBRCiARIsAF6q06scZ5teDIexIYz_j85yy2ZH_v1kiQcytNvYf3AelfE3LcZndTbhrOwaAqv2EALw_wcB.	Recent Trends In Civil Engineering-And Technology
10	https://www.flatworldsolutions.com/engineering/articles/6-latest-trends-in-civil-engineering.php.	Latest Trends In Civil Engineering.

Name & Signature:

S.S. Mude
Lecturer in Civil Engineering
(Course Expert)

Mrs.S.R Panapalli
Lecturer in Civil Engineering
(Course Experts)

Name & Signature:

V.B. Kondawar
(Programme Head)

Name & Signature:

S.B. Kulkarni
(CDC In-charge)

GOVERNMENTPOLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**CAPSTONE PROJECT**
COURSE CODE	**CE41207**
PREREQUISITE COURSE CODE & TITLE	**ACQUIRED MINIMUM OF 60 CREDITS**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE41207	CAPSTONE PROJECT	INP	--	--	--	4	--	2	--	--	--	--	--	--	50	20	50#	20	--	100

Total IKS Hrs for Term: 2 Hrs

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing the minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that Course.
2. If a candidate does not secure the minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit the SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Project work at the institute level serves as a vital bridge between theoretical learning and practical application. It offers students a valuable platform to apply the concepts, knowledge, and technical skills acquired in classrooms and laboratories to address real-world problems—ranging from well-defined tasks to complex, open-ended challenges. This experiential learning approach fosters a deeper understanding of engineering and technological principles by encouraging students to design, develop, and implement solutions in realistic contexts.

The course is strategically designed to integrate interdisciplinary knowledge gained throughout the diploma program, thereby enhancing students' ability to approach problems holistically. Furthermore, it plays a crucial role in nurturing essential professional competencies such as critical thinking, problem-solving, creativity, teamwork, project planning, and innovation.

In alignment with industry and societal expectations, students are encouraged to undertake projects that go beyond conventional solutions and aim to provide impactful, sustainable outcomes. By engaging in such projects, students not only reinforce their technical capabilities but also improve their employability by developing a mindset geared towards innovation, collaboration, and continuous improvement.

III. INDUSTRY EXPECTED OUTCOME

This course is designed to enable students to develop the industry-relevant competency of:

Effectively executing innovative solutions to real-world problems through collaborative teamwork, adhering to defined timelines, and delivering a well-documented project report.

IV. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Identify real-world field problems relevant to the project work conducted at the institute.
CO2: Analyse the feasibility and viability of the project by conducting data collection and experiments, as well as evaluating required resources, costs, and support.
CO3: Apply technical knowledge and engineering skills to develop effective solutions for real-life or industrial problems.
CO4: Evaluate the proposed project work's ethical considerations and societal impacts.
CO5: Create a comprehensive project report and present the methodology and results within the institute.
CO6: Demonstrate the project outcomes, findings, and achievements effectively through presentations and exhibits.

V. GENERAL GUIDELINES FOR PROJECT WORK

a) Project Selection and Scope

- The project must align with the field of engineering or technology. Interdisciplinary projects are permitted if expected to deliver outcomes aligned with industry relevance or societal needs.

Indicative Project Focus Areas:

i) Construction Technology and Management.
ii) Green Building & Sustainability.
iii) Design and CAD/BIM Applications.
iv) Structural Engineering.
v) Transportation Engineering.
vi) Water Resources Engineering.
vii) Smart & Innovative Solutions in Civil Engineering.
viii) Renewable Energy Technologies
ix) Geotechnical Engineering
x) Environmental Engineering
xi) Interdisciplinary and Smart Systems
xii) Agricultural and Rural Engineering Solutions

- Students should select projects that match their skills, knowledge and interests. Faculty should support students in identifying suitable topics.
- Study-based (theoretical-only) projects are **not encouraged**. Projects should involve practical implementation.

i) Team Structure and Mentorship

- Each project must be executed by a group of 3–4 students under the guidance of an assigned faculty mentor.
- Faculty may organize teams based on:
    - Students' individual strengths and interests
    - Industry-relevant functional roles
    - Project requirements and scope
    - Balanced skill distribution among team members
    - Academic performance and specialization

ii) Nature and Type of Projects

Projects may involve:

- Hardware development
- Software development
- Combination of both

All projects must demonstrate logic building, problem-solving, and application of technologies learned during the diploma program.

Acceptable project formats include:

- Prototype design (design, build, test, and evaluate)
- Application/software development

iii) Project Execution and Documentation

- Students must develop a working model/prototype/software and simultaneously prepare a comprehensive project report.
- Submissions must include:
- One hard copy and one soft copy of the project report
- A soft copy of the source code or a demonstration video/file of the working model
- The project report should include (as applicable):
- Problem Definition
- Platform/Hardware Specifications
- Feasibility Study (Cost & Time Estimates)
- Design Diagrams (UML, Use Case, Activity, DFD, CFD, ERD, etc.)
- Key Code Snippets
- Testing Methodology and Results
- Limitations and Future Scope
- References (Books, Journals, Websites)

iv) Project Diary and Supervision

A project diary must be maintained by each group to log:

- Weekly progress and milestones
- Design decisions and challenges
- Faculty feedback and updates
- Faculty mentors should review the diary weekly and provide constructive feedback. The diary should be concise (5–10 pages) and follow the format outlined in Annexure IV.

v) Learning Outcomes Expected (As Applicable)

- Faculty should ensure students gain the following competencies through project execution:
- Identify and define real-world problems within their domain
- Investigate root causes and possible solutions
- Evaluate solution feasibility, including financial implications
- Gather and analyze data from reliable sources (e.g., books, web, experts, market)
- Develop required designs and execution plans
- Prepare and deliver effective seminar presentations.

vi) Industry-Sponsored Projects

- For industry-guided projects, implementation steps may vary per industry standards.
- However, students must still meet institutional submission criteria:
- Project report format
- Project diary
- Final demonstration
- Assessment based on institutional RUBRICs

b) National Relevance

Projects should ideally address national thrust areas such as:

- Environmental Sustainability
- Digitization
- Automation
- Renewable Energy
- Other relevant socio-technical development domains.

VI. COURSE IMPLEMENTATION STAGES

1. Orientation Session

A Project Orientation Session shall be conducted during the last week of the fourth term by the Portfolio In-charge faculty. This session will brief students on:

- Project objectives.
- Scope and expected deliverables
- Guidelines for execution and assessment
- Faculty and institutional support

2. Mapping of Students and Faculty Mentors

Students will be organized into teams and assigned faculty mentors based on the following criteria:

- Alignment of student interests
- Faculty expertise
- Team size and project scope

3. Problem Identification and Finalisation

Students are required to:

- Conduct a field survey or exploratory study under faculty supervision
- Identify a real-world, relevant, and feasible problem
- present the idea to a group of faculty members for approval
- This activity may begin in the 4th semester (concurrent with the seminar) and must be completed by the **first week of the 5th semester**

4. Requirement Gathering

A dedicated week is allotted for collecting detailed project requirements, including:

- Estimation of human resources
- Identification of technical (hardware/software) needs
- Feasibility study and cost analysis

Outcome: Students must present their findings to the faculty mentor for approval.

5. Project Planning

Students must prepare a comprehensive project plan covering:

- Task allocation and resource planning
- Timeframe and cost estimation
- Team member responsibilities
- Selection of an appropriate development model (e.g., Waterfall, Agile, Spiral)

Deliverables: A clear roadmap including timelines, milestones, and expected outcomes.

6. Project Proposal Submission

The finalized project proposal must be submitted in **soft copy format** and should include:

- Project title and objectives
- Detailed requirement analysis
- Project plan and execution strategy
- Expected deliverables and outcomes
- Development model and tools to be used

7. Project Development, Testing & Report Preparation

Under the continuous guidance of faculty mentors, students shall:

- Develop the project according to the approved plan
- Maintain project documentation throughout the development lifecycle

- Prepare a detailed final report that includes:
  - System design and architecture
  - Implementation details
  - Testing procedures and results
  - Challenges encountered and solutions adopted
  - Final outcomes and evaluation metrics

8. Project Demonstration

Students must present their project in two stages:

- **Preliminary Demonstration:** A progress review shown to the faculty guide during the development phase.
- **Final Demonstration:** A complete presentation of the working model or application during the End Semester Examination (ESE).

VII. DETAILED WEEKWISE TIMELINE FOR THE COURSE IMPLEMENTATION STAGES:

Week	Activity	Responsibilities
Week 1	**Orientation Session** (Last week of 4th Term)	Portfolio In-charge Faculty: Brief students on project objectives, scope, deliverables, guidelines, execution, and assessment.
Week 2	**Mapping of Students and Faculty Mentors**	Portfolio In-charge Faculty: Organize students into teams based on interests, faculty expertise, team size, and project scope.
Week 3-4	**Problem Identification and Finalisation**	Students: Carry out a field survey or exploratory study under faculty supervision, identify a relevant real-world problem, finalise the issue, and submit a synopsis for faculty approval.
Week 5	**Requirement Gathering**	Students: Collect detailed project requirements (human resources, technical needs, feasibility study, and cost analysis).
Week 6	**Requirements Gathering Presentation**	Students: Present findings to the faculty mentor for approval.
Week 7	**Project Planning**	Students: Prepare a project plan including task allocation, resource planning, timeline, budget, development model, and deliverables. Faculty Mentor: Review plan.
Week 8	**Project Proposal Submission**	Students: Submit final project proposal (title, objectives, requirements, plan, tools, outcomes). Faculty Mentor: Review and approve.
Week 9-12	**Project Development, Testing & Report Preparation**	Students: Begin project development according to the plan. Maintain documentation. Test and iterate. Prepare final report (design, implementation, testing results).
Week 13	**Preliminary Demonstration**	Students: Present a progress review to the faculty mentor.

Week	Activity	Responsibilities
Week 14	**Project Finalisation & Report Completion**	Students: Finalise development. Prepare a detailed project report with system design, testing results, challenges, and outcomes.
According to the Examination Schedule	**Final Demonstration (End Semester Examination)**	Students: Conduct final demonstration of the working model/application during the ESE. Faculty: Evaluate the project based on the demonstration and report.

VIII. CRITERIA FOR ASSESSMENT/EVALUATION OF PROJECT WORK

A. Formative Assessment (FA) Criteria

The evaluation of students during the fifth semester for Progressive Assessment (PA), totalling **50 marks**, will be carried out based on the following criteria:

Category	Week(s)	Assessment Criteria	Max Marks	Performance Description (Rubric Scale: 1 to 5)	Group Enrollment Nos.	Group Marks
i) Team Assessment (30 Marks)	Week 3-4	Project Selection & Problem Definition	5	2 – Lacks clarity and relevance 3 – Relevant and defined 4 - Clearly defined and suitable 5 – Innovative and impactful		
	Week 5	Literature Review & Data Collection	5	1 – Insufficient or irrelevant sources 2 – Limited data with unclear relevance 3 – Adequate review with relevant data 4 – Structured, relevant data 5 – Comprehensive and critically evaluated sources		

	Week 6	Project Design / Concept & Execution	10	1–2 Design is poorly structured; minimal or no execution 3–4 Weak concept, unclear goals, and limited execution 5–6 Basic concept with moderate execution; design may lack innovation or clarity 7–8 Solid, functional design with good planning and consistent execution 9–10 Creative, technically sound design with excellent planning and thorough execution		
	Week 7	Progress as per Action Plan / Milestones	5	1 – No measurable progress 2 – Progress is significantly behind schedule 3 – Moderate progress; some tasks completed 4 – Mostly on schedule with minor delays 5 – Fully on schedule and meeting milestones		
	Week 8	Quality & Presentation of Project Report	5	1 – Poorly organized and unclear 2 – Disorganized with formatting issues 3 – Fair structure and readability 4 – Well-organized and readable 5 – Professionally formatted and well-written report		

Category	Week(s)	Assessment Criteria	Max Marks	Performance Description (Rubric Scale: 1 to 5)	Individual Enrollment Nos.	Individual Marks
ii) Individual Assessment (20 Marks)	Week 2–13 (Ongoing)	Individual Contribution to the Team	10	1 -2 Rarely involved or shows minimal effort 3 -4 Occasionally contributes with limited involvement 4 –5 Participates adequately 6 – 7 Active and dependable team member 8 –10 Consistently proactive, often leads initiatives		
	Week 2–13 (Ongoing)	Subject Knowledge & Understanding	10	1–2 Very limited understanding of subject concepts; unable to answer questions 3–4 Basic awareness but with significant gaps in understanding 5–6 Fair knowledge of concepts; can answer general questions correctly 7–8 Good understanding of a subject; explains concepts clearly and applies them logically 9–10 Excellent grasp; demonstrates deep insight, applies concepts to real-world/project scenarios		
Total			**50**			

i) Total Formative Assessment (FA) Marks

Sr. No.	Assessment Criteria	Marks
1	Team Assessment	30
2	Individual Assessment	20
Total		**50**

Note: The Total **Formative Assessment (FA) Marks** for the individual student.

B. Summative Assessment Criteria

*The summative assessment for students in the Fifth Semester End-Semester Examination (ESE) will carry a total of **50 marks** and shall be conducted by the faculty. Appropriate rubrics may be developed by the faculty for evaluation.*

Course Name:		**Course Code:**	
Student Name:		**Enrollment Number:**	
Project Batch Number:		**Division :**	
Faculty Guide Name:		**Term :**	

Sr. No.	Week	Assessment Criteria	Max Marks	Performance Description (Score Range)	Marks
1	According to the Examination Schedule	**Knowledge and Skill Set Developed**	10	**1–2**: Minimal knowledge gained	
				3–4: Basic understanding with limited skills	
				5–6: Moderate knowledge and practical exposure	
				7–8: Sound knowledge and good skill application	
				9–10: Excellent grasp and skill mastery with advanced application	
2	According to the Examination Schedule	**Quality and Potential of the Project**	10	**1–2**: Poor quality, unclear purpose	
				3–4: Basic functionality with low impact	
				5–6: Adequate quality with moderate potential	
				7–8: High-quality, practical utility	
				9–10: Exceptional quality and strong potential for real-world implementation	

3	According to the Examination Schedule	**Creativity, Innovation, and Teamwork**	10	**1–2**: Lacks originality, poor collaboration	
				3–4: Limited creativity and uneven teamwork	
				5–6: Shows creativity and fair teamwork	
				7–8: Innovative and well-coordinated efforts	
				9–10: Highly original ideas with exemplary team synergy	
4	According to the Examination Schedule	**Project Design, Development, Execution**	10	**1–2**: Poor design and implementation	
				3–4: Basic structure with several gaps	
				5–6: Functional design and moderate execution	
				7–8: Well-planned and executed efficiently	
				9–10: Robust, optimized design with flawless execution	
5	According to the Examination Schedule	**Project Presentation**	10	**1–2**: Disorganized and unclear	
				3–4: Lacks confidence and structure	
				5–6: Acceptable delivery with room for improvement	
				7–8: Clear, engaging, and well-structured	
				9–10: Highly professional, confident, and impactful presentation	

Note: The above rubric will be used as the assessment framework for evaluating individual student performance.

IX. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1 -Basic and Discipline-Specific Knowledge	PO2- Problem analysis	PO 3- Design/ Development of Solutions	PO-4 Engineering Tools, Experimentation and Testing	PO-5 Engineering Practices for Society, Sustainability, and Environment	PO-6 Project Management	PO-7 Lifelong Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	--	--	2	2	2	2	2	--
CO2	2	3	2	2	--	3	2	2	3	2
CO3	3	3	3	3	2	2	2	3	3	3
CO4	--	--	--	--	3	2	2	--	--	--
CO5	2	2	2	2	--	3	2	2	2	2
CO6	2	2	2	2	2	3	3	2	2	2

X. TYPOGRAPHICAL GUIDELINES FOR PROJECT REPORT WRITING

After the completion of the project work, each student is required to submit a project report. The report should adhere to the following structure and formatting guidelines:

A. STRUCTURE OF THE REPORT

The project report must include the following sections in the given order:

1. **Cover Page** – As per *Annexure I.*
2. **Title Page** – As per *Annexure I.*
3. **Certificate** – As per *Annexure II.*
4. **Acknowledgment** – A brief section in which the student may express gratitude to individuals and organizations who supported the project. As per *Annexure III*.
5. **Abstract** – A one-page summary outlining the objective of the project and the methodology adopted. As per *Annexure IV*.
6. **Table of Contents** – Prepared as per general guidelines. As per *Annexure V.*
7. **List of Figures-**The **purpose of the List of Figures** in a project report is to provide a clear and organized index of all visual representations used throughout the document. As per *Annexure VI*
8. **List of Tables -**The **purpose of the List of Tables** in a project report is to provide a structured overview of all tabular data included in the document. As per *Annexure VI*
9. **Project Description** –
   - Divided into chapters or sections.
   - Each chapter should comprehensively describe a specific phase or component of the project.
   - Include properly labelled diagrams, tables, and flowcharts wherever applicable.
10. **Conclusion** – Summarizes findings and outcomes of the project work.
11. **References** –
    - Begin two spaces below the heading "**REFERENCES**", aligned to the left.
    - Use **single spacing** within entries and list in **alphabetical order**.
    - References must be cited in the text using **square brackets [ ]**, numbered according to their first appearance.
    - Include author name(s), publication year, and other relevant details.
    -

B. REPORT SPECIFICATIONS

1. **Binding**: Hard-bound only
2. **Cover Color**: Black with gold-embossed text (as per *Annexure 1*)
3. **Number of Copies**: Five – One per student and one departmental copy

Paper Size: A4 (portrait orientation)

4. **Margins**:
   - Top: 1 inch
   - Bottom: 1 inch
   - Right: 1 inch
   - Left: 1.5 inches
5. **Font Style**: Times New Roman
6. **Font Sizes**:
   - **Chapter Titles:** 16-point**, Bold, Uppercase**
   - **Headings:** 14-point, **Bold**
   - **Body Text:** 12-point, **Regular**
7. **Line Spacing**: 1.5 throughout the report
8. **Page Numbering**: Bottom center in the format "Page X of N"

Annexure-I

GOVERNMENT POLYTECHNIC, PUNE

(An Autonomous Institute of the Government of Maharashtra)

DEPARTMENT OF CIVIL ENGINEERING

PROJECT REPORT

ON

"[TITLE OF THE PROJECT IN CAPITAL LETTERS]"

Submitted By

Student name 1 (enrollment no.)
Student name 2 (enrollment no.)
Student name 3 (enrollment no.)
Student name 4 (enrollment no.)

UNDER THE GUIDANCE OF

[Guide's Full Name]
(Designation, e.g., Lecturer, Department of Civil Engineering)

Submitted in Partial Fulfilment

of

The Requirements for the Award of the Diploma in

CIVIL ENGINEERING

ACADEMIC YEAR: 20__–20_

GOVERNMENT POLYTECHNIC, PUNE, Ganeshkhind Road, Shivajinagar, Pune – 411016

Annexure-II

GOVERNMENT POLYTECHNIC, PUNE

(An Autonomous Institute of the Government of Maharashtra)

DEPARTMENT OF CIVIL ENGINEERING

CERTIFICATE

This is to certify that

1) Name of Student Enrollment Number
2) Name of Student Enrollment Number
3) Name of Student Enrollment Number
4) Name of Student Enrollment Number

has completed the necessary project work and prepared the bonafide report on

"PROJECT TITLE"

in a satisfactory manner as a partial fulfillment of the requirements for the

DIPLOMA IN

CIVIL ENGINEERING

FOR THE ACADEMIC YEAR

20__ - 20_

(Internal Guide) **(External Examiner)**

(H.O.D) **(Principal)**

Annexure-III

Acknowledgment

(Sample Format)

We would like to express our sincere gratitude to all those who supported and guided us throughout the successful completion of this project.

We are especially thankful to **[Guide's Name]**, our project guide, for their constant encouragement, valuable suggestions, and constructive feedback during the entire duration of this project work.

We would also like to thank **[Head of Department's Name]**, Head of the Department of **[Branch Name]**, Government Polytechnic, Pune, for providing us with the necessary infrastructure and support.

We are deeply grateful to **[Principal's Name]**, Principal, Government Polytechnic, Pune, for providing us with this valuable opportunity and for fostering an academic environment conducive to learning and innovation.

Our heartfelt thanks go to all the faculty members and technical staff of the **[Department Name]** for their help in various ways during this project.

We also wish to acknowledge the support of our classmates, friends, and family members who encouraged and motivated us throughout the journey.

Lastly, we are thankful to the **Government Polytechnic, Pune**, for allowing us to work on this project as a part of our academic curriculum.

Student name 1 (enrollment no.)
Student name 2 (enrollment no.)
Student name 3 (enrollment no.)
Student name 4 (enrollment no.)

Annexure-IV

Abstract

The abstract serves as a one-page comprehensive summary that encapsulates the core aspects of the project. It begins by clearly stating the primary objective or goal of the work, providing the reader with an understanding of the problem being addressed or the purpose behind the study. Following this, the abstract outlines the methodology employed, detailing the approach, techniques, tools, and processes used to achieve the project's objectives. This section may also briefly touch on the scope of the work, key findings, and any conclusions or implications derived from the results. The abstract offers a concise yet informative overview, enabling readers to quickly grasp the essence and significance of the project without delving into the full report.

Annexure-V

Table of Contents

Annexure-VI

List of Figures

List of Tables

Annexure-VII
PROJECT DAIRY

Course code :		**Course Name :**	
Student Name :		**Enrollment Number :**	
Project Batch Number:		**Division :**	
Faculty Guide Name:		**Term :**	

Date	Enrollment Numbers of Present Students	Work Assigned/Corrections Suggested	Faculty Remarks	Faculty Signature

Signature of Faculty **Signature of HOD**

Name & Signature: **Mrs.S.R. Panapalli** Lecturer in Civil Engineering	Name & Signature: **Shri. S.B. Kulkarni** Lecturer in Mechanical Engineering (Course Expert)	Name & Signature: **Dr. N. G. Kulkarni** HoD in Mechanical Engineering
Name & Signature: **Shri.V B Kondawar** (Programme Head)		Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**Diploma in Civil Engineering**
PROGRAMME CODE	**01**
COURSE TITLE	**Contracts and Accounts**
COURSE CODE	**CE51208**
PREREQUISITE COURSE CODE & TITLE	**-----**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51208	CONTRACTS AND ACCOUNTS	DSC	2	00	02	02	6	3	3	30	70	100	40	25	10	0	0	25	10	150

Total IKS Hrs for Term: 02 Hrs

Abbreviations: CL-Classroom 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,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that semester.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.*Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Contracts and accounts plays important role in the execution of construction projects as they establish legally binding agreements and provide a detailed record of financial transactions between owner and contractor. Contracts ensure clarity, enforceability, and risk management, while accounts track expenses, revenue, and performance, enabling informed decision-making and financial transparency.

III. COURSE LEVEL LEARNING OUT COMES(CO'S).

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning.

CO1 - Implement the Public Works Department procedure for execution of the works.

CO2 - Prepare the contract document for given civil engineering works.

CO3 - Prepare the tender documents for the given civil engineering work.

CO4 - Use the prescribed formats to pay the bill of the executed work.

CO5- Prepare valuation report of the existing/ new buildings.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT- I Fundamentals of Executiont of PWD works (CL Hrs- 04, Marks-10)				
1.	TLO1.1Daw the flowchart representing organization structure of PWD. TLO1.2.Explain the roles and responsibilities of engineering personnel in the PWD. TLO 1.3 . Explain the PWD procedure followed for the construction of the given work. TLO 1.4 Justify the relevant method of contracting for the given type of work adopted in PWD.	1.1 Organization structure of Public Works Department (PWD). 1.2 Roles and responsibilities of engineering 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.	Video Simulation Chalk-Board Improved Lecture Presentations	CO1
UNIT- II Contracts:Types and Clauses (CL Hrs -07 , Marks-16)				
2	TLO 2.1 Explain the requirements of valid contract in the given situation. TLO 2.2 Justify the necessity of provisions made regarding breach of contract in given contract. TLO 2.3. Classify the construction Contracts based on the given criteria. TLO 2.4 Explain the significance of FIDIC contract along with its provisions. TLO 2.5 Illustrate the Registration process of contractor in the given class in PublicWorksDepartment (PWD). TLO 2.6 Justify the importance of Built operate transfer (BOT) contract in the given situation.	2.1 Definition of contract, objects of contract, requirements of valid contract. 2.2 Indian Contract Act 1872 2.3 Objectives of the act, Clauses related to contract formation,contract performance, breach of contract, importance of workman's compensation act on construction projects only. 2.4 Types of engineering contract with advantages, disadvantages and their suitability- Lump sum contract, item rate contract, percentage rate contract, labour contract, demolition contract, target contract, negotiated contract, All in contract, Engineering Procurement Construction Contract (EPC),(IKS*-Informal Agreements and Oral Contracts) 2.5 Classification of contractor on basis of financial limits, Requirement of documents for registration of contractor in Public Works Department (PWD). 2.6 Built Operate Transfer (BOT) Contract: Objectives, scope,	Video Demonstrations, Presentations, Chalk-Board, Improved Lecture Presentations	CO2

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		advantages, Disadvantages, Provisions, conditions, etc. with relevant examples.		
UNIT- III Tender and Tender Documents (CL Hrs- 10, Marks-22)				
3	TLO 3.1 Justify the need of the tender document for the given situation. TLO 3.2 Explain the given relevant terms related to tendering procedure. TLO 3.3 Draft the Notice Inviting Tender (NIT) for the given type of work. TLO 3.4 Reproduce the prescribed relevant format/s used in tender document. TLO 3.5 Use the relevant condition of contract in the given situation. TLO 3.6 Explain the process of Two envelope system for submitting tender document. TLO3.7 Justify the necessity of implementing E-Tendering system for the given type of work. TLO3.8 Explain the significance of the arbitration clause/s used in the given contract in resolving the disputes raised during execution of work.	3.1Tender - Definition, necessity,Types -local, Global, open, Limited and negotiated tender 3.2 Terms used in tender documents: - Earnest Money Deposit (EMD), Security deposit (SD), Additional Performance Security Deposit, Validity period, right to reject one or all tenders, corrigendum to tender notice and its necessity. 3.3 Notice Inviting Tender (NIT) - Points to be included while drafting tender notice. 3.4 Tender documents – Index, tender notice, general instructions, special instructions, ScheduleA, Schedule B, Schedule C. 3.5 Conditions of tender documents – contract conditions- time limit, time extension, penalty, defective material and workmanship, termination of contract, suspension ofwork, subletting of contract, extra items, price variation clause(escalation), defect liability Period, liquidated and un-liquidated Damages 3.6 Procedure of submitting filled tender Document (Two envelope system) by offline method, procedure of opening tender, comparative statement, scrutiny of tenders, award of contract, acceptance letter and work order.	Video Demonstrations Presentations Chalk-Board Improved Lecture Presentations	CO3

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		3.7 Tendering System Online procedure of Submission of Tender in PWD, Online procedure of opening of Tender in PWD. 3.8 Arbitration- Meaning Qualification of an arbitrator, appointment, Causes and Settlement of disputes, Powers and duties of Arbitrator, Award of result. Important features of Arbitration and Conciliation Act		
UNIT – IV PWD Accounts and Procedure (CL Hrs-05, Marks-12)				
4	TLO 4.1 Record the measurements of relevant work/s in the measurement book for payment. TLO 4.2 Explain the relevant terms associated with advances and payment of the given civil work. TLO 4.3 Billing procedure used for the given type of work with reference to issue of materials etc. from the department/ owner.	4.1Various account forms and their uses – Measurement Books, E-Measurement book(E-MB), Completed Measurements, Nominal Muster Roll(NMR)- Issue and write of muster roll, Imprest Cash, Indent, Invoice, Bills,Vouchers,Handreceipt, Cash-bBook,Temporary Advance. 4.2 Mode of Payment to the contractor and its necessity - Interim Payment, Advance Payment, Secured Advance, Petty advance,Mobilization advance, First And Final bill, Final bill, Running account bill, retention money, Reduce rate payment.(IKS*- Remuneration system : Builders and artisans were often paid in grain, land, royal patronage, or other goods rather than cash) 4.3 PWD Stores procedure.	Video Demonstrations, Presentations, Chalk-Board, Improved Lecture Presentations	CO4
UNIT – V Valuation (CL Hrs-04, Marks-10)				
	TLO5.1 Explain the purpose of valuation of given structure.	5.1 Definition, Purpose of valuation, Define- cost, Price and Value,	Video Demonstrations, Presentations,	CO5

Sr. No.	Theory Learning Outcomes(TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	TLO5.2 Classify the value of the given structure based on given criteria. TLO5.3 Calculate the depreciation of the given structure using relevant method for the given data. TLO5.4 Classify the give term 'outgoings' in the given situation. TLO5.5 Calculate monthly rent of the given building from the given data as per PWD procedure.	Factors affecting value. 5.2 Types of value- Book Value, Scrap Value, Salvage Value, Speculative Value, Distress value, Market Value, Sentimental Value, Factors affecting value. 5.3Depreciation, Obsolescence, Sinking fund, Methods of calculation of depreciation – Straight Line Method, Sinking Fund Method, Constant Percentage Method. 5.4 Computation of Capitalized value, Gross Income, Outgoing, Net Income, Year Purchase, Types of Outgoings. 5.5 Fixation of rent as per PWD practice.	Chalk-Board, Improved Lecture Presentations	

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/ Tutorial/ Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Organize of various activities required for initiating the works	*Develop the format for sequential activities involved in initiation of the given type of work	2	CO1
2	LLO2.1Evaluate the elements of given contract	*Prepare a detailed report on evaluation of elements of given contract of the project.	2	CO2
3	LLO 3.1 Identify the BOT projects to write a review on it.	Write a critical review on any one BOT project in your locality with your suggestions / recommendations.	2	CO2
4	LLO 4.1 Examine any five tender notices from the known source to offer your comments.	*Collect tender notice and write report.	2	CO3
5	LLO 5.1 Draft minimum two NIT for the given type of construction work.	*Prepare a NIT from the given data for the Construction of given structure.	2	CO3
6	LLO 6.1 Draft minimum two NIT for a work through E-tendering.	Prepare a NIT from the given data for the Construction of given structure through E - tendering	2	CO3
7	LLO7.1Analyze of given tender documents.	*Interpret the given elements of tender document with justification.	2	CO3

Sr. No	Practical/ Tutorial/ Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
8	LLO 8.1 Identify the documents required for E- tendering.	Prepare list of documents that are required to submit the tender through E- tendering.	2	CO3
9	LLO 9.1 Identifying the documents required for preparing tender document for the given civil engineering structure in a group of five students on the basis of provided/collected detailed estimate with respect	*Prepare Tender document for the construction of a structure prepared in Estimating and Costing.	2	CO3
10	LLO 10.1 Prepare Tender document for the given civil engineering structure in a group of five students on the basis of detailed estimate provided/collected by teacher/student. Generally prepared Brief tender n	*Prepare Tender document for the construction of a structure prepared in Estimating and Costing.	2	CO3
11	LLO 11.1 Prepare Tender document for the given civil engineering structure in a group of five students on the basis of detailed estimate provided/collected by teacher / student. Generally prepared Brief tender .	*Prepare Tender document for the construction of a structure prepared in Estimating and Costing.	2	CO3
12	LLO 13.1 Record the measurements in the prescribed format of measurement book for minimum five items of works with abstract, completion certificate and prepare final bill for payment with relevant form of bill	*Prepare final bill of works.	2	CO4
13	LLO 14.1 Prepare E- tender document for the given civil engineering structure in A group of five students on the basis of detailed estimate provided / collected / by teacher / students.	*Prepare E- tender for the proposed construction of a building.	2	CO4
14	Determine the value of a given structure and submit the valuation report in prescribed format	Prepare the valuation report of a given building .	2	CO5
15	Determine monthly rent of the given building as per PWD method	Prepare report of the monthly rent of a building/ quarter as per PWD method	2	CO5

Note : Out of above suggestive LLOs -

1. '*' Marked Practicals (LLOs) are mandatory.
2. Minimum 80% of above list of lab experiment are to be performed.
3. Judicial mix of LLOs is to be performed to achieve desired outcomes.

VI. SUGGESTED MICROPROJECT /ASSIGNMENT /ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT(SELF-LEARNING)

Assignment

- Prepare detailed specification for any two item for following structure – Transportation Structure/Public Health structures/Irrigation structures.
- Prepare power point presentation on given topic

- Collect various account forms used in any one of following organization and write report on it like
- Preparing report on procedure of registration as a contractor in different organizations.
- Prepare power point presentation on Procedure of "E-Tendering".

Microproject

- Prepare a report on provisions made in arbitration conciliation act1996.
- Visit to on going project and study various aspects related to accounting process (MB, RAbill, various advances) .
- Visit to ongoing project and study various aspects related to contracts and tender document.
- Prepare a report on significance and applicability of GST in construction contracts.
- Write salient features of contract clauses included in Indian Contract Act 1872.
- Prepare a report on software used in tender related activities.
- Draft detailed specification for minimum one items for following structures – Transportation Structures, Irrigation Structures and Public Health Structures.
- Compare the tender documents of similar work of three different organizations.

VII. LABORATORY EQUIPMENT /INSTRUMENTS /TOOLS /SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with Internet Connection	1,3,4,6,8,9,10,11

VIII. SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS & ASSESSMENT PURPOSE

(Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of Execution of PWD works	CO1	04	04	04	02	10
2	II	Contracts:Types and Clauses.	CO2	07	04	06	06	16
3	III	Tender and Tender Documents	CO3	10	06	06	10	22
5	IV	PWD Accounts and Procedure	CO4	05	04	04	04	12
6	V	Valuation	CO5	04	02	04	04	10
Grand Total				**30**	**20**	**24**	**26**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two unit tests of 30 marks and an average of two unit tests.	End semester assessment of 70 marks theory examination

X. 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	2	3	2	1	2	1	1	1
CO2	2	2	3	1	2	1	2	1	2	3
CO3	2	2	2	2	2	2	2	1	2	3
CO4	1	2	2	2	1	1	1	1	1	2
CO5	2	2	2	1	2	2	2	1	1	1

Legends:-High:03,**Medium:**02,**Low:**01,**NoMapping:**-
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No.	Author	Title	Publisher with ISBN Number
1	Datta B.N.	Estimating and Costing in Civil engineering	UBS Publishers Pvt. Ltd. New Delhi. ISBN:9788174767295
2	Raina V.K.	Construction Management and Contract Practices	Shroff Publishers & Distributers Pvt. Ltd. New Delhi ISBN: 9788184047875,
3	Rangawala S.C.	Estimating and Costing	Charotar Publishing House PVT. LTD.,Anand (Gujrat) Reprint -2011
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.

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1	www.mahapwd.com	PWD official website.
2	https://mahatenders.gov.in	PWD official website realted to tender.
3	https://eprocure.gov.in/eprocure/app	e-tendering for construction and other government procurement processes.
4	https://nhai.gov.in/#/tenders	NHAI posts construction and maintenance tenders related to national highways and expressways
5	https://nhai.gov.in/nhai/sites/default/files/mix_file/BOT-Projects-FY.pdf	This portal by the Indian government provides detailed information on BOT projects, across

		various sectors like roads, railways, airports, and urban infrastructure.
6	https://www.irc.nic.in/Tenderarchive.aspx	The Indian Roads Congress (IRC) publishes archive tenders with start and end date.
7	https://cpwd.gov.in/cpwde_tender.aspx	Details about E-Tenders
8	https://www.youtube.com/watch?v=-wxYHWCe1Ok	E -TenderingTraining
9	https://www.youtube.com/watch?v=G3M1ffidoao	E-Tender filling process

Name & Signature: **Dr.R. M. Aghav** Lecturer in Civil Engineering (Course Experts)	**S.V.Kolhe** Lecturer in Civil Engineering (Course Experts)
Name & Signature: **V.B. Kondawar** (Programme Head)	Name & Signature: **S.B.Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**Maintenance and Repair of Structures**
COURSE CODE	**AM51201**
PREREQUISITE COURSE CODE & TITLE	**NA**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
AM51201	**Maintenance and Repairs of Structures**	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	00	00	25	10	150

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Civil engineering structures like buildings, bridges, and roads are exposed to weather, loads, and environmental effects over time. These factors cause damage such as cracks, leaks, rusting of steel, and surface wear. If not repaired on time, these issues can become serious and reduce the life and safety of the structure.

This subject helps students understand why structures get damaged and how to inspect, maintain, and repair them properly. Students learn about different repair materials, modern techniques, and tools used to fix concrete and masonry structures. They also learn how to plan maintenance and carry out repairs to keep structures safe and in good condition.

By learning this subject, diploma students become capable of handling repair works on-site, conducting structural audits, and preventing future damage — skills that are very useful in government, private construction, and maintenance jobs.

III. INDUSTRY EXPECTED OUTCOME

To help the student to attain the following industry identified competency through various teaching learning experiences: ' Maintain different types of building structures.

COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: State the importance of maintenance, types of maintenance activities, and the factors affecting maintenance planning for civil structures.
CO2: Identify causes of structural deterioration and suggest appropriate techniques for inspection and diagnosis including non-destructive testing methods.
CO3: Select suitable materials like polymers, epoxy, bonding agents, and grouts for repairing and strengthening different structures.
CO4: Identify common defects in masonry structures and recommend suitable maintenance and repair techniques for masonry works.
CO5: Diagnose common defects in RCC structures and propose appropriate repair and strengthening techniques ensuring durability.
CO6: Prepare the structural audit and budget for the maintenance of structures.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

SECTION I

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT I- INTRODUCTION TO MAINTENANCE AND REPAIRS (CL Hrs-3, Marks-5)				
1.	TLO 1.1: Explain the necessity of maintenance and repairs of civil structures. TLO 1.2: Identify and justify the factors influencing the maintenance of a given structure. TLO 1.3: Explain the concepts of retrofitting, re-strengthening, rehabilitation, and restoration. TLO 1.4: Describe periodical maintenance, maintenance manuals, monsoon maintenance, and maintenance history sheets.	1.1 Maintenance and its classifications; repair, retrofitting, re-strengthening, rehabilitation, and restoration. 1.2 Necessity, objectives, and importance of maintenance and repairs. 1.3 Factors influencing maintenance and repairs. 1.4 Advantages and limitations of maintenance and repairs. 1.5 Periodical maintenance; maintenance manual containing - building plan, reinforcement details, material sources, maintenance frequency and pre- and post-monsoon maintenance procedures.	Chalk-Board Demonstration Presentations	**CO1**

UNIT-II CAUSES AND DETECTION OF DAMAGES (CL Hrs-8, Marks-12)				
2	TLO 2.1: Explain the causes of damages occurring in given structures. TLO 2.2: Describe the systematic approach for damage detection. TLO 2.3: Perform appropriate tests on damaged structural elements. TLO 2.4: Explain the procedures of non-destructive tests used to detect damages.	2.1 Causes of damages due to distress, earthquake, wind, flood, dampness, corrosion, fire, and dilapidation. 2.2 Systematic approach for damage detection; various tests and visual observations for detection of damages. 2.3 Introduction to Tests on damaged structures: Rebound Hammer Test, Ultrasonic Pulse Velocity Test, Rebar Locator, Cover Gauge, Crack Detection Microscope, Chloride Test, Sulphate Attack Test, pH Measurement, and Half-Cell Potential Meter.	Chalk-Board Demonstration Presentations	**CO2**
Unit- III MATERIALS FOR MAINTENANCE AND REPAIRS (CL Hrs-12, Marks-18)				
3	TLO 3.1: Explain suitable materials used for anti-corrosion coatings, adhesives, and mortar repairs. TLO 3.2: Explain appropriate materials for waterproofing and joint sealants used in structural repairs. TLO 3.3: Explain relevant materials for surface coatings and grouts used in repairing structures. TLO 3.4: Select appropriate materials for repairing specific types of damages with justification. TLO 3.5: Choose additional repairing materials for damaged structures with justification.	3.1 Factors influencing material selection for maintenance and repairs. 3.2 Anti-corrosion coating materials: cement slurry mortar, polymer-modified cement slurry, and epoxy zinc coatings. 3.3 Adhesive materials: • Solvent-free adhesives: epoxy adhesive, polyester adhesive, acrylic adhesive. • Water-borne adhesives: polyvinyl acetate and vinyl acetate co-polymer. 3.4 Mortar repair materials: cementitious mortar, polymer-modified cementitious mortar and resin mortar. 3.5 Joint sealant materials: oleo-resinous mastics, bitumen/rubber-based sealants, and acrylic resin sealants. 3.6 Grout materials: cement grout, cement-sand grout, cement-sand grout with additives, polymer-modified cement grout, and normal epoxy grouts. 3.7 Waterproofing materials for roofs: polyisobutylene (PIB) sheets, glass fiber reinforced plastics, bitumen, bituminous emulsions, and latex cement coatings. 3.8 Surface coating materials for concrete protection: bituminous cutbacks, chlorinated rubber coatings, vinyl coatings, epoxy coatings, and coal tar epoxy. 3.9 Additional repairing materials: polyester putty, 1:3 cement-sand mortar, and galvanized steel wire fabrics and clamping rods.	Chalk-Board Demonstration Presentations	**CO3**

SECTION II

UNIT-IV REPAIRS OF MASONRY STRUCTURES (CL Hrs-8, Marks-14)				
4	TLO 4.1: Explain various causes of wall cracks and their probable locations. TLO 4.2: Explain the repairing methods for different types of cracks in civil structures. TLO 4.3: Select relevant repair techniques for damages in given civil structures with proper justification. TLO 4.4: Explain the effects of dampness in walls and the related repair techniques. TLO 4.5: Explain the effects of dampness in walls and the related repair techniques.	4.1 Causes of wall cracks due to bulging of wall, shrinkage, poor bonding, shear and tension forces, differential settlement of foundations, thermal movements, and vegetation growth. 4.2 Probable crack locations such as: junction of main and cross walls, junction of RCC columns and walls, junction of slab and wall, and cracks in masonry joints. 4.3 Stages of repair: material removal and surface preparation, fixing suitable formwork, applying bonding/passivating coat, and repair applications. 4.4 Repair techniques: grouting, patching, spalling replacement or delamination, and epoxy-bonded mortar application. 4.5 Repair methods for minor and medium cracks: epoxy injection, grooving and sealing, shotcreting, stitching, grouting, and guniting. 4.6 Repair methods for major cracks (width more than 5 mm): fixing mesh across cracks, inserting dowel bars, providing RCC bands, installing ferrocement plates at corners, and propping. 4.7 Effects of dampness in walls and dampness repair techniques: replacement or insertion of damp-proof course (DPC) in brick walls, bituminous painting, waterproof painting solutions, and cement coatings with adhesive gums.	Chalk-Board Demonstration Presentations	**CO4**
UNIT-IV REPAIRS OF RCC STRUCTURES (CL Hrs-11, Marks-16)				
5	TLO 5.1: Explain the probable crack locations in RCC elements and the causes of RCC failures. TLO 5.2: Explain the causes of dampness in roof slabs and the various repair techniques. TLO 5.3: Explain the repair methods for cracks in RCC structures. TLO 5.4: Describe the repair methods for corroded RCC elements. TLO 5.5: Explain the repair methods for honeycombs and larger voids in RCC structures.	5.1 Probable locations of cracks in RCC elements and various causes of RCC failures. 5.2 Causes of dampness in roof slabs and their repair techniques such as mud phuska with brick tile topping, lime concrete terracing, ferrocement topping, and brick coba. 5.3 Repair methods for cracks in RCC structures: epoxy injection, grooving and sealing, stitching, rebaring, grouting, spalling replacement, jacketing, shotcreting, and guniting. 5.4 Repair of corroded RCC elements: exposing and undercutting rebars, cleaning reinforcing steel, compensating reinforcement, and applying protective coatings. 5.5 Repair methods for honeycombs and larger voids in concrete structures.	Chalk-Board Demonstration Presentations	**CO5**

UNIT –VI STRUCTURAL AUDIT AND BUDGET (CL Hrs-3, Marks-5)				
	TLO 6.1: Explain the necessity and importance of structural audit & budget estimation TLO 6.2: Explain the procedure involved in structural audit and budget. TLO 6.3: Know the formats preparation for the process in structural audit & budget estimation. TLO 6.4: Introduction to rules & regulations of structural audit and budget estimation as recommended by competent authority.	6.1 Necessity and importance of structural audit and budget estimation. 6.2 Steps involved in structural audit and budget estimation. 6.3 Preparation of format for structural audit, including general information of the building, building data, complaints reported by users, and inspection of internal and external areas of the building. 6.4 Overview of rules and regulations related to structural audit and budget estimation as recommended by competent authorities such as the Public Works Department (PWD). (Not to be asked in theory Exam)	Chalk-Board Demonstration Presentations	

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES (Any TEN Practicals only)

Sr. No	Practical/Tutorial/ Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles (Any 8)	Number of hrs.	Relevant COs
1	LLO 1.6	Prepare a sample Periodic maintenance table for a building during Pre-Monsoon & Post-Monsoon.	2	CO1
2	LLO 2.1	Prepare the list of causes of building damages for any building component.	2	CO2
3	LLO 3.2, 3.3, 3.4	Prepare the check list for materials required for repair	2	CO3
4	LLO 4.1, 4.2	Checklist for building repairs for any building component.	2	CO4
5	LLO 2.3	Study of reinforcement corrosion test using Half Cell Potentiometer	2	CO2
6	LLO 5.1	To determine compressive strength of extracted Core	2	CO5
7	LLO 4.1, 4.2, 2.3	Prepare a checklist of material requirements and checklist for repair of wall cracks	2	CO4
8	LLO 3.4	Prepare a checklist for repair and material requirement for flooring repairs.	2	CO3
9	LLO (Extra)	Prepare a checklist for materials and resources required for the repair of sanitary units of a building.	2	CO3

10	LLO 6.3	Prepare a budget estimation considering materials, task force, equipment, and methodology for the given damaged structure.	2	CO6
11	LLO 3.2, 3.3	Prepare a list of Anti-corrosion coating materials & Adhesive materials used in Modern day repairs with their availability & market price	2	CO3
	Any 02 tests to be performed from *marked practicals given below			
12*	LLO 2.3	Determine the compressive strength of any two structural elements (column, beam, slab, etc.) for damaged or undamaged structures using Rebound Hammer.	2*	CO2
13*	LLO 2.3	Study of Efflorescence test on bricks	2*	CO2
14*	LLO 2.3	Study of Ultrasonic Pulse Velocity Test	2*	CO2
15*	LLO 2.3	Study of Rebar Locator	2*	CO2
16*	LLO 2.3	Study of Rapid Chloride Test	2*	CO2
17*	LLO 2.3	Study of Carbonation Test	2*	CO2
18*	LLO 2.3	Study of moisture contest test	2*	CO2

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Only one micro-project is planned to be undertaken by a student individually (or in a group of 3) that needs to be assigned beginning of the semester.

SUGGESTED SELF-LEARNING - MICRO **PROJECT/ASSIGNMENT/ACTIVITIES:**

"Condition Survey and Minor Repair Plan for a Residential Building"

Objective of Microproject:
To conduct a basic condition survey of a small residential structure.
To identify visible damages (like cracks, dampness, spalling, etc.).
To prepare a simple damage assessment report.
To suggest minor repair techniques and materials for restoration.

Scope of Microproject:
Students will:
Inspect any nearby residential building (own house, neighbor's house, or institute premises).
Identify and record types of damages (e.g., cracks, corrosion, damp patches).
Classify damages: Minor / Major.
Suggest appropriate repair materials and techniques.
Prepare a simple maintenance schedule.

Steps involved:
Selection of Building: Choose a small building (G+1 or G+2 structure).

Inspection and Observation: Carry out visual inspection and note:
Location and nature of cracks.

Signs of dampness, corrosion, efflorescence.
Distress in structural/non-structural elements.

Documentation:
Prepare sketches and photographs.
Mark areas of damage.
Damage Analysis: Identify probable causes.

Repair Suggestion:
Suggest appropriate repair methods (grouting, sealing, patch repair, etc.).
List recommended materials.

Maintenance Planning:
Suggest periodic maintenance activities.

Reporting:
Compile all findings into a short report (8–10 pages).

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Ultrasonic Pulse Velocity Test, Rebar Locator, Cover Gauge, Crack Detection Microscope, Chloride Test, Sulphate Attack Test, pH Measurement, and Half-Cell Potential Meter.	LLO 2.3

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Unit	Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to maintenance and Repairs	03	02	03	00	05
II	Causes and detection of damages	08	04	04	04	12
III	Materials for maintenance and repairs	12	04	10	04	18
IV	Repairs for Masonry Structures	08	04	06	04	14
V	Repairs for RCC framed Structures	11	04	08	04	16
VI	Structural audit and budget	03	02	03	00	05
	Total	45	20	34	16	70

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning, test exam 30 marks.	Final exam70mks

X. 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
CO1	2	2	2	3	2	2	2	1	2
CO2	2	2	2	3	2	2	2	1	2
CO3	2	2	2	3	2	2	2	1	2
CO4	2	2	2	3	2	1	2	1	2
CO5	2	2	2	3	2	1	2	1	2
CO6	2	2	2	3	2	1	2	1	2

Legends: - High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	B. L. Gupta, Amit Gupta	Maintenance and Repair of Civil Structures	Standard Publishers
2	Central Public Works Department (CPWD)	CPWD Handbook on Maintenance of Buildings	Government of India
3	P. S. Gahlot, Sanjay Sharma	Building Repair and Maintenance Management	CBS Publishers & Distributors Pvt. Ltd., New Delhi ISBN: 81-239-1243-9
4	B. S. Nayak	Maintenance Engineering for Civil Engineers	Khanna Publishers, New Delhi ISBN: 978-81-7409-051-7
5	P. K. Guha	Maintenance and Repairs of Buildings	New Central Book Agency, New Delhi ISBN-10: 8173810737 ISBN-13: 9788173810732
6	B. D. Hutchinson	Maintenance and Repairs of Buildings	Newnes-Butterworth, London (UK) ISBN: 0408001917
7	R. K. Bansal	Structural Audit of Buildings	Laxmi Publications

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal
1	https://www.youtube.com/watch?v—7ypSU6ZDJlwhttps://www.youtube.com/watch?v =zX8HNbHmT0M
2	https://www.youtube.com/watch?v=zZsstKuF14s
3	https://www.youtube.conl/watch?v=zXglx8BXR-Y
4	https://www.youtube.com/watch?v-EmmzpQd510E
5	https://www.youtube.com/watch?v=ANORiqAJ7kc
6	https://www.youtube.com/watch?v=zp4f ReeSOO
7	https://www.youtube.com/watch?v—wPBqOyVLEa8
8	https://www.youtube.com/watch?v=lqwt0HpWgbU
9	https://www.forconstructionpros.com/concrete/repair-rehab
10	https://www.youtube.com/c/TheConstructorOrg

Name & Signature:

Shi. S. V. Khadake
Lecturer in Applied Mechanics

Shi. K. P. Bagade
Lecturer in Applied Mechanics

(Course Experts)

Name & Signature:

V.B. Kondawar
(Programme Head)

Name & Signature:

Shri. S.B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**SOLID WASTE MANAGEMENT (ELECTIVE -I)**
COURSE CODE	**CE51203**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code)	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory Practical				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51203	SOLID WASTE MANAGEMENT	DSE	3	--	2	1	6	3	3	30	70	100	40	25	10	--	--	25	10	150

Total IKS Hrs. for Term: 1 Hrs.

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

1. **FA-TH** represents an average of two class tests of 15 marks each conducted during the semester.
2. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
3. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Industrialization and Urbanization is increasing day by day. As a result of this the generation of solid waste is a major problem all over the country within the urban as well as rural area. In view of this the management of solid waste produced is of prime need to keep the environment safe and clean.

Information on classification and characteristics of solid waste will enable to decide appropriate decision about the collection and transportation of waste produced. Various disposal methods of solid waste will enable to recommend suitable method of disposal of solid waste with economy and acceptable environmental constraints including reuse and recycle wherever applicable.

Content on other types of solid waste such as bio-medical waste, Construction waste, E-waste and plastic waste will be useful in deciding appropriate method for collection, transportation and disposal of these wastes.

Thus, the knowledge of solid waste management with the concept like recycling, recovering and reuse will lead to proper disposal with acceptability. This will further lead to keeping the natural resources contamination free.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1 - Identify the different sources of solid wastes.

CO2 - Understand different methods of collection, transportation and disposal of solid waste.

CO3 - Apply different method of disposal of solid waste for safe disposal.

CO4 - Understand concept of Bio medical waste, E-waste and Industrial waste.

CO5 - Understand recycling and reuse of solid waste.

CO6- Implement the relevant laws related to solid waste management.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant Cos
SECTION – I				
Unit – I Fundamental of Solid Waste Management (CL Hrs-06, Marks-08)				
1.	**TLO 1.1** Define solid waste. **TLO 1.2**. Explain types of solid waste. **TLO 1.3**. State sources of municipal solid waste. **TLO 1.4**. Justify the need of solid waste management in the given situation **TLO 1.5**. Assess the impact of solid waste management on the environment in the give situation. **TLO 1.6**. List the factors generating solid wastes in the given specific area with justification.	1.1 Definition of solid waste 1.2 Meaning of different solid waste – Domestic waste, commercial waste, industrial waste, market waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste, etc. 1.3 Sources of solid waste 1.4 Classification of solid waste – hazardous and non- hazardous waste. 1.5 Physical and Chemical characteristics. 1.6 Impact of solid waste on environment. 1.7 Solid waste management techniques – solid waste management Hierarchy, waste prevention and waste reduction. 1.8 Factors affecting on solid waste generation.	Video Demonstrations Lecture Using Chalk-Board Presentations Site/Industry Visit Collaborative learning	**CO1**
Unit – II. Storage, collection and transportation of municipal solid waste (CL Hrs-08, Marks-12)				
2	**TLO 2.1**. State methods of storage of municipal solid waste. **TLO 2.2** List methods of collection of municipal solid waste. **TLO 2.3**. List various transportation equipments. **TLO 2.4**. Draw the organization pattern of solid waste management	2.1 Storage of municipal waste. 2.2 Collection methods of municipal waste. 2.3 Tools and Equipment's-Litter Bin, Broom, Shovels, Handcarts, Mechanical Road sweepers, Community Bin like movable and stationary Bin 2.4 Transportation of municipal waste. Transportation vehicles with their capacity and working-Animal carts, Auto vehicles, Tractors or Trailers, Trucks, Dumper, Compactor vehicles. Transfer station- meaning, necessity, location 2.5 Role of rag picker. 2.6 Organization pattern of solid waste Management.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Collaborative learning	**CO2**

Unit - III. Disposal of Municipal Solid Waste (CL Hrs-10, Marks-15)				
3	**TLO3.1** Explain principle of Composting process. **TLO3.2**. List factors affecting Composting process. **TLO3.3**. Explain different methods of composting process. **TLO3.4**. Explain different methods of land filling. State the relevant parameters to select a site for land filling with justification. Explain the method for controlling Leachate from land fill site. **TLO3.5**. Explain different types of incinerators. Define the term 'Pyrolysis'. **TLO3.6** State advantages and disadvantages of incineration process.	3.1 Composting of waste, Principles of composting process. 3.2 Factors affecting on composting process. 3.3 Methods of composting – A) Manual Composting – Bangalore method, Indore method B) Mechanical Composting – Dano Process C) Vermi composting 3.4 Land filling technique, Factors for site Selection • Land filling methods: Area method, Trench method and Ramp method. • Leachate and its control, Biogas from Landfill • Advantages and Disadvantages of landfill method • Recycling of municipal solid waste 3.5 Incineration of waste: • Introduction of incineration process, • Types of incinerators-Flash, Multiple chamber incinerators, • Products of incineration process with their use. • Pyrolysis of waste – Definition, methods 3.6 Advantages and Disadvantages of incineration Process		**CO3**
SECTION – II				
Unit - IV Biomedical waste management and health aspects and public involvement in solid waste management (CL Hrs-10, Marks-15)				
4	**TLO 4.1** Define biomedical waste. **TLO 4.2** State sources of biomedical waste. **TLO 4.3** Classify biomedical waste on the basis of given criteria. **TLO 4.4** Explain management technologies of biomedical waste. **TLO 4.5** Explain ill effects on the human health during handling of biomedical waste. **TLO 4.6** Explain public involvement and participation in solid waste management..	**Biomedical Waste Management** 4.1 Definition of Biomedical Waste. 4.2 Sources and generation of Biomedical Waste 4.3 Classification of Biomedical Waste. 4.4 Management technologies. **Health Aspects and Public involvement in solid waste management** 4.5 Health aspect during handling and processing 4.6 Health problem during time of segregation, reuse, recovery, recycling of solid waste. 4.7 Public Involvement and participation in solid waste management	Video Demonstrations Lecture Using Chalk-Board Presentations Site/Industry Visit Collabor ative learning	**CO4**

Unit – V Industrial waste management and e-waste management (CL Hrs-06, Marks-10)				
5	**TLO 5.1.** Define 'Industrial Waste' **TLO 5.2.** Explain industrial waste Classification. **TLO 5.3.** Explain the relevant method of disposal of given type of industrial waste. **TLO 5.4.** Explain 4R's strategy for industrial waste management **TLO 5.5.** Define 'E-Waste' **TLO 5.6** List of E-waste **TLO 5.7.** Explain the ill effects of given type of E-waste on the environment of that area	. **Industrial Waste Management** 5.1 Definition of industrial waste 5.2 Industrial waste classification: hazardous and non-Hazardous 5.3 Industrial Waste Management techniques: Landfill, incineration and deep well injection 5.4 4R's Strategy: Reduce, reuse, recycle and recover **E-Waste Management** 5.5 Definition of E- waste, Varieties of E-waste, Dangers of E- waste 5.6 Disposal of E- waste 5.7 Recycling of E- waste	Lecture Using Chalk-Board Video Demonstrations Case Study Presentations Site/Industry Visit Collaborative Learning	**CO5**
Unit – VI Legal aspects of solid waste management (CL Hrs-05, Marks-10)				
6	**TLO 6. 1.**Suggest the existing legal frame work to regulate the given type of solid waste with justification. **TLO 6.2.** Explain the relevant major provisions of Municipal Solid Waste Management Rules, 2016 for disposal of given type of solid waste. **TLO 6.3.** Explain different major provisions of Bio-medical Waste Management Rules, 2016 for managing the given type of biomedical waste. **TLO 6. 4.**Compile the major features of Construction and Demolition Waste Management Rules, 2016 for the disposal of the given type of waste. **TLO 6.5.** Explain role of CPCB (Central Pollution Control Board) and MPCB (Maharashtra Pollution Control Board) in managing given type of solid waste.	6.1 Legal aspects- present scenario 6.2 Municipal Solid Waste Management Rules, 2016 6.3 Bio-medical Waste Management Rules, 2016 6.4 E-Waste Management Rules, 2016 6.5 Construction and Demolition Waste Management, 2016 6.6 Plastic Waste Management Rules, 2016 6.7Sailent features of Central Pollution Control Board and Maharashtra Pollution Control Board in management of solid waste from various sources.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations Case Study Presentations Site/Industry Visit Collaborative Learning	**CO6**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles/Tutorial Titles	No. Of Hrs.	Relevant Cos
1	LLO1.1. Prepare detailed technical report for the identified parameter	Submit your observations along with your comments on physical parameters of different solid wastes by viewing relevant video / simulation / photographs.	02	CO1
2	LLO 2.1. Prepare a report on the methodology used in collection and transportation	Undertake the survey through internet to prepare a report on the methodology used in collection and transportation of solid waste.	02	CO2
3	LLO 3.1. Prepare flowchart of operations in transfer station.	View the relevant video of the operations in transfer station to draw the flow chart for the same.	02	CO2
4	LLO 4.1Prepare report on w.r.t. population to be served, pattern, machineries, equipment, manpower etc	Design the organization chart for the agency managing solid waste for a given area with a report on w.r.t. population to be served, pattern, machineries, equipment, manpower etc.	04	CO3
5	LLO 5.1 Prepare report on solid waste management plant.	Submit your observations along with your comments on solid waste disposal plant by viewing the relevant video / simulation / photographs.	04	CO4
6	LLO 6.1 Prepare detail report on composting.	Submit your observations along with your comments on composting plant by viewing the relevant video/ simulation / photographs.	02	CO4
7	LLO 7.1 Prepare detailed report on Bio- gas plant.	Submit your observations along with your comments on Bio- gas plant by viewing the relevant video/ simulation / photographs.	02	CO5
8	LLO 8.1 Prepare a detailed report on Bio-medical waste.	Submit your observations along with your comments on disposal of Bio-medical waste by viewing the relevant video / simulation.	04	CO5
9	LLO 9.1 Prepare detail report on disposal of Industrial waste	Submit your observations along with your comments on the disposal of industrial waste by viewing the relevant video / simulation	02	CO6
10	LLO 10.1Interpret the Municipal solid waste management Rules 2016.	Interpret the Municipal Solid Waste Management Rules, 2016 by viewing in the relevant video / simulation/ search engine.	02	CO6
11	LLO 10. Industrial visit	Organize Industrial visit to Municipal corporation solid waste treatment and waste to energy management projects. Prepare visit report.	04	All COs
All practicals are compulsory.				

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Student should prepare 10-15 pages microproject on any topic in a group of 4 students only. Course teacher can allot following topics to microproject group. Microproject report should be prepared with new information other than classroom teaching. The necessary guidance for the microproject work should be provided by course teacher.

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

a. Cary out comparative study of vehicles used for collection of solid wastes from various sources.
b. Collect the relevant technical and commercial information of tools, equipment, vehicles and machineries used for collection, segregation, transportation, processing and disposal of solid waste with specification.
c. Preparation of report about route used for collection and transportation of solid waste of the city and optimization of it.
d. Preparation of report regarding solid waste management practices adopted in the campus of the institute.
e. Writing a report on case studies for solid waste management practices of specific cities of the country.
f. Writing a detailed report on legal aspects about Municipal Solid Waste Management Rules, 2016.

LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with broad specifications	Relevant LLO
1	N. A	All

VII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamental of solid waste management	CO1	06	04	04	00	08
2	II	Storage, collection and transportation of municipal solid waste	CO2	08	02	04	06	12
3	III	Disposal of Municipal Solid Waste	CO3	10	04	06	05	15
4	IV	Biomedical waste management and health aspects and public involvement in solid waste management	CO4	10	04	06	05	15
5	V	Industrial waste management and e-waste management	CO5	06	02	04	04	10
6	VI	Legal aspects of solid waste management	CO6	05	04	06	-	10
Grand Total				45	**20**	**30**	**20**	**70**

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered. For formative assessment of laboratory learning 25 marks.	Theory paper of 70 marks (Pen –paper test)

IX. 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	3	2	2	2	2	2	1	2
CO2	3	2	2	2	3	3	2	3	2	2
CO3	3	3	2	2	2	2	2	3	2	2
CO4	2	2	3	3	2	3	2	3	2	3
CO5	3	2	2	2	1	2	3	3	2	2
CO6	2	2	2	1	2	2	2	3	2	2

Legends: - High:03, **Medium:**02, **Low:**01, **No Mapping: -**
*PSOs are to be formulated at the institute level

X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No.	AUTHOR	TITLE	PUBLISHER
1	Bhide A.D.	Solid Waste Management	Indian National Scientific Documentation Centre, 1983
2	T.V. Ramachandra,	Management of Municipal Solid Waste	**Coordinator, Energy and Wetlands Research Group, Centre For Ecological Sciences, Indian Institute of science, Bengaluru – 560 012, 2009, India**
3	AL. Ramanathan Jagbir Singh,	Solid Waste Management: Present and Future Challenges	Dream tech Press (*1 November 2019*
4	George Techobanoglous,	Integrated Solid Waste Management: Engineering Principles and Management Issues	Hilary Theisen, Samuel A. Vigil, McGraw Hill Education; 1st edition (28 April 2014)
5	K. Sasikumar, Sanoop Gopi Krishna,	Solid Waste Management	Prentice Hall India Learning Private Limited (1 January 2009)

XI. LEARNING WEBSITES & PORTALS

Sr. No.	Link/Software	Description
1	http://www.moef.nic.in/legis/hsm/mswmhr.html	This page from India's Ministry of Environment and Forests outlines the Municipal Solid Wastes (Management and Handling) Rules.
2	En.wikipedia.org/wiki/waste management	This comprehensive article covers the principles and practices of waste management globally.
3	https://www.mpcb.gov.in/node	The official website of MPCB provides information on environmental regulations in Maharashtra, including waste management policies, consent procedures for industries, and monitoring of air and water quality.
4	http://www.cyen.org/innovaeditor/assets/solid%20waste%20management.pdf	This PDF document offers insights into solid waste management practices, emphasizing the importance of systematic collection, treatment, and disposal to maintain environmental hygiene.
5	http://www.ilo.org/oshenc/part-vii/environmental-pollution-control/item/514-solid-waste-management-and-recycling	This resource from the International Labor Organization discusses occupational safety and health aspects of solid waste management and recycling, highlighting the need for proper practices to protect workers and the environment.
6	www.houstontx.gov/solidwaste	The City of Houston's Solid Waste Management Department provides information on waste collection schedules, recycling programs, and guidelines for residents to manage their waste effectively
7	www.epa.gov/tribalmsw/	This U.S. EPA program supports tribal communities in developing and implementing waste management plans, promoting sustainable practices and environmental protection.
8	www.unc.edu/courses/2009spring/.../solidWasteIndiaReview2008.pdf	This academic review analyzes the state of solid waste management in India, discussing challenges, policy frameworks, and recommendations for improvement.

Name & Signature:	
S.S. Mude Lecturer in Civil Engineering	**Mrs.S.R Panapalli** Lecturer in Civil Engineering
(Course Expert)	
Name & Signature:	Name & Signature:
V.B. Kondawar **(Programme Head)**	**S.B. Kulkarni** **(CDC In-charge)**

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**SOIL AND WATER CONSERVATION (ELECTIVE –I)**
COURSE CODE	**CE51204**
PREREQUISITE COURSE CODE & TITLE	**…….**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL Practical				Based on SL		Total Marks
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51204	Soil And Water Conservation	DSE	3	0	2	1	6	3	3	30	70	100	40	25	10	--	--	25	10	150

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that courser.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Water resources play a very important role in the overall development of a country like India. Water resources are becoming scarce day by day & users are multiplying in larger number. It is need of the hour to adopt scientific approaches for making use of water resources judiciously and intelligently. This is diversified course gives knowledge of use and construction different water conservation measures to conserve water and soil need be undertaken in an integrated manner to manage the resources effectively.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of the course-based learning

CO1:Introduction to water resources,watershed.

CO2:Calculate run off from a watershed by different method.

CO3:Describe problem caused by erosion, factors affecting soil erosion, types of Erosion.

CO4: Explain the concept of watershed and its different characteristics.

CO5: Explain the use and construction of water conversion agronomic and engineering measure for a watershed.

CO6: Prepare plan and design the roof rainwater harvesting for buildings.

THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
SECTION I				
UNIT I: INTRODUCTION (Hrs-04, Marks – 08)				
1.	1a. Describe the Importance, classification, availability and use of water Resources. 1b.Explain Principles of soil conservation 1c.Explain the concept of watershed and its different characteristics.	1.1 Water resources- types & its availability, its use and importance. 1.2 Classification of water resources 1.3 Principles of soil conservation. 1.4 Approaches to Soil conservation. 1.5 Concept of water shed, characteristics, of watershed	Chalk & Board	CO1
UNIT II: COMPUTATION OF RUN OFF (Hrs-08, Marks – 12)				
2	2a.Explain types of run off 2b.Describe factors affecting Run off. 2c.Calculate run off from a watershed by rational method.	2.1 Run off cycle, types of run off, factors affecting run off 2.2 Methods of run off computation of run off by Rational method, Limitation of Rational method, Cook's method, Unit hydrograph method, Limitation of unit hydrograph method.	Chalk & Board	CO2
UNIT III: EROSION (Hrs-08, Marks – 15)				
3	3a. Explain different effect of erosion on soil properties and productivity. 3b. Describe problem caused by erosion, factors affecting soil erosion, types of erosion. 3c.Explain different gully control measures	3.1 Soil conservation in India, effect of erosion on soil properties and productivity. 3.2 Definition, problem caused by erosion, factors affecting soil erosion, types of erosion. 3.3 Mechanics of water erosion, types of water erosion. 3.4 Gully erosion- Causes of gully formation, factor affecting gully formation, classification of gully, preventive measure of gully, gully treatment measures. 3.5 Gully control- Improvement of catchment, stabilization of gully, diagnosis for gully erosion, Gully treatment measures.	Chalk & Board	CO3
SECTION II				
UNIT-IV AGRONOMIC AND ENGINEERING MEASURES (Hrs- 12, Marks - 15)				
4	4a. Explain objective . Contour cultivation 4b. Describe strip cropping 4c.Explain tillage practices. 4d.Describe purpose of mulching and list materials used for mulching,	**Agronomic Measures** 4.1 Contour cultivation objectives, design considerations, advantages disadvantage 4.2 Strip cropping-advantages, types 4.3 Tillage practices. 4.4 Mulching- purpose, materials used for	Chalk & Board	CO4

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	4e. Explain the different types of Engineering measures of water conservation.	mulching, 4.5 Pastures, grazing practices. **Engineering Measures** 4.6 Bunding- Types, Classification- contour bunding and graded bunding, design criteria, alignment & construction, surplus arrangement, 4.7 Contour trenching-graded trenches and staggered trenches, 4.8 Terraces- Main features, Classification, bench terraces- types, objectives, location, limitations, layout, design, construction. maintenance , Broad Base Terraces-Types, objectives, limitations, design , maintenances, 4.9 Grassed water ways –location, selection of suitable grasses, construction and maintenances, 4.10 Gully control measures- safe conduct of water and adaptation of gully control measure-Vegetation, Plantation, Nala bunding; check dams structures such as temporary check dam - Brush wood dams, loose rock dam or gully plugging by stone, soil, netting dam, log check dam, Permanent structures spillways, rubble masonry dam, concrete dam, gabions-construction, components, advantages. 4.11 Farm ponds- types, components, selection of site, construction.		
UNIT V: WATER HARVESTING AND ARTIFICIAL RECHARGE (Hrs- 6,Marks - 10)				
5	5a. Explain the concept water harvesting, need for water, and harvesting principles. 5b.Describe different Water Harvesting methods. 5c. Design roof water harvesting system. 5d.Explain methods of waste water recharge.	5.1Water Harvesting – History, Need for water harvesting , concept and definitions, soil requirement for water harvesting , harvesting principles , site and technique selection, 5.2Water Harvesting methods- Tassa, half moons, contour stone bunds, Nigerian micro catchment, contour bunds, Semi circular bunds, contour ridges 5.3Roof rain water harvesting –concept, advantages, disadvantages, amount, layout, design of roof water harvesting system. 5.4 Ground water recharge- Deep recharge through dug well,bore well,shallow recharge-pit method Spreading method, induced recharge method, recharge –well method , subsurface dams.	Chalk & Board	CO3

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		5.5Waste water recharge.		
UNIT VI : WATERSHED MANAGEMENT AND PLANNING (Hrs-07, Marks - 10)				
6	6a. Explain the Principles, objectives, factors affecting watershed. 6b.Explain the Components of watershed management 6c.Describe the Watershed planning and management- activities and framework. 6d.Explain the formulation of project proposal for watershed management work.	6.1 Watershed management- Principles, Objectives, factors affecting watershed management, 6.2 Components of watershed management, 6.3 watershed management 6.4 Types of Water management- participatory watershed management, adaptive watershed management, community watershed management, integrated watershed management, 6.5 Watershed management practices. Watershed planning and management- activities and framework. ,Government Schemes. 6.6 Formulation of project proposal for watershed management work, steps of watershed management, Evaluation. .	Chalk & Board	CO6

IV. LABORATORY LEARNING OUTCOME AND PEDAGOGICAL/TUTORIAL EXPERIENCES.

Sr. No.	Practical/Tutorial/Laboratory LearningOutcome (LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
1	LLO1. Report of water shed developments works	Prepare report of Literature survey & collection of various articles/photographs/sketches related to water shed developments works from books, journals, news papers and internet.	6	1
2	LLO2.Report on roof rainwater harvesting	Prepare a small report on roof rainwater harvesting of a residential / public building/township/campus with necessary drawings and technical details. .	6	6
3	LLO3. Study watershed map and draw neat sketches	Identify and locate and the various measures in upper, middle and lower reaches on watershed map and draw neat sketches of it. Suggest the proper gully control structure across a gully section by studying favorable condition and draw the sketches of any three types gully control measures.	6	3

Sr. No.	Practical/Tutorial/Laboratory LearningOutcome (LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
4	LLO4. Report on watershed management programmes	Visit to nearby water shed to study various aspects watershed management programmes and write a report.	6	4,6
5	LLO5. Report on planning, development of small watershed	Prepare a mini project report on any one: Case study- consisting the planning, development of small water shed including data, drawings with suggestive measures.	6	2,3,4.5,6

V. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES OR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Microproject:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application-based, internet-based, workshop-

based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

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

Investigate, design, construction and maintenance of different types of water conservation measures.

Assignment: -

- Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:
- Prepare journals based on practical performed and visits.
- Conduct survey, analyze the need of watershed management.
- Interact with nearby villages on water conservation measures.
- Prepare and analyze the detail layout plan and design of water supply system, drainage system, and roof rain water harvesting for an existing apartment.

VI. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

NA

VII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS &ASSESSMENT PURPOSE

(SpecificationTable)

Sr.No	Unit	UnitTitle	Aligned COs	LearningHours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction	CO1	04	04	02	02	08
2	II	Computation of Run off	CO2	08	04	04	04	12
3	III	Erosion	CO3	08	04	04	07	15
4	IV	Agronomic And Engineering Measures	CO4	12	06	04	05	15
5	V	Water Harvesting And Artificial Recharge	CO5	06	04	04	02	10
6	VI	Watershed Management And Planning.	CO6	07	04	04	02	10
Grand Total				45	26	22	22	70

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two unit tests of 30 marks and an average of two unit tests.	End semester assessment of 70 marks theory examination

IX. CO-PO 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/ Development of Solutions**	**PO-4 Engineer-ing 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**	**1**	**1**	**3**	**1**	**2**	**1**
CO2	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**1**	**1**	**1**
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**1**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**1**	**1**	**1**
CO5	**3**	**2**	**3**	**2**	**1**	**2**	**3**	**1**	**2**	**2**
CO6	**2**	**3**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**

Legends:-High:03, Medium:02, Low:01, NoMapping:-
***PSOs are to be formulated at the institute level**

X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R. Suresh	Water and Soil conservation Engineering	Standard Distributer, New Delhi
2	J. V. S. Murthy	Watershed management	New Age Internotional publishers New Delhi
3	R. K. Karanth	Ground water assessment, development & management	Tata Mc Grahil Publication
4	Dr. Punmia B. C. & Dr. Pande B.B.	Irrigation and water Power Engineering 12th Edition	Laxmi Publication

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	http://www.watershed.kar.nic.in	watershed
2.	https://nwm.gov.in/	Integrated water resource management
3.	https://www.jalshakti-dowr.gov.in/	Rejuvenation of rivers
4.	https://www.india.gov.in/topics/agriculture/soil-and-water-conservation	Soil and water conservation
5.	https://nwm.gov.in/	Integrated water resource management

Name & Signature:

S. S. Mude
Lecturer in Civil Engineering

B. N. Makam
Lecturer in Civil Engineering

(Course Experts)

Name & Signature:

V. B. Kondawar
(Programme Head)

Name & Signature:

S.B.Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMAINCE**
PROGRAMME CODE	**01/02/04/ 05/05/06/07**
COURSE TITLE	**GREEN BUILDING (ELECTIVE –II)**
COURSE CODE	**CE51205**
PREREQUISITE COURSE CODE &TITLE	**-**
CLASS DECLARATION COURSE	**YES**

I. LEARNING&ASSESSMENTSCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration Hrs.	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51205	GREEN BUILDING	DSC	2	-	2	2	6	3	1.5	15	35*#	50	20	25	10	00	00	25	10	100

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that courser.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.*Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

As the world grapples with the challenges of climate change, environmental degradation, and resource depletion, the construction industry has a significant role to play in reducing its ecological footprint. Green building practices offer a promising solution by promoting sustainable, energy efficient and environmentally responsible building design, construction and operation.

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

After completing the course, student will be able to

CO1: Justify the need of Green Building.

CO2: Explain the principles and benefits of green building including energy efficiency, water conservation, and sustainable materials.

CO3: Suggest the Sustainable Building Materials and Technologies.

CO4: Develop an audit plan and check list for green building.

CO5: Analyze the procedure of green building certification and relevant documents.

IV. THEORYLEARNINGOUTCOMESANDALIGNEDCOURSECONTENT:

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I Fundamental of Green Building (CL Hrs-4, Marks-4)				
1.	TLO 1.1 Justify the need of energy conservation in the given civil engineering project TLO 1.2 Adopt the legal provisions in the energy conservation and green building in given situation. TLO 1.3 Explain the principles and importance of green building TLO 1.4 Implement the relevant principles in green building required for sustainable development	1.1 Introduction to Green Building: Definition and Importance of green building concept, History and evolution of green building construction practices, Role of Green Building in sustainable development 1.2 Introduction to Energy Conservation: Global energy consumption scenario, Energy conservation: Definition, objectives and Importance. 1.3 Salient features of Energy Conservation Act–2001 1.4 Overview of Sustainable construction: Environmental, economic, and social development.	Presentations Video Demonstrations Site/Industry Visit Case Study	CO1
UNIT-II Green Building Concepts and Sustainable Practices (CL Hrs -8, Marks- 8)				
2	TLO 2.1 Identify the principles of the given category of green building considering sustainability aspects TLO 2.2 Explain the Salient features of green building TLO 2.3 Illustrate the relevant benefits of green building for the given criteria TLO 2.4 Discuss the future trend in construction of green building TLO 2.5 Evaluate the economic impact of Green Building construction on Stakeholders.	2.1 Green Building Principles: a. Sustainable Site Design b. Energy Efficiency and conservation c. Water Efficiency and conservation d. Materials selection and life cycle analysis e. Indoor environmental quality (IEQ) 2.2 Salient features of Green Building 2.3 Benefits of Green building: Environmental, economic and social benefits. 2.4 Future trends in green building Economical Consideration of green buildings: Initial cost, long term Financial Benefits and Economic Impacts on Stakeholders.	Presentations Video Demonstrations Site/Industry Visit Case Study	CO2
UNIT-III Sustainable Building Materials and Technologies (CL Hrs-8, Marks-8)				

3	TLO 3.1 Suggest the relevant types of sustainable materials required for the green building construction TLO 3.2 Propose the relevant energy-efficient technologies based on the given climatic condition TLO 3.3 Implement the professional standards related to sustainability set by various professional organizations	3.1 Sustainable building Materials: (Bamboo, Hempcrete, Recycled Plastic Lumber, Ferrock, Cross-Laminated Timber (CLT) etc.) Uses, characteristic, advantages, benefits and limitations, Criteria for selecting sustainable materials. 3.2 Energy-Efficient Technologies: a. Building envelope improvement system: Insulation, windows and glazing, air sealing, Cool roofs and green roofs system. b. Building management system: energy management. c. Lighting: LED and daylighting strategies. d. HVAC unit in green Building: Concept and importance 3.3 Ethics and Professional Responsibility: Ethical considerations in sustainable design and construction, the role of professionals in promoting sustainability.	Presentations Video Demonstrations Site/Industry Visit Case Study	CO3
UNIT- IV Green Building Audit (CL Hrs-4, Marks-7)				
4	TLO 4.1 Justify the necessity of audit in the given green building construction. TLO 4.2 Create a comprehensive audit plan based on given criteria. TLO 4.3 Conduct an audit of the given green building. TLO 4.4 Prepare the action plan based on the given audit report	4.1 Introduction to Green Building Audits: Definition, scope, Importance and benefits of green building audit. 4.2 Planning and Preparation for Green Building Audits: Setting audit objectives and scope, Developing an audit plan and checklist. 4.3 Conducting the Green Building Audits: On-site audit procedures and techniques, Data collection methods (e.g., interviews, observations, document reviews). 4.4 Reporting and Documentation: Audit reports and documentation, Communicating audit findings and recommendations, Corrective Actions and Continuous Improvement.	Presentations Video Demonstrations Site/Industry Visit Case Study	CO4
UNIT –Green Building Standards and Certification Systems CL Hrs-6, Marks-8)				
5	TLO 5.1 Explain the role of the relevant agency responsible for conducting an audit green building TLO 5.2 Conduct an energy audit as per the given type of green rating system.	5.1 Functions of government organization working for Energy conservation and Audit (ECA): Ministry of New and Renewable Energy (MNRE), Bureau of Energy efficiency (BEE) Maharashtra Energy Development Agency (MEDA). 5.2 Green building rating system: Leadership in Energy and Environmental Design (LEED) criteria, Indian Green Building council (IGBC)	Presentations Video Demonstrations Site/Industry Visit Case Study	CO5

		and Green Rating for Integrated Habitat Assessment. (GRIHA): Salient Features and Evaluation Criteria for assessment		

V. LABORATORYLEARNINGOUTCOMEANDALIGNEDPRACTICAL/TUTORIALEXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	Develop a set of ethical guidelines for green building construction.	Comparison of ethical guideline provided by various organization for green building construction	02	CO2
2	Conduct a site assessment to evaluate the suitability of the building for solar installation.	*Estimation of solar plant capacity of a building on the basis of total electricity consumption	04	CO2
3	Identify the benefits of green belts in improving building energy efficiency	* Identify the impact of green belt on the energy level of the building. (By physical verification).	04	CO2
4	Prepare a report on properties and performance characteristics of sustainable building materials	*Collect the information of any five sustainable building materials for a proposed green building project	04	CO3
5	Identify the components of HVAC systems in the context of green building design.	* Identify the components of HVAC unit with space calculation	04	CO3
6	Effectively plan and prepare for the energy audit thorough understanding of the chosen energy rating system	*Prepare the action plan for converting conventional building into green building on the basis of energy audit.	04	CO4
7	Develop a comprehensive action plan for converting the conventional building into a green building.	*Preparation of action plan for upgrading existing green building to next level.	04	CO5
8	Determine the building's compliance with green building standards and the rating system.	*Comparative Study of IGBC and GRIHA Certification Processes in Buildings.	04	CO5

Note: Out of above suggestive LLOs-

'*'Marked Practical's (LLOs) are mandatory.

Minimum 80% of above list of lab experiment are to be performed.

Judicial mix of LLOs is to be performed to achieve desired outcomes.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFICLEARNING /SKILLS DEVELOPMENT (SELF- LEARNING)

Microproject:

- Prepare a report by taking case study to classify the terms and the construction methodologies between Traditional building and green building.

- Conduct an energy audit of a small building to identify areas of energy wastage and propose energy-saving measures
- Collect the relevant information of recent technologies in green building construction and prepare a report on it. Prepare a questionnaire for environmental audit.
- Design a green roof for a small building or shed. Research suitable plants, materials, and construction methods that promote energy efficiency, improve air quality, and manage stormwater runoff.
- Design a rainwater harvesting system for a building or home. Calculate potential water savings, design storage solutions, and propose implementation steps.
- Explore ways to reuse or upcycle building materials (e.g., reclaimed wood, recycled glass) in construction or renovation projects. Calculate the environmental impact and cost savings.
- Research and analyze different green building certification programs (e.g., LEED, IGBC). Compare their criteria, costs, and benefits, and propose steps for a building to achieve certification.

NOTE: These are the optional activities for extra learning of students

Assignment: -

Visit to construction site to identify energy resources

- Prepare a report on silent provision made in energy conservation act – 2001
- Prepare a report on sustainable building material available in vicinity.
- Compare the working methodology of different Government organizations such as ECA, MNRE,MEDA& BEE
- Collect the sample Audit Report of any one rating Agency such as IGBC, GRIHA etc.
- Prepare a report on Local Construction Techniques and locally available material which will vary from city to city or from state to state.

NOTE: These are the optional activities for extra learning of students.

Model/Prototype

- Develop a prototype for a smart home energy monitoring system. Use sensors to monitor energy usage and provide real-time feedback to homeowners on their consumption habits.
- Make a model of solar energy plant.

NOTE: These are the optional activities for extra learning of students.

VII. LABORATORYEQUIPMENT/INSTRUMENTS/TOOLS/SOFTWAREREQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1 to 8	All practicals are based on Field visits, survey, and report writing. No specific equipment's are required.	ALL

SUGGESTED FORWEIGHTAGETO LEARNING EFFORTS&ASSESSMENTPURPOSE

(Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	**Fundamental of Green Building**	1	4	2	2	-	4
2	II	**Green Building Concepts and Sustainable Practices**	2	8	2	2	4	8
3	III	**Sustainable Building Materials and Technologies**	3	8	2	2	4	8
4	IV	**Green Building Audit**	4	4	2	2	3	7
5	V	**Green Building Standards and Certification Systems**	5	6	2	2	4	8
Grand Total				**30**	**10**	**10**	**15**	**35**

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 15 marks and an average of two-unit tests. For laboratory learning 25 marks. For Self-learning 25 marks.	End semester assessment of 35 marks theory examination.

IX. 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	2	3	2	3	2	3	2	2	2
CO2	3	2	2	3	3	1	2	2	2	2
CO3	2	2	3	2	3	2	3	2	2	2
CO4	2	2	3	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2

Legends: -High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

X. SUGGESTEDLEARNINGMATERIALS/BOOKS

Sr.No.	Author	Title	Publisher with ISBN Number
1	Sam Kubba	Handbook of Green Building Design and Construction	Butterworth-Heinemann; 1st edition (30 July 2012); CBSPD - NEW DELHI - 110092 , ISBN-13:978-0123851284
2	Indian Green Building Council (IGBC)	Introduction to Green Buildings & Built Environment	BS Publications
3	Bureau of Energy Efficiency (BEE)	Energy Conservation Building Code - India	Bureau of Energy Efficiency (BEE)
4	Chetan singh, solanki	Renewable energy technologies: a practical guide for beginners	PHI Learning Pvt. Ltd., 2008 ISBN 8120334345, 9788120334342

XI. LEARNING WEBSITES &PORTALS

Sr.No	Link/Portal	Description
1	https://www.mahaurja.com/	Official website of Maharashtra Energy Development Agency (MEDA)
2	https://www.youtube.com/watch?v=VE2tpwGCN0U	Green Building Ratings and Components

Name & Signature:

SEEMA V. KOLHE
Lecturer in Civil Engineering
(Course Expert)

Dr.R M AGHAV
Lecturer in Civil Engineering
(Course Expert)

Name &Signature:

V.B.Kondawar
(Programme Head)

Name &Signature:

S.B.Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**BUILDING SERVICES (ELECTIVE –II)**
COURSE CODE	**CE51206**
PREREQUISITE COURSE CODE & TITLE	**…….**
CLASS DECLARATION COURSE	**YES**

I. LEARNING&ASSESSMENTSCHEMEZ

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51206	**Building Services**	DSE	2	0	2	2	6	3	1.5	15	35*#	50	20	25	10	--	--	25	10	100

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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, ***#** - Online Examination, **@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 15 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Building services are the systems installed in buildings to make them comfortable, functional, efficient and safe. Building Services are required to provide comfort to the users of the building. Plumbing service is necessary for proper water supply & efficient drainage facility. This course has been designed to develop skills to understand and test building services. After studying this course students will develop an insight to identify, build and troubleshoot building services

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of the course-based learning

CO1: Identify and study various building services and its component & extract market survey of material with reference to each service.
CO2: Understand proper co-ordination of building services work with Architects and structural engineers.
CO3: Interpret plumbing drawings and electrification drawings
CO4: Follow safety measures and fire fighting services as per Notional Building Code.
CO5: Understand acoustics, lift installation, escalators as per NBC.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant CO's
UNIT I: OVERVIEW OF BUILDING SERVICES (Hrs-6, Marks – 08)				
1.	1a. Classify buildings as per NBC 1b. Explain the importance of building services 1c. Explain various types of Building Services. 1d. Describe the Role & Responsibility of Building Service Engineer.	1.1 Introduction to Building Services 1.2 Classification of Buildings as per N.B.C. 1.3 Necessity of building services. 1.4 Types of Building Services- a HVAC b Lift, Escalators c Fire Safety d Plumbing Services e RWH f SWH g Lighting, Acoustics, Sound Insulation 1.5 Role & Responsibility of Building Service Engineer 1.6 Building Management System and Governance, Computerized Application-Reporting and Finance. Smart Building.	Chalk & Board	CO1
UNIT-II VERTICAL COMMUNICATION IN THE BUILDINGS (Hrs- 8, Marks - 10)				
2	2a. Explain different Modes of vertical communications in the buildings 2b. Explain the necessity of lift, Escalators 2c. Explain with sketches the working principle of the Lift and Escalator.	**2.1Modes of vertical communications in the buildings**. **2.2Lift-** 2.2a. Necessity 2.2b. Types 2.2c. Component Parts 2.2d. Location, space requirements 2.2e. Safety measures 2.2f. construction and working principle of Lift **2.3 Escalators-** 2.3a. Necessity 2.3b. Types 2.3c. Component Parts 2.3d. Location, space requirements, Layout, Safety measures 2.3e. construction and working principle of Escalator **2.4 Ramp-** 2.4a. Necessity 2.4b. Types 2.4c. Component Parts 2.4d. Location, space requirements,	Chalk & Board	CO2

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant CO's
		Layout, Safety measures.		
UNIT III: FIRE SAFETY AND PLUMBING (Hrs- 10,Marks - 10)				
3	3a. Explain necessity of different fire resisting material. 3b. Classify different types of material and its degree of fire. 3c. Identify fire zones and techniques and method of fire safety. 3d. Define terms used in Plumbing. 3e. List different valves used in water supply and drainage. 3f. Describe need of licensing, duties & responsibilities of plumber.	3.1 Terminology – Combustible material, Down comer, Dry riser, Fire load, Fire load density, Fire resistance rating 3.2 Fire resistant materials and its properties. 3.3 Classification of building based on occupancy, fire Zones. 3.4 General measures of fire safety in building. 3.5 Alarm system, Fire extinguishing Arrangements, escape routes. 3.6Terminology- Water main, Service pipe, Communication pipe, Supply pipe, Distribution pipe Consumers pipe, Air Gap 3.7 Application for obtaining water supply connection, drawing /document required for connection. 3.8 Licensing of plumbers, basic qualification of plumbing contractor, duties and responsibilities of the plumbing contractor.	Chalk & Board	CO3 CO4
UNIT IV: VENTIALATION, AIRCONDITIONING AND ACOUSTICS (Hrs-06, Marks - 07)				
4	4a. Explain need of ventilation system 4b. Explain purpose of A.C. with its principles. 4c. Classify various types of A.C. and its essentials. 4d. Identify different acoustical defects and its causes and remedial measures.	4.1 Definition and necessity of ventilation. 4.2 Different Ventilation systems. 4.3 Purposes and classification of air conditioning, systems of air conditioning. 4.4 Definition and necessity of Acoustics of building 4.5 Acoustical materials and its classification.	Chalk & Board	CO5

V. LABORATORY LEARNING OUTCOME AND PEDAGOGICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant CO's
1	LLO1. Market survey of acoustic material	Conduct market survey of latest material for acoustic material	6	5
2	LLO2.Report of vertical communication	Report writing on the building showing system of vertical communication and prepare report for lift.	4	2
3	LLO3. Requirement for firefighting services	Suggest requirement for firefighting services for a building	6	4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant CO's
4	LLO4. Report on Plumbing system for multi storied residential building.	Prepare a report on Plumbing system for multi storied residential building	4	3
5	LLO5. Application for obtaining water supply connection.	Prepare application for obtaining water supply connection.	4	3
6	LLO6. Report on ventilation and air conditioning system for house.	Prepare report on ventilation and air conditioning system for house.	6	5

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES OR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented CO's.

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

Lifts, escalators
RWH
SWH
Air conditioning
Acoustics
Modern Fire safety

Assignment: -

Students should conduct the following activities in groups and prepare reports of about five pages for each activity, also collect/record physical evidence for their (student's) portfolio, which will be helpful in their placement interviews:

a. Prepare journals based on practical performed and visits.
b. Conduct survey, analyze the specifications, costs, quality and availability for various types of plumbing, acoustical and various proofing materials.
c. Interact with owner and list common troubles in plumbing services water proofing.
d. Prepare report on fire resisting appliances available in market. Collect data of auditorium/cinema hall/conference hall where acoustical planning, artificial ventilation fire fighting services and electrification is made.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Various plumbing fittings-latest material available in market.	4
2	Various fire fighting equipments –latest available in market.	3
3	Various acoustical -latest material available in market.	1

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS &ASSESSMENT PURPOSE

(Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of building services	CO1	06	04	02	02	08
2	II	Vertical communication in the buildings	CO2	08	04	04	02	10
3	III	Fire safety and plumbing.	CO3,CO4	10	04	04	02	10
4	IV	Ventilation, air conditioning and acoustics.	CO5	06	01	02	04	07
Grand Total				30	13	12	10	35

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two-unit tests of 15 marks and an average of two-unit tests.	End semester assessment of 35 marks theory examination

X. CO-PO 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/ Development of Solutions**	**PO-4 Engineer-ing 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**	**1**	**1**	**3**	1	2	2
CO2	**3**	**3**	**3**	**2**	**1**	**1**	**3**	1	1	1
CO3, CO4	**3**	**3**	**3**	**2**	**1**	**1**	**3**	1	1	3
CO5	**3**	**3**	**3**	**2**	**1**	**1**	**3**	1	1	2

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

*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	S.P. Arrora & Bindra	Building Construction	Dhanpat Rai & sons, Delhi. ISBN: 9788189928803
2	S.K. Garg	Water Supply And Sanitary Engineering	Tata McGraw Hills Publications, Delhi. ISBN: 978-81-7409-120-8
3	Kale, Shaha, Patki	Building Drawing	Dhanpat Rai & sons, Delhi, ISBN NO: 9780074638767
4	Year 2005	Notional Building Code	New Delhi
5	Sanjay Mantri	A to Z practical Building Construction	Mantri House publication, Pune. ISBN NO: 9789351922629
6	Kamala	Environmental Engineering-	Khanna Publications , ISBN NO: 9780074517086
7	Subhash Patil	Plumbing Engineering.	Seema Publication Mumbai, ISBN NO: 9788175259805
8	S.P. Arora & Bindra	Building Construction	Dhanpat Rai & sons, Delhi, ISBN: 9788189928803`
9	S.K. Garg	Water Supply And Sanitary Engineering	Tata McGraw Hills Publications, Delhi, ISBN: 978-81-7409-120-8
10	Kale, Shaha, Patki	Building Drawing	Dhanpat Rai & Sons, Delhi, ISBN NO: 9780074638767

XII. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1.	www.nptel.com	Building services
2.	http://www.plumbing.com/fixtures.	Plumbers, fixtures
3.	http://acostical material.com/	Acoustical material
4.	http://fire fighting equipments.com/	Fire fighting equipments
5.	https://www.youtube.com/watch artificial ventilation	Ventilation

Name & Signature:

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Lecturer in Civil Engineering

B. N. Makam
Lecturer in Civil Engineering

(Course Experts)

Name & Signature:

Shri.V B Kondawar
(Programme Head)

Name & Signature:

Shri. S. B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE**
PROGRAMME CODE	**01**
COURSE TITLE	**Environmental Pollution and Control (ELECTIVE –II)**
COURSE CODE	**CE51207**
PREREQUISITE COURSE CODE & TITLE	**…….**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CE51207	**Environmental Pollution and Control**	DSC	2	0	2	2	6	3	1.5	15	35*#	50	20	25	10	--	--	25	10	100

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom 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,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that courser.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) 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. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.*Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The model curriculum prepared for the programme is designed to impart such basic skills that would help students later in their careers to serve in various professional skills.Environmental pollution is a significant concern in today's world, affecting every aspect of life on Earth. It refers to the contamination of the natural environment by harmful substances or activities, which leads to adverse effects on the health of living organisms and the ecosystem. Understanding environmental pollution is crucial for everyone in our planet.

III. COURSE LEVEL LEARNING OUTCOMES(CO's)

Students will be able to achieve & demonstrate the following CO's on completion of the course-based learning

CO1.Elaborate types of pollution,acts and factors affeting on environmental pollution.

CO2.Classify air pollutants and its effect on environment.

CO3.Summarize types of air pollution control equipment.

CO4.Elaborate the concept of noise pollution,thermal pollution it's causes,effects and control measures

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT 1: INTRODUCTION TO ENVIRONMENTAL POLLUTION (HRS- 06,MARKS-08)				
1.	1a.state factors contributing to Urban Pollution. 1b.State types of Environmental Pollution. 1c.Describe roles of MPCB,CPCB 1d.state salient features of Environmental protection law,water Act,Air Act	1.1 Introduction to Environmental Pollution, Environmental imbalances 1.2 Factors Contributing to Urban Pollution in India 1.3 Types of Environmental Pollution-Air,water ,soil,noise,thermal pollution,sources of it 1.4 Roles of agencies related Environmental Pollution like MPCB,CPCB. 1.5 Environmental Protection Law, Water pollution control acts and legislation. 1.6 Air pollution act, Legislation in India, Control Acts.	PPT,Chalk & Board	CO1
UNIT 2: AIR POLLUTION EFFECT (HRS- 08, MARKS- 10)				
2	2a.Enlist sources of air pollution. 2b.Classify air pollutants. 2c.State effects of air pollution on Health,vegitation,materials etc. 2d.Explain air sampling and its principles. 2e.state emission standard of pollutants.	2.1 Air pollution - Definition, sources of air pollution. 2.2 Types and classification of air pollutants, Primary and Secondary air pollutants and their importance,AQI. 2.3 Atmospheric stability, mixing heights 2.4 Effect on Health, vegetation, materials and atmosphere. 2.5 Reactions of pollutants in the atmosphere and their effects- Smoke, smog and ozone layer disturbance. 2.6 Air sampling and principles. 2.7 Ambient air quality and emission standard.	PPT,Chalk & Board	CO2
UNIT 3: AIR POLLUTION CONTROL EQUIPMENTS(Hours- 10,Marks- 10)				
	3a.explain control of pollution by process modification, change of raw materials, fuels etc. 3b. Explain removal of gaseous pollutants by adsorption, absorption 3c. Explain particulate emission control by settling chambers, cyclone separation. 3d.Explain land use planning for air pollution control.	3.1 Control of Pollution: By process modification, Change of raw materials, Fuels, process equipment and process operation by use of air pollution control equipment, 3.2 Removal of gaseous pollutants by adsorption, absorption,reaction and other methods. 3.3 Particulate emission control, settling chambers, cyclone separation 3.4 Wet collectors, fabric filters,	PPT,Chalk & Board	CO3

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
3		electrostatic precipitators 3.5 Land use planning: As a method of air pollution control		
UNIT 4:NOISE AND THERMAL POLLUTION (Hrs- 06, Marks- 07)				
4	4a.State sources,effects and control of noise pollution. 4b.State Causes ,effects and control measures of thermal pollution. 4c. State Causes ,effects and control measures of nuclear hazards.	4.1 Noise Pollution: Sources, Noise characteristics 4.2 Measurement of noise, Effects of noise, Control of noise. 4.3 Thermal pollution : Definition,Causes ,effects and control measures. 4.4 Causes,effects and control measures of Nuclear hazards	PPT,Chalk & Board	CO4

V. LABORATORY LEARNING OUTCOME AND PEDAGOGICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/LaboratoryLearningOutcome (LLO)	Laboratory Experiment / Practical Titles /TutorialTitles	Number of hrs.	Relevant COs
1	LLO1. Features of Environmental protection Act.	State the salient features of Environmental protection Act.	2	1
2	LLO2. Role of MPCP,CPCB.	State the role of MPCP,CPCB and other agencies.	4	1
3	LLO3.Air quality index calculation.	Calculate AQI of nearby station.	4	2
4	LLO4. Emmision standards of air pollutants.	Enlist emmision standards of air pollutants as per various standards.	4	2
5	LLO5. Effects of pollutants on materials.	Enumerate effects of pollutants on health,materials,plants and environment.	4	2
6	LLO6. Air pollution control equipments.	Explain air pollution control equipment with neat sketch.	4	3
7	LLO7. Measurement of Noise and control of noise.	Assignment on measurement of Noise and control of noise.	4	4
8	LLO8. Nuclear Hazards causes,effects and control measures.	Assignment on Nuclear Hazards.	4	4

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES OR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Microproject:

1. Study of Air (Prevention and Control of Pollution) Act, 1981
2. Study acts and policies related to Air pollution
3. Study of Environment Protection Act of 1986 (EPA**)** with recpect to Bopal Gas tragedy
4. Study ozone-depleting substances (regulation and control) rules, 2000
5. Study of the National Green Tribunal Act, 2010

6. Roles of MPCP,CPCB and emission standards
7. Study of Noise Pollution (Regulation and Control) Rules, 2000.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Not applicable for this course.

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS &ASSESSMENT PURPOSE

(SpecificationTable)

Sr.No	Unit	UnitTitle	Aligned COs	LearningHours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Environmental Pollution	CO1	06	02	04	02	08
2	II	Air pollution Effect	CO2	08	02	04	04	10
3	III	Air pollution control equipments	CO3	10	02	04	04	10
4	IV	Noise and Thermal pollution	CO4	06	02	02	03	07
Grand Total				30	08	14	13	35

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Two unit tests of 15 marks and an average of two unit tests.	End semester assessment of 35 marks theory examination

X. CO-PO 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/ Development of Solutions	PO-4 Engineer-ing 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	1	2	2	1	1	2
CO2	3	2	2	3	1	2	2	3	3	1
CO3	3	2	1	2	3	1	2	2	2	1
CO4	3	2	3	2	2	3	2	2	3	3

Legends:-High:03, **Medium:**02, **Low:**01, **NoMapping:**-
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	M.N. Rao	Air Pollution	Tata McGraw hill 1989 edition
2	Perkins	Air Pollution	McGraw-Hill Edition 2000
3	Muralikrishna, K. V. S. G	Air Pollution and Control	Kaushal & Co., Kakinada, AP, 1995.
4	Viessman W. Jr. and Hammer M.J.	Water supply and Pollution control	Harper & Row Publications Inc., Singapore
5	Lawrence K. Wang, Norman C. Pereira	Air and Noise Pollution Control: Volume 1 (Handbook of Environmental Engineering)	Humana Press Inc.; Softcover reprint of the original 1st ed. 1979 edition (14 October 2011), ISBN-10 : 1461262380,ISBN-13 : 978-1461262381

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
3.	moef.gov.in	Ministry of Environment, Forest and Climate Change
4.	www.mpcb.gov.in	Maharashtra Pollution Control Board
5.	https://cpcb.nic.in/displaypdf.php?id=Tm9pc2UtU3RhbmRhcmRzL25vaXNlX3J1bGVzXzIwMDAucGRm	Noise Pollution (Regulation and Control) Rules, 2000.

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