

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE1401 ^(S)****COURSE TITLE : ESTIMATING AND COSTING****PREREQUISITE : CE1301, BUILDING DRAWING****TEACHING SCHEME: TH :02; TU:00; PR :04; TOTAL CREDITS: 06 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	50@	25#	175
MIN.	32	--	40	---	20	10	--

(# - External & Internal Assessment ; @ - Internal Assessment only , \$-Award of class course)

TIME ALLOTTED FOR TERM EXAM : 04 HRS.**TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.****❖ RATIONALE :**

The course “Estimating and costing” is a core technology course which enable civil engineering student to acquire the estimating and costing skill which is needed by them when performing their job in construction industries. The course enables the students to prepare the approximate and detailed estimate for all type civil engineering construction works. In absence of market rates they can prepare their own rate and thereby prepare the detailed estimate, Strength, durability and quality of civil engineering construction work can not be directly ensured through laboratory testing hence it is necessary to depend upon the specification of quality and workmanship.

❖ OBJECTIVES :**After completing this course students will be able to –**

- Prepare a various types of estimates for different civil engineering works.
- Know the different methods and procedures of estimating.
- Get acquainted with current market rate and schedule of rate.
- Know the different types of Govt. approval / sanctions like administrative approval, technical sanction, budget provision etc. by preparing various types of estimates.
- Derive the rates per unit items of civil engineering works.
- Draft specification of items of civil engineering works.

❖ SKILLS: After completion of this course, the Students will acquire the following skills

1. Develop the skill of determination of quantity of an item of work by referring given drawing of civil engineering structure.
2. Prepare the estimates of any civil engineering structure and decide the probable costing of it before construction.
3. Decide the rate of any items of civil engineering works by analyzing the cost and quantities of different materials and labours.
4. To work out the material requirement and manpower requirement for various items of work.
5. Drafting of technical specification of any items of civil engineering work.

CONTENTS :
A. THEORY :

SR. NO.	CHAPTER	MARKS	HOURS
1.	INTRODUCTION OF ESTIMATING AND COSTING.	10	04
	1.1 Definition / meaning of (a) Estimating (b) Costing		
	1.2 Purpose /need of Estimating and costing.		
	1.3 Types of estimates (a) Approximate Estimate (b) Detailed Estimates (c) Revised Estimate (d) Supplementary Estimate (e) Annual maintenance and repair estimate.		
2.	PRINCIPLES OF ESTIMATING.	10	04
	2.1 Units and standard modes of measurements for different civil engineering items of works as per I.S. 1200 / as per P.W.D. hand book.		
	2.2 Desired accuracy in taking measurements for different / various items of works and rules for deduction as per I.S.1200 / P.W.D. hand books.		
	2.3 Provision and purpose of (a) Contingencies charges (b) Work charge establishment charges (c) Quality control charges (d) Centages Charges (e) Electrification Charges (F) Water supply and sanitary charges.		
	2.4 Terms used in estimates (a) Prime cost (b) Provisional sum (c) Provisional quantities (d) Spot items (e) Extra items (f) Lum sum.		
3.	APPROXIMATE ESTIMATE.	10	04
	3.1 Purpose of preparing approximate estimate.		
	3.2 Method / Types / Classification of approximate estimate for buildings with application and numericals. (a) Service unit method (b) Plinth area method (c) Cubical content Method (d) Typical Bay Method (e) Approximate quantity method		
	3.3 Preparation of approximate estimate for following civil engineering structures - (a) Irrigation Project (b) Water supply & sanitary Project (c) Road Project (d) Railway Project (e) Bridge Project.		
4.	DETAILED ESTIMATE.	30	12
	4.1 Check list of items of Civil Engineering works		
	4.2 Steps in preparing detailed estimate – (a) Measuring the dimension (b) Squaring the dimension (c) Abstracting or working up (d) Billing.		
	4.3 Contents of measurement sheets / Abstract sheet And General Abstract sheet, Face sheet		
	4.4 Methods / Procedure for taking out quantities of various items of works by (a)- (i) Long wall & short wall methods (ii) Centre line method with examples for load bearing structure. (b) For Framed structure with examples.		
	4.5 Methods of earthwork estimate for road and canals with examples.		
	4.6 Calculation of M.S. bar reinforcement with bar bending schedule in R.C.C. members like footings .beams, columns and slabs.		
	4.7 Calculation of woodwork for king post truss and roofing members.		
5.	RATE ANALYSIS.	12	05
	5.1 Definition / meaning of rate analysis.		
	5.2 Purpose and importance of rate analysis.		
	5.3 Factors affecting rate analysis (Major & minor).		
	5.4 Meaning of lead and lift.		

	5.5	Task work, factors affecting task works and schedule of rates.		
	5.6	Categories of labour with their prevailing wages.		
	5.7	Transportation of materials and capacities of trucks and bullock-carts.		
	5.8	Working the quantities of materials required for different items of civil engineering works.		
	5.9	Preparing rate analysis for a few common items of civil engineering works such as - (a) Excavation in any type of soil (b) II nd class B.B. masonry in C.M. 1:6 (c) 12 mm thick cement Plaster in C.M. – 1:5 (d) R.C.C. (1:2:4) mix excluding reinforcement.		
6.	SPECIFICATION.		08	03
	6.1	Definition / meaning of specification.		
	6.2	(a) Necessity (b) Importance (c) Purpose of specification.		
	6.3	Points to be observed in drafting the specification of an items – (a) Method of writing specification (b) Specification paragraph (c) Legal aspect of specification.		
	6.4	Types of Specification – (a) Brief Specification (b) Detailed Specification.		
	6.5	Types of Detailed specification.		
	6.6	Writing / Drafting of Detailed specification for a Few common civil engineering items such as – (a) II nd class B.B. masonry in CM - 1:6 (b) Coursed or Uncoursed rubble masonry in C.M. 1:6 (c) 12 mm thick cement Plaster in C.M. 1:5 (d) R.C.C. 1:2:4 mix		
Total			80	32

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Sr.No.	Title of Practical/Lab. Work/Assignments	Hrs.
1.	Prepare a check list of items of the following types of civil engineering works. (a) Load Bearing type Building. (Ground Floor only) (b) Frame structure type Building. (Ground Floor only) (c) Water Bound Macadam Road. (d) any three (i) Septic tank (ii) Community well (iii) Hume pipe culvert or slab culvert (iv) Percolation Tank (v) Cannal Earthwork.	16
2.	Preparing detailed estimate of a load bearing structure of single storied residential building for all items of works (Considering quantity of reinforcement in percentage (%)).	08
3.	Preparing detailed estimate of R.C.C. single storied residential building for all items of works (Considering quantity of reinforcement in percentage (%)).	08
4.	Preparing the estimate of small R.C.C. hall by considering only following items of works. - (i) Quantity of cement concrete for footing, columns, beams and slabs. (ii) Quantity of steel reinforcement for above items of works by preparing bar bending schedule. (iii) Formwork for above items.	08
5.	Preparing detailed estimate of road for State or National Highway of any category of road for 1 KM length.	08
6.	Preparing detailed estimate of any three of the following – (i) Septic tank (ii) Community well (iii) Hume pipe culvert or slab culvert (iv) Percolation Tank (v) Cannal Earthwork.	08
7.	Preparing rate analysis of following items of works for building work. (a) Excavation in any type of soil (b) II nd class B.B. masonry in C.M. 1:6 (c) 12 mm thick cement Plaster in C:M – 1:5 (d) R.C.C. mix for e.g M20 excluding reinforcement.	04

8.	Drafting a specification for following items of works. (a) II nd class B.B. masonry in C.M. 1:6 (b) Coursed or Uncoursed rubble masonry in C.M. 1:6 (c) 12 mm thick cement Plaster in C.M. 1:5 (d) Reinforcement Cement Concrete mix.for e.g M20	04
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Note: Drawing for preparing estimate shall be provided by course teacher.

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term end oral examination.

❖ **SUGGESTED LEARNING RESOURCES :**

- i. Lecture method
- ii. Q & A technique
- iii. Case study

❖ **SUGGESTED LEARNING STRATEGIES :**

1. **PRINT** : Text books/Reference books / Drawing of related chapters.
2. **NON PRINT** : CDS / PPT / Transparencies / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks Obtained	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
				Knowledge	Comprehension	Application	Total
1.	Introduction of Estimating and Costing.	10	15	08	04	03	15
2.	Principles of Estimating.	10	15	06	06	03	15
3.	Approximate Estimate.	10	15	06	06	03	15
4.	Detailed Estimate.	30	45	10	25	10	45
5.	Rate Analysis.	12	18	06	06	06	18
6.	Specification.	08	12	03	06	03	12
Total		80	120	39	53	28	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Estimating & Costing	B. N. Datta, UBS Publisher, Distributor Pvt. Ltd. New Delhi.	----
2.	Estimating, Costing & Valuation	M. Chakraborty; 21 B, Bhabananada Rd., Calcutta -7000 26	----
3.	Elements of Estimating & Costing.	S. C. Rangwala, charotar publication, court rd. Anand - 388001	----
4.	Estimating & Costing	G. S Birdie Dhanpat rai & sons, Delhi.	----
5.	Estimating Contract & Accounts Vol - I	B. S. Patil, Orient Longman Ltd.	----

		Hyderabad	
6.	IS 1200 SP 27-1987	PWD Handbook	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Teaching Experience	Designation	Institute / Industry
1.	S. R. Ukey	22 years	Lect. (Sl. Gr.)in Civil Engineering	Govt. Polytechnic Nagpur
2.	S. D. Atey	22 years	Lect. (Sl. Gr.)in Civil Engineering	Govt. Polytechnic Nagpur
3.	R. N. Giradkar	24 years	HOD, Civil Engg.	Govt. Polytechnic Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

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COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE 1402 ^(S)****COURSE TITLE : HIGHWAY ENGINEERING****PREREQUISITE : CE1303****TEACHING SCHEME: TH :02 ; TU : 00; PR :04; TOTAL CREDITS: 06 (Hrs per Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	--	--	--	--	75@	25#	100
MIN.	--	--	--	--	30	10	---

(# - External & Internal Assessment ; @!- Internal Assessment; \$-Award of class course)

TIME ALLOTTED FOR TERM EXAM : --**TIME ALLOTTED FOR PROGRESSIVE TEST : --**❖ **RATIONALE :**

Road is important, largest and basic mode of transportation in India. The transportation by road is the only one mode which could give maximum service to all. The road is also easy and effective mode of transportation. There is very much scope of road development work and its maintenance in our country. Students of Diploma in Civil Engineering have very much job opportunities in this field. Students could work as a technician in P.W.D. and road construction organization. Also students could take the road construction works on contract basis. This subject gives the knowledge and skills required to carry investigation, planning, design, construction, maintenance works related to the roads.

❖ **OBJECTIVES :****After completing this course students will be able to –**

- Survey and investigate for location of new road.
- Organize, supervise and co-ordinate construction activities of road.
- Prepare & interpret the drawings related to the work.
- Select & test materials on site and laboratory as per requirements.
- Handle skilled workers and monitor quality control parameter related to work
- Improve, maintain and repairs of existing roads.

❖ **SKILLS :****The student will acquire the following skills -**

1. Collection of data for road project.
2. Preparation of estimates of roads, read & draw cross section of them.
3. Supervision of construction of roads.
4. Repairing and maintaining the roads.
5. Understanding fundamental of traffic flow on roadways
6. Knowing traffic regulations and laws.

CONTENTS :
A. THEORY :

SR. NO.	CHAPTER	MARKS	HOURS
1.	ROAD ENGINEERING	--	02
	1.1 Importance of roads in India.		
	1.2 Classification of roads according to Nagpur plan (Location and function) and third road development plan. Traffic and tonnage		
	1.3 Classification of urban roads.		
2.	INVESTIGATION FOR ROAD PROJECT	--	04
	2.1 Reconnaissance survey, Preliminary survey and Location survey for a road project.		
	2.2 Detailed survey for cross drainage- L-section and C/S Sections.		
	2.3 Fixing the alignment of road, factors affecting alignment of road.		
3.	GEOMETRIC DESIGN OF HIGHWAYS	--	09
	3.1 Camber- definition, purpose, types, IRC – specifications.		
	3.2 Kerbs, road margin, road formation, right of way		
	3.3 Design speed- IRC – specifications		
	3.4 Gradient – definition, types, IRC specifications		
	3.5 Sight distances– definition, types. IRC specification, problems		
	3.6 Curves–Necessity, types– horizontal, vertical and transition curves		
	3.7 Widening of roads on curve, problems		
	3.8 Super Elevation – definition, formula for calculating super elevation, minimum and maximum values of super elevation, and methods of providing super elevation, problems		
	3.9 Sketching of standard C/S of national highway in embankment and cutting.		
4	CONSTRUCTION OF ROADS PAVEMENTS	--	08
	4.1 Pavement – objective of pavement, structure of pavement, function of pavement components, types of pavement.		
	4.2 Construction procedure of earthen roads.		
	4.3 Soil stabilized roads – necessity, methods of soil stabilization, brief details of mechanical soil stabilization.		
	4.4 Construction procedure of water bound macadam roads.		
	4.5 Construction of bituminous roads.		
5.	DRAINAGE OF ROADS	--	02
	5.1 Importance of highway drainage		
	5.2 Surface drainage - side gutter, catch water drain, surface drainage.		
	5.3 Sub-surface drainage – Longitudinal drains and cross drains.		
6.	MAINTENANCE AND REPAIRS OF ROADS	--	03
	6.1 Necessity of maintenance of roads		
	6.2 Classification of maintenance operation – ordinary routine and periodic maintenance.		
	6.3 Maintenance of W.B.M.& Bituminous roads.		

7.	TRAFFIC ENGINEERING		--	04
	7.1	Traffic Engg- Definition, Traffic characteristics		
	7.2	PCU, Traffic density, traffic capacity		
	7.3	Traffic volume study		
	7.4	Traffic control devices - road signs, marking, Signals Traffic island and its types		
Total				32

LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

B. (Term work shall consist of following lab work/assignments/visit report. Oral is based on TW)

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	Road project for a road of minimum 0.5 km. length having at least one small cross drainage work. 1.1 Site selection. 1.2 Reconnaissance survey. 1.3 Fixing the alignment. 1.4 Detailed profile survey along the alignment and cross section of road and CD Work. 1.5 Prepare drawing of longitudinal section and typical cross sections of the road in cutting and filling.	40
2.	Visit to a W.B.M. and Bituminous road for observing the different types of defects in roads. Prepare a visit report. Which should consist of (a) List of various defects observed b) Suggestions regarding the possible remedial measure.	08
3.	Preparing drawings to show detailed sections in cutting and banking for (a) major district road b) state Highway c) National highway d) Express highway	08
4.	Traffic volume study and its representation of an important road intersection or roadway in your city.	08
Total		64

❖ ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :

Continuous assessment of Term Work and Term end oral examination.

❖ SUGGESTED IMPLEMENTATION STRATEGIES :

1. Lecture method
2. Q & A technique.
3. Demonstration
4. Seminars
5. Field visit

❖ SUGGESTED LEARNING RESOURCES :

1. **PRINT** : Text books/Reference books/Manuals/Journals.
2. **NON PRINT** : CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE (NOT APPLICABLE)**D. REFERENCE & TEXT BOOKS:**

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Highway Engineering	Khanna and Justo, Khanna	----

		Publication	
2.	Traffic Engineering	L.R. Kadiyali	----
3.	Transportation Engineering	N.L. Arora, S.P. Luthara, I.P.H. New Delhi	----
4.	Transportation Engineering	Vazarani & Chandola, Khanna Publication	----
5.	Road, Railway, Bridges	Biridi & Ahuja., S.B.H.New Delhi	----
6.	Transportation Engineering	Kamala., T.M.H. New Delhi	----
7.	DATA book of P.W. D.	--	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Mr. A. W. Pawde	Lecturer in Civil Engg	Govt Polytechnic, Nagpur
2.	Mr. R. N. Giradkar	H. O. D. Civil Engg. Dept.	Govt Polytechnic, Nagpur
3.	Dr. D. K. Parbat	Lecturer in Civil Engg	Govt Polytechnic, Sakoli

(Member Secretary PBOS)

(Chairman PBOS)

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COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE1403****COURSE TITLE : TRANSPORTATION ENGINEERING****PREREQUISITE : NIL****TEACHING SCHEME: TH :04; TU:00; PR :02; TOTAL CREDITS: 06 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	25@	---	125
MIN.	32	--	40	---	10	---	--

(# - External & Internal Assessment ; @ - Internal Assessment only)**TIME ALLOTTED FOR TERM EXAM : 03 HRS.****TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.****❖ RATIONALE :**

Transportation of people & goods is carried on land, through water and air. Railways are categorised under transportation system. It promotes nation's wealth by keeping its people & goods moving. Railways are therefore compared with arteries in a human body, which maintains person's health by the circulation of blood through these arteries. Thus, the progress of a nation depends much on railways. Hence, they are the lifelines of nation's economy

❖ OBJECTIVES :**After completing this course students will –**

- Know component parts of railway, bridges tunnels.
- Understand methods of survey and investigation of alignment of railway, bridges and tunnels.
- Supervise construction and maintenance of the railway, bridges and tunnels.

❖ SKILLS:

1. To supervise construction of railway track
2. To repair and maintain the railway track.
3. To supervise the small work in bridge construction.
4. To work out the hydraulic design of culvert.

CONTENTS :**A. THEORY :**

Sr. No.	CHAPTER		MARKS	HOURS
1.	OVERVIEW OF TRANSPORTATION ENGINEERING		04	04
	1.1	Role of transportation in the development of nation.		
	1.2	Modes of transportation system – roads, railway, airways, waterways, Importance of each mode, comparison and their relative merits and demerits.		
	1.3	Necessity & importance of cross drainage works for roads		

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RAILWAY ENGINEERING				
2.	Alignment and Gauges		06	04
	2.1	Classification of Indian Railways, zones of Indian Railway. Alignment- Factors governing rail alignment.		
	2.2	Rail Gauges – types, factors affecting selection of gauge. Rail track cross sections – standard cross section of BG & M.G single & double line in cutting and embankment.		
3.	PERMANENT WAYS		06	04
	3.1	Ideal requirement, component parts. Rails – types, function. Rail Joints – requirements, types, Creep of rail, causes & prevention of creep. Sleepers – functions & Requirement, types – wooden, metal, concrete sleepers & their suitability, sleeper density. Ballast – function & different types with their properties, relative merits & demerits. Rail fixtures & fastenings – fish plate, bearing plates, spikes, bolts, keys, anchors & anti creepers.		
4.	RAILWAY TRACK GEOMETRICS		08	06
	4.1	Coning of wheels, tilting of rails, Gradient & its types, Super elevation, limits of Super elevation on curves, cant deficiency negative cant, grade compensation on curves.		
5.	BRANCHING OF TRACKS		08	06
	5.1	Definition of point & crossing, a simple split switch turnout consisting of points and crossing lines. Sketch showing different components, their functions & working. Line sketches of track junctions-crossovers, scissor crossover, diamond crossing, triangle. Inspection of points and crossings.		
	5.2	Track Maintenance- Necessity, types, Tools required and their function, organisation, duties of permanent way inspector, gang mate, key man.		
6.	STATION AND YARDS		04	04
	6.1	Site selection for railway stations, Requirements of railway station, Types of stations (way side, crossing, junction & terminal)		
	6.2	Station yards , types of station yard, Passenger yards, Goods yard Locomotive yard – its requirements, water column , Marshalling yard – its types.		
BRIDGE ENGINEERING				
7.	SITE SELECTION AND INVESTIGATIONS		04	03
	7.1	Factors affecting selection of site of a bridge. Bridge alignment Collection of design data Classification of bridges according to function, material, span, size, alignment, position of HFL.		
8.	COMPONENT PARTS OF BRIDGES.		12	10
	8.1	Plan & sectional elevation of bridge showing component parts of, substructure & super structure. Different terminology such as effective span, clear span, economical span, waterway, afflux, scour, HFL, freeboard, etc.		
	8.2	Foundation – function, types Piers-function, requirements, types. Abutment – function, types Wing walls – functions and types. Bearing – functions, types of bearing for RCC & steel bridges. Approaches –in cutting and embankment. Bridge flooring- open and solid floors.		

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9.	PERMANENT AND TEMPORARY BRIDGES-		04	04
	9.1	Permanent Bridges - Sketches & description in brief of culverts, causeways, masonry, arch, steel, movable steel bridges, RCC girder bridge, prestressed girder bridge, cantilever, suspension bridge.		
	9.2	Temporary Bridges- timber, flying, floating bridges.		
10.	INSPECTION & MAINTENANCE OF BRIDGES.		04	03
	10.1	Inspection of bridges Maintenance of bridges & types – routine & special maintenance.		
TUNNEL ENGINEERING				
11.	INTRODUCTION TO TUNNEL ENGINEERING		04	04
	11.1	Definition, necessity, advantages, disadvantages		
		Classification of tunnels. Shape and Size of tunnels Tunnel Cross sections for highway and railways.		
12.	TUNNEL INVESTIGATIONS AND SURVEYING		04	03
	12.1	Tunnel surveying locating center line on ground, transferring center line inside the tunnel. Shaft - its purpose & construction.		
13.	METHODS OF TUNNELLING		12	09
	13.1	Soft rock-needle beam method, fore-poling method. Line plate method, shield method. Methods of tunnelling in Hard rock-Full-face heading method, Heading and bench method, drift method.		
		13.2		
	Total		80	64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Sr.No.	Title of Practical/Lab. Work/Assignments	Hrs.
Drawing work: It shall consist of drawing (with suitable scale) & sketches (not to scale) with H or HB pencils on A-4 size drawing plates.		
1.	Cross section of Double line B.G./M.G. Track in Embankment/Cutting on straight path/curved path	06
2.	One detailed & other line diagrams of all types of points & crossings double turnout, sidings, acute & obtuse angle crossings, ladder crossings, diamond crossing etc.	06
3.	Detailed drawing of a pipe culvert with suitable scale showing plan (@ two different levels), elevation & section.	08
	Visits :- Visit report should be very concise.	
4.	Visit to construction site of Bridge /Culvert and Report on it	06
5.	Visit to Railway station or section to explore the following points - Gauge - Different fixtures & fastenings such as pandrol clips, Fishplates, bolts, anticreepers etc. conning of wheels, tilting of rails, creep of rails, stub & split switch, different points & Crossings etc. - Width of platform - Height of platform - R.L. of the place - No. of working tracks - Type of station- - Type of sleepers used	06

	- Sleeper density - No. of trains/day - Gradient provided - Type of ballast	
Total		32

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term end oral/practical examination.

❖ **SUGGESTED LEARNING RESOURCES :**

- i. **Lecture method**
- ii. **Q & A technique**
- iii. **Case study**
- iv. **Demonstration**
- v. **Seminars**
- vi. **Field Visits**

❖ **SUGGESTED LEARNING STRATEGIES :**

1. **PRINT** : Text books/Reference books / Drawing of related chapters.
2. **NON PRINT** : CDS / PPT / Transparencies / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Overview of Transportation Engineering	06	04	02	--	06
2.	Alignment and Gauges	09	06	03	--	09
3.	Permanent Ways	09	06	--	03	09
4.	Railway Track Geometrics.	12	06	03	03	12
5.	Branching of Tracks	12	08	04	--	12
6.	Station and Yards	06	04	--	02	06
7.	Site selection and Investigation	06	04	--	02	06
8.	Component parts of Bridges	18	10	04	04	18
9.	Permanent and Temporary Bridges	06	04	02	--	06
10.	Inspection & Maintenance of Bridges	06	04	--	02	06
11.	Introduction to Tunnel Engineering	06	04	02	--	06
12.	Tunnel Investigations and Surveying	06	04	--	02	06
13.	Methods of Tunnelling	18	10	04	04	18
Total		120	74	24	22	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Railway Engg	Saxena and Arora	----
2.	Railway engg	Agarwal	----

3.	Road, Railway & Bridges	Ahuja & Birdi	----
4.	Tunnel Engg	Saxena	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Dr D K Parbat	Lecturer in Civil Engg	Govt Polytechnic, Sakoli
2.	Prof. A. W. Pawde	Lecturer in Civil Engg	Govt. Polytechnic, Nagpur
3.	Prof. R. N. Giradkar	HOD, Civil Engg. Dept	Govt. Polytechnic, Nagpur
4	Prof. R. M. Walke	Lecturer in Civil Engg	Govt. Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.
(An Autonomous Institute of Govt. of Maharashtra)
COURSE CURRICULUM

PROGRAMME : DIPLOMA IN CIVIL ENGINEERING

LEVEL NAME : APPLIED TECHNOLOGY

COURSE CODE : CE 1404 ^(S)

COURSE TITLE : WATER RESOURCES ENGINEERING

PREREQUISITE : NIL

TEACHING SCHEME: TH :04; TU :00; PR :02; TOTAL CREDITS: 06 (Hrs/Week)
(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	25@	25#	150
MIN.	32	--	40	---	10	10	--

(# - External & Internal Assessment ; @ - Internal Assessment only; \$-Award of Class Course)

TIME ALLOTTED FOR TERM EXAM : 03 HRS.

TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.

❖ **RATIONALE:**

Irrigation is an important civil engineering subject as our country being an agricultural country its significance in Indian condition is great. This is specially due to water needed for the cultivation throughout the year but irregular rainfall obtain mostly in 3 to 4 months of the year Thus whatever water obtained is required to be store and use carefully throughout the year. Similarly the water tapped from wells, tube-wells & other sources has to be transported over a long distance to supply crops of different type.

To fulfill the crop requirement of the nation, the cultivation of various crops is required to be carried out throughout the year. Thus irrigation plays the vital role to fulfill the water requirements of the crop. It is essential that technicians in civil engineering become aware of basic background of theory & practice and acquire the skill of understanding the importance & necessity of various irrigation structures. The purpose of learning this subject is to prepare students to efficiently supervise and construct & maintain various irrigation structures.

❖ **OBJECTIVES :**

After completing this course students will be able to–

- Necessity and importance of irrigation in our country.
- Various irrigation schemes.
- Factors for selecting various types of irrigation works.
- Principles of distribution system.
- Methods of construction of various irrigation structures.
- Maintenance of various irrigation structures.

❖ **SKILLS :**

The student will acquire the following skills:

1. Selection of various irrigation works as per local condition.
2. Method of construction of various irrigation works.
3. Selection of appropriate method of irrigation as per the crop requirement.

4. Know the importance of various components of distribution system.
5. Maintenance of various irrigation works.

CONTENTS :**A. THEORY :**

SR. NO.	CHAPTER		MARKS	HOURS
1.	INTRODUCTION		03	02
	1.1	Definition of irrigation, Concept, necessity, scope and development of irrigation in India. Benefits of Irrigation, possible ill effects of over- irrigation,		
	1.2	Types of irrigation schemes, single & multipurpose projects.		
2.	HYDROLOGY		08	07
	2.1	Hydrological Cycle, Rainfall, Factors affecting rainfall, Characteristic of rainfall in India, Average Rainfall calculations using.(a) Thiessen polygon method. (b) Isohyetal method (c) Arithmetic Mean method. Numerical on Average Rainfall calculations		
	2.2	Catchment area, definition & types, Run-off coefficient, calculation of run-off from 1. Rainfall records, 2. River gauging 3. Inglis formula		
	2.3	Max. Flood discharge from catchments area , Purpose & methods of determination by using (a) Inglis formula, (b) Past flood records Numerical		
3.	WATER REQUIREMENT OF CROP		08	07
	3.1	Crops in Maharashtra, cropping seasons in Maharashtra, Kharip, Rabi, Hot weather & Perennial, Study of different systems of applying water to the crop. Base period, Crop period for a crop.		
	3.2	Duty and Delta: Factors affecting duty, Methods of improving duty, Gross, Culturable and Irrigable command area, time factor, capacity factor, numerical on water requirements and capacity of canal.		
4.	RESERVOIR PLANNING		09	08
	4.1	Different surveys for reservoir planning, area – capacity curve, computation of capacity of reservoir, suitability of foundation, silting of reservoir, Factors affecting silting, Methods to reduce silting, evaporation from reservoir.		
	4.2	Calculation of dead storage, live storage, gross storage. Flood absorption capacity of reservoir, Fixing control levels – dead storage level, Full reservoir level, high flood level and top of bund level, simple calculations of fixing of control levels. numerical		
5.	DAMS AND SPILLWAYS		17	15
	5.1	Types of dams- Gravity (Masonry, Concrete) and Earthen dams, choice of type of dam.		
	5.2	Gravity dams – Forces acting on dams, theoretical and practical profiles, construction details, drainage gallery, transverse and longitudinal joints in concrete dam.		
	5.3	Earthen dams – Components of earthen dam and their function, typical cross section of an earthen dam, construction material used, seepage through earthen dams, methods to reduce seepage through embankment and foundation, construction procedure of earthen dams, causes of failure, outlets through earth and masonry dams, functions and component parts.		
	5.4	Percolation tank – Necessity, selection of site, component parts.		
	5.5	Spillways- purpose, Ogee spillway with and without gates, Saddle/ Chute spillway , Side channel spillway emergency spillway, length & flood lift required for spilling. Tainter gate		

Syllabus 2021				
6.	BANDHARA AND BARRAGE		05	04
	6.1	Component parts of Bandhara, advantage, disadvantage, construction of Kolhapur type bandhara.		
	6.2	Barrages – Components and their functions, layout of typical barrage, situation favoring construction of barrage, comparison between weir and barrage. with respect of crest level, afflux during flood, clearance of flood, silting.		
7	DIVERSION HEAD WORKS		05	03
	7.1	Necessity of diversion head work, Layout of diversion head work, weir, silt excluder, channel head regulator, fish ladder, divide wall.		
8	CANALS		11	09
	8.1	Alignment of canals, classification of canals according to alignment, ridge, contour, side slope canal, types of canal according to position in network –main canal, branch canal, distributaries, field canals, function of each canal in the network, typical canal section, ,		
	8.2	Definition of Critical velocity, expression of critical velocity given by Kennedy ,critical velocity ratio no Numerical		
	8.3	Balancing depth of canal Numerical		
	8.4	SardaFall, glacier fall		
	8.5	Canal lining – purpose and common material used, properties determining the suitability of lining material, advantages of canal lining, maintenance of canal.		
9.	CANAL CROSS DRAINAGE WORK		04	02
	9.1	Cross drainage work, aqueduct, siphon aqueduct, super-passage, level crossing, cross regulator, head regulator, escapes.		
	9.2	Simple or non modular outlets on canal.		
10.	LIFT, SPRINKLER AND DRIP IRRIGATION SYSTEM		05	04
	10.1	Lift Irrigation-advantages and disadvantages of Lifting irrigation.		
	10.2	Quality parameters for sprinkler and drip irrigation , layout of scheme, component parts, merits & demerits, maintenance of scheme, common care & precautions to be taken for efficient working.		
11	WATER LOGGING AND WATER ASSESSMENT		05	03
	11.1	Causes of water logging, effect of water logging, prevention and remedial measure against, water logging, salt efflorescence- Method of preventing salt efflorescence, Reclamation of land affected by water logging and salt efflorescence.		
	11.2	Water rates- Volumetric assessment based and area under crop.		
Total			80	64
B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS: (Term work shall consist of following lab work/assignments/visit report. Oral is based on TW)				
S.No.	Detailed sketches of following on A4 size plate			Hrs.
1.	Typical cross-section of earthen dam showing its all components			02
2.	Cross-section of earthen dam as per locally available material (and three type)			04
3.	Layout of drainage in earthen dam			02
4.	Sketch of Ogee spillway with gate and energy dissipation arrangement			04
5.	Kolhapuri type weir (plan & sectional elevation)			04
6.	Diversion head work, detailed sketch of any one component of it. (Divide wall / Silt excluder / Fish ladder)			04
7.	Canal cross- drainage work i.e. Aqueduct, super passage, level crossing (any two)			04
8.	Layout of lift irrigation scheme with source as river & canal.			02
C. VISIT				
- 17 -				

9.	Detailed reports with sketches should be written on the visit to Irrigation structures dam, spillway or Irrigation canals structures.	06
	Total	32

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term end oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Case study**
5. **Seminars**
6. **Field visit**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Introduction	05	03	02	-	05
2.	Hydrology	12	03	05	04	12
3.	Water Requiremnt Of Crop	15	04	04	07	15
4.	Investigation And Reservoir Planning	13	05	04	04	13
5.	Dams And Spillways	25	10	07	08	25
6.	Bandhara, Percolation Tank	07	03	02	02	07
7.	Diversion Head Works	07	03	02	02	07
8.	Canals	16	06	04	06	16
9.	Cross Drainage Work	06	02	02	02	06
10.	LIFT Sprinkler AND Dripirrigation	07	02	02	03	07
11	Water Logging And Water Assessment	07	02	02	03	07
	Total	120	43	36	41	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Irrigation and Water Power Engineering	B. C. Punmia, Pande B.B. Lal Laxmi Publication, Delhi, 2010	8131807637
2.	Irrigation and Hydrauloc Structure	S. K. Garg, Khanna Publisher, New Delhi, 2010.	8174090479

3.	Irrigation and Water Resources Engg.	G. L. Asawa New Age International, 2006	8122416738
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E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Mr. R.N.Giradkar	HOD, Civil Engg. Dept	Govt. Polytechnic Nagpur
2.	Mr. A.W.Pawde	Lecturer in Civil Engg.	Govt. Polytechnic Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE1405****COURSE TITLE : CONTRACT, ACCOUNT & VALUATION.****PREREQUISITE : CE 1401, ESTIMATING AND COSTING.****TEACHING SCHEME: TH :04; TU:00 , PR :02; TOTAL CREDITS: 06 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	50@	25#	175
MIN.	32	--	40	---	20	10	--

(# - External & Internal Assessment ; @ - Internal Assessment only)**TIME ALLOTTED FOR TERM EXAM : 03 HRS.****TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.****❖ RATIONALE :**

The course is an extension of “Estimating and costing”. This is a core technology course which will enable the student to know the different facts concept & procedure of valuation of property, tender and tender documents, contracting procedure , P.W.D. account and execution method , working knowledge of stores and stock account, preparation of contractor’s bill, materials accounts etc. & also knowing about various formats used by P.W.D. for accounting purpose.

❖ OBJECTIVES :

After completing this course students will be able to –

- do the valuation of property.
- Know the P.W.D. method of execution of work.
- draft tender notices for various civil engineering works.
- get familiar with tender and tendering procedures.
- know the various contract types and procedure.
- prepare bills for work done , to make the different payments to the contractor
- know the procedure of maintaining accounts of materials at site, road metal return accounts, Imprest cash accounts and store and stock accounts.

❖ SKILLS : Students will acquire the following skills ---

1. Determining the value of property by using various methods of valuations.
2. Knowing the P.W.D. method of execution of works and also maintaining the measurement book, muster roll etc.
3. To know the departmental work methods through NMR, Rate list.
4. To maintain the material at site account, Imprest cash account etc.
5. Preparing all documents related to tenders.
6. Preparing the contract document.
7. Preparing the bills of work done and arrange to the payments to the contractors.

CONTENTS :
A. THEORY :

SR. NO.	CHAPTER	MARKS	HOURS
1.	VALUATION.	13	10
1.1	Definition of cost, price & value & their difference. Definition of valuation and necessity of valuation.		
1.2	Different type of value : - (a) Book value, (b) Scrap value (c) Salvage value (d) Speculative value (e) Distress value (f) Market value (g) Monopoly value (h) Sentimental value (i) Accommodation value etc. And factors affecting the value of property.		
1.3	Depreciation, Obsolescence, Sinking fund. (A) Method of calculation of depreciation: – Straight Line Method, Sinking Fund Method, and Constant Percentage Method And Quantity Survey Method.		
1.4	Determination of Capitalized Value, Gross Income, Outgoing, Net Income, Years Purchase, Types of outgoing & their percentage.		
1.5	Free hold and Lease hold property.		
1.6	Meaning of Rent, Gross rent and Net rent. Determining the Rent of Property.		
1.7	Valuation of lands and buildings, Factors affecting the valuation, Book value method and Comparison method. Use of Valuation method		
2.	PUBLIC WORKS DEPARTMENT METHOD OF EXECUTION OF WORKS.	08	08
2.1	P.W.D. Procedure of initiating the works, Classification of Works, Administrative Approval, Technical Sanction, Expenditure Sanction, Budget Provision.		
2.2	Method of execution – (a) Departmental method by employment of labours on daily wages. (b) Contracts methods (only introductory); Rate List Methods, Piece Work Method, & Day Work Method.		
2.3	Nominal Muster Roll (all three part) Measurement Books & Rules regarding recording measurements in M.B., Standard Measurement Book & Rules regarding recording measurements in S.M.B.		
3.	TENDERS AND TENDER DOCUMENTS.	12	10
3.1	Definition of tender, Necessity of Tenders, Types - (a) Local Tender (b) Global tender		
3.2	Tender notice, Points to be included while drafting Tender Notice, drafting of Tender Notice, Pretender Conference, Preparation and submission of Tender, Three envelop system, Tender Forms		
3.3	Procedure for opening, scrutiny and acceptance of Tender. Rejection of lowest Tender and Rejection of all Tenders, Issue of work order, comparative statement, and unbalance bid.		
3.4	Tender documents -- Schedule A, Schedule B, Schedule C		
4.	ESSENTIALS OF CONTRACT	20	16
4.1	Definition of contract as per Indian contract act 1872, objects of contracts, essential requirements of valid Contract, conditions of		

		contract, special conditions, clauses, schedules.		
	4.2	Types of contracts (a) Lump sum contract (b) Item Rate Contract (c) Percentage Rate Contract (d) Cost Plus Fixed Fee Contract (e) Cost Plus Percentage Contract (f) Turnkey Contract (g) BOT Contract / BOLT contract (h) Target Contract (i) Labour Contract (j) Negotiated Contract (k) Cost Plus Fluctuating Fee Contract (l) Demolition Contract (m) All in One Contract.		
	4.3	Contract document, registration of contractor.		
	4.4	Contract condition – (a) Earnest money deposit (b) Security deposit (c) Time Limit (d) Time extension (e) Breach of contract (f) Termination of contract (g) Subletting of contract, (h) Defects liability period (i) Escalation (j) Extra items (k) Termination of contract (l) Arbitration.		
5.	PAYMENTS TO THE CONTRACTORS.			
	5.1	Mode of payments to the Contractors - Interim Payments, Final Payments, First and Final Payments, Intermediate Payments.		
	5.2	Advances to the contractors – (a) Secured Advances (b) Advance Payments (c) Petty Advances (d) Mobilization Advances/ Machinery advances, Imprest, Temporary advance.	10	07
	5.3	Forms of Bills and Vouchers, Hand Receipts.		
6.	MATERIALS AT SITE ACCOUNTS & ROAD METAL RETURN.			
	6.1	Meaning of Materials at Site Accounts. Form used for register of Materials at Site Accounts. Form no. 35- Detailed statement of materials compared with Estimated Requirements. Form no. 37- Reporting the value and verification of unused Materials. Form no. 38- Statement showing disposal of unused material at site.		
	6.2	Salient features of materials at Site Accounts, Issue of materials to contractors, accounts of materials directly charge to work site, Disposal of Surplus Materials.	06	05
	6.3	Circumstances under which the materials charged directly to work - case (i) The Materials issued in a small quantity and when the work done departmentally, case (ii) The Materials issued in huge & large quantity & the reserve stock limit over, case (iii) When the work is done through contractors on labour basis.		
	6.4	Meaning of Road Metal Return, used of Form no. – 16, Form no. – 16/16A and Form no. – 17		
	6.5	Rules of maintaining the Road Metal Return, Shortage & Surplus Road Metal		
7.	IMPREST CASH ACCOUNT / IMPREST & IMPREST ACCOUNT.			
	7.1	Definition of Imprest cash/ Imprest, purpose of Imprest, nature of Payments of Imprest, use of Form no. – 2 or PW A/D 3 for Imprest cash account	05	03
	7.2	Rules/Procedure to maintained Imprest; granting limits and responsibilities of Imprest to Imprest cash holders.		

8.	STORES AND STOCK ACCOUNTS.		06	05
	8.1	Meaning of store & stock; Classification of stores – (a) General Store and Stock (b) Tools & plants (c) Road Metal Accounts (d) Inflammables Materials (petrol, oil and lubricants) Accounts.		
	8.2	Accounting procedure of stores; Procedure for purchase of stores materials, safe custody at store.		
	8.3	Indent for issue of materials, Issue arte; Unstamped receipt; Sales and write off stores.		
	8.4	Stock accounts; Reserve Stock Limit; Physical Verification of Stock; Indemnity Bond, Credit Note.		
Total			80	64

B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

Sr.No.	Title of Practical/Lab. Work/Assignments	Hrs.
1.	Collection of Tender notices Published in News Papers for – (a) W.B.M. road (b) Residential Building (c) Any three civil Engineering structure except (a) & (b) of Govt. deptt. / Undertaking Govt. deptt. / Public (Local) bodies	02
2.	Collecting old set of Tender documents & writing a report on it.	04
3.	Preparing a Tender document stated below for W.B.M. road or Residential building covered in estimating and costing (CE.....) (a) Tender Notice (b) Tender Agreement (c) Condition of contract (related with W.B.M. Road or Residential Building) (d) Schedule A (e) Schedule B	10
4.	Collection of various accounts forms stated below from P.W.D. and writing on it. (a) Ruling the forms of nominal Muster Roll. (All three type) (b) Measurement book (c) Daily labour Report. (d) Rate list. (e) Hand receipt. (f) Form of materials at site account. (g) Road Metal Return account. (h) Form of Imprest. (i) Form of Indent for issue of materials.	16

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term end oral examination.

❖ **SUGGESTED LEARNING RESOURCES :**

- i. **Lecture Method**
- ii. **Q & A technique**

❖ **SUGGESTED LEARNING STRATEGIES :**

1. **PRINT** : Text books/Reference books.
2. **NON PRINT** : / PPT / Transperencies

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total

1.	Valuation	18	08	04	06	18
2.	Public Works Department method of execution of works	12	04	08	-	12
3.	Tenders and tender documents	21	08	13	-	21
4.	Contracts and condition of contracts	33	08	16	09	33
5.	Payments to the contractors	12	06	06	-	12
6.	Materials at site accounts & Road metal Return	09	06	03	-	09
7.	Imprest cash account / Imprest & Imprest Account	06	02	04	-	06
8.	Stores and Stock Accounts	09	03	06	-	09
Total		120	45	60	15	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Valuation Of Real Properties	S. C. Rangwala, charotar publication, court rd. Anand – 388001	----
2.	Contracts and Estimating	B. S. Patil, Orient Longman Ltd. Hyderabad	----
3.	Estimating, Costing, Specification and Valuation	M. Chakraborty; 21 B Bhabananada Rd., Calcutta - 7000 26	----
4.	Estimating & Costing	B. N. Datta, UBS Publisher, Distributor Pvt. Ltd. New Delhi.	----
5.	Estimating & Costing	Vazirani & chandola	----
6.	Text book of Estimating & Costing	G. S Birdie , Dhanpat rai & sons, Delhi	----
7.	Contracts, Tender & Accounts	Dr. S. V. Deodhar, Central Techno Publication-23 Central Bazar Rd. Nagpur	----
8.	P.W.D. Account code	P.W.D. Govt. of Maharashtra	----
9.	P.W.D. Manual	Govt. of Maharashtra	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Teaching Experience	Designation	Institute / Industry
1.	Satish R. Ukey	22 years	Lect. (Sl. Gr.)in Civil Engineering	Govt. Polytechnic Nagpur
2.	Shrikant D. Atey	22 years	Lect. (Sl. Gr.)in Civil Engineering	Govt. Polytechnic Nagpur
3.	S. K. Rangari	20 years	Lect. in Civil Engineering	Govt. Polytechnic Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.**(An Autonomous Institute of Govt. of Maharashtra)****COURSE CURRICULUM****PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE1406 ^(S)****COURSE TITLE : ENVIRONMENTAL ENGINEERING****PREREQUISITE : NIL****TEACHING SCHEME: TH :04; TU :00; PR :02; TOTAL CREDITS: 06 (Hrs. per Week)**
(1 CREDIT = 1 CLOCK HR.)**EVALUATION SCHEME:**

MARKS	THEORY			PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	--	--	25#	125
MIN.	32	NIL	40	--	--	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only; \$- Award of Class Course)**TIME ALLOTTED FOR TERM EXAM : 03 HRS.****TIME ALLOTTED FOR PROGRESSIVETEST : 01 HR.****RATIONALE :**

Water and air are the basic needs of every living being. So maintaining supply of these basic necessities in adequate quantity and in desired pure form have assumed a great importance especially in view of the rapid accelerated growth of industries and the consequent water. A huge quantity of waste products in solid, liquid and gaseous form are generated by living –being after the use of food, water & air etc. If these are not disposed off in scientific and hygienic manner, the environmental balance gets disturbed which ultimately leads to health hazard. Environmental Engg. is thus a study of interdependency of natural agencies and surrounding like lands, water, air, plant and animal life, etc for the convenience and use of mankind. With a view to provide adequate water supply of required quality and quantity to every village, town and city. Water supply schemes are being commissioned on large scale. Similarly efforts at different levels are being made to maintain healthy environmental conditions by providing efficient method of sewage disposal, making use of renewable sources of energy etc. Due to industrial growth in this country, Emphasis on pollution free air, water etc. has assured greater importance and hence engineering requirement of water supply and sanitation is of importance from the focal aspects of study under this subjects.

**OBJECTIVES :****After completing this course, students will be able to -**

- Estimate water demands.
- Analyse the quality of water.
- Suggest treatment required by knowing the quality of water.
- Know the sewerage system.
- Analyse the sewage.
- Suggest the waste water treatment.

SKILLS :

Students will acquire the following skills:

1. Supervise construction and execution of medium size environmental engineering projects for town or village.
2. Prepare working drawing for the environmental project for town or village.
3. Operation and maintenance of water supply and sewage disposal scheme.

CONTENTS :**A. THEORY :**

SR. NO.	CHAPTER	MARKS	HOURS
1.	INTRODUCTION:	04	02
	1.1 Need for protected water supply, water borne diseases.		
	1.2 Surface and subsurface sources of water.		
	1.3 Intake structures definition and types.		
2.	ESTIMATION OF DEMAND OF WATER	06	04
	2.1 Demands of water – Domestic, Industrial, Commercial, Public, Fire demand, Losses and wastages.		
	2.2 Rate of demand, Factor's affecting rate of demand, variations of rate of demand.		
	2.3 Design period for water supply scheme.		
	2.4 Forecasting of population – Methods of forecasting, Numerical problem on forecasting of population.		
	2.5 Estimation of total quantity of water for a town/city.		
3.	QUALITY OF WATER	08	08
	3.1 Meaning of potable water.		
	3.2 Impurities present in water and it's classification.		
	3.3 Need for analysis of water.		
	3.4 Tests on water- Physical test for colour, taste. Odour and Turbidity; Chemical test for total solids, Hardness, Chlorides, Dissolved oxygen, pH, Fluoride, Nitrogen and it's compounds; Bacteriological test – E coli index, MPN.		
	3.5 Sampling of water, Precautions to be taken for collection of samples.		
	3.6 Water quality standards as per IS specifications.		
4.	TREATMENT OF WATER	10	10
	4.1 Aeration – Objects and method, aeration fountain.		
	4.2 Sedimentation – objects, plain sedimentation, sedimentation with coagulation, principles of coagulation, types of coagulation, process of coagulation, Types of sedimentation tanks, study of clariflocculator and it's working.		
	4.3 Filtration – objects and theory of filtration, filter media, classification of filters: Slow sand filters, rapid sand filters, construction, working and design aspects of slow sand filter and rapid sand filter, suitability merits and demerits, back working of rapid sand filters.		
	4.4 Disinfections - objects and methods, Chlorination – different forms, Application of chlorine, Residual chlorine and it's importance.		
	4.5 Components of water treatment plant.		
5.	CONVEYANCE AND DISTRIBUTION OF WATER	08	06
	5.1 Different types of pipes used for conveyance of water, choice of pipe material.		
	5.2 Joints in cast iron pipes and concrete pipes.		

	5.3	Laying of pipes, testing of pipe line – pressure test and leakage test		
	5.4	Valves – types, functions, use and location on a pipe line.		
	5.5	Methods of distribution of water- Gravity, pumping and combined system.		
	5.6	Layouts of distribution of water – Dead end, Grid iron, Circular and radial system; their suitability, merits and demerits.		
6.	SANITARY ENGINEERING			
	INTRODUCTION			
	6.1	Necessity of building sanitation	02	01
	6.2	Term – Sewage, sullage, refuse, garbage, rubbish, storm water, domestic sewage.		
7.	BUILDING SANITATION			
	7.1	Terms- Water pipe, Rainwater pipe, Soil pipe, Sullage pipe, Vent pipe.	04	03
	7.2	Building sanitary fittings- Water closet, Flushing cistern, Wash basin, Sink, Urinals, Traps – Types, their function and location. Inspection chambers.		
8.	SYSTEMS OF SEWAGE			
	8.1	System of sewerage – Separate system, Combined system, Partially separate system, their comparison and suitability.	10	09
	8.2	Types of sewers – Their comparison, suitability and selection.		
	8.3	System of sewerage		
	8.4	Laying, testing and maintenance of sewers.		
	8.5	Sewer Appurtenances: Manholes and drop.		
	8.6	Manholes: their component parts, location, spacing, construction details, sewer inlets street inlets.		
9.	TREATMENT OF SEWAGE			
	9.1	Characteristics of sewage, B.O.D. / C.O.D. and its significance, Aerobic and anaerobic process.	16	12
	9.2	Objects of sewage treatment general layout and flow diagram of sewage treatment plant, Grit chamber, skimming tank, sedimentation tank, sludge digestion tank, trickling filters, Activated sludge process.		
	9.3	Disposal of sewage, septic tank, Oxidation pond.		
10.	SOLID WASTE AND ITS DISPOSAL			
	10.1	Dry refuse, common constituents of dry refuse.	04	03
	10.2	Collection and method of disposal of dry refuse.		
11.	INDUSTRIAL WASTE			
	11.1	Industrial waste water, Characteristics of industrial waste water from following industry- Sugar, Dairy Textile, Paper and pulp.	04	03
	11.2	General idea regarding disposal of waste water from above industries.		
12	ENVIRONMENTAL POLLUTION			
	12.1	Air pollution – Its sources, effects and control (only brief idea)	04	03
	12.2	Noise pollution – Its sources, effects and control (only brief idea)		
	12.3	Global warming, Acid rain (only brief knowledge)		
Total			80	64

B.

LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:

(Term work shall consist of following lab work/assignments/visit report. Oral is based on TW)

S. No.	Title of Practical/Lab. Work/Assignments	Hrs.
1.	To determine the pH of a given water sample by using digital pH meter.	04

2.	To determine the turbidity of the given sample by using Turbidity meter.	04
3.	To determine residual chlorine of a given sample by Orthotolidine test.	04
4.	To determine fluoride concentration in given water sample.	04
5.	To determine the hardness of a given water sample by standard E.D.T.A. method.	04
6.	Design and drawing of septic tank and soak pit for hostel on half imperial sheet.	04
7.	Report on visit to the water treatment plant at Gorewada	04
8.	Report on visit to sewage treatment plant at Bhandewadi.	04
Total		32

❖ ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :

Continuous assessment of Term Work and Term end oral examination.

❖ SUGGESTED IMPLEMENTATION STRATEGIES :

1. Lecture method
2. Improved lecture method.
3. Q & A technique.
4. Demonstration
5. Case study
6. Seminars
7. Field visit

❖ SUGGESTED LEARNING RESOURCES :

1. **PRINT** : Text books/Reference books/Manuals/Journals.
2. **NON PRINT** : CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Introduction	06	04	01	01	06
2.	Estimation of demand of water	09	04	03	02	09
3.	Quality of water	12	06	03	03	12
4.	Treatment of water	15	08	04	03	15
5.	Conveyance and distribution of water	12	08	02	02	12
6.	Introduction to sanitary engineering	03	01	01	01	03
7.	Building sanitation	06	04	01	01	06
8.	Systems of sewerage	15	08	04	03	15
9.	Treatment of sewage	24	12	08	04	24
10.	Solid waste and it's disposal	06	04	01	01	06
11.	Industrial waste	06	04	01	01	06
12.	Environmental pollution	06	02	02	02	06
Total		120	65	31	24	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Environmental Engineering	Kamale and Kamth Rao	----
2.	Water supply & Sanitary Engg.	G. S. Birdi	----

3.	Water supply Engg.	V. N. Gharpure	----
4.	Water supply Engg.	Gurucharan Sing	----
5.	Water supply & Sanitary Engg.	S. C. Rangwala	----
6.	Water supply and Water disposal	Fair and Geyer	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof. R. M. Walke	Lecturer in Civil Engg.	G.P. Nagpur
2.	Prof. R. N. Giradkar	H.O.D. Civil Engg. Dept.	G.P. Nagpur
3.	Prof. S. D. Atey	Lecturer in Civil Engg.	G.P. Nagpur
4.	Prof. Ms. D. A. Khandare	Lecturer in Civil Engg.	G.P. Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE1407****COURSE TITLE : BUILDING SERVICES****PREREQUISITE : NIL****TEACHING SCHEME: TH :02; TU :00; PR :04; TOTAL CREDITS: 06 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	--	--	--	NIL	50@	25@	75
MIN.	--	--	--	---	20	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)**TIME ALLOTTED FOR TERM EXAM : NIL****TIME ALLOTTED FOR PROGRESSIVE TEST : NIL****❖ RATIONALE :**

Building cannot be used for occupancy unless various services required for effective working of a building are provided. In fact, good building services, if provided create a healthy & conducive working environment, in occupied buildings. They influence the architecture of a building and play a significant role on the sustainability and energy demand of a building. A Civil Engineer, with adequate knowledge of building services shall be able to work closely with Construction Professionals, Structural Engineers etc.

❖ OBJECTIVES :**After completion of this course, students shall be able to –**

- Understand various building services, required for the maintenance of building structures.
- Plan & design various building services required in residential & commercial buildings.
- Know various areas, wherein it is important to provide building services.

❖ SKILLS : After completion of this course, students shall acquire following skills-

1. Execute installation of water supply, sanitary, electrical, fire fighting systems in a building.
2. Organize for the maintenance of various systems, fittings, sanitary fixtures & building drainage systems.
3. Propose suitable water proofing/termite proofing & damp proofing treatments.

CONTENTS :
A. THEORY :

SR. NO.	CHAPTER		MARKS	HOURS
1.	PLUMBING			08
	1.1	Elements of plumbing Objectives of plumbing, purpose of plumbing, role of plumber, licensing of plumbers, their functions, systems of plumbing – One Pipe system, Two Pipe system, Plumbing arrangement for high rise buildings		
	1.2	Pipes joints & fittings Introduction. Types of Pipes – G.I. Pipes, PVC Pipes, Copper pipes, C.I. Pipes, A.C. Pipes, Prestressed concrete pipes, joints in pipes, method of fixing pipes such as G.I. fitting, C.I. fitting etc.		
	1.3	Valves & Terminal Fittings Types of valves & their purposes, Sluice valve, Reflux valve, Scour valve, Air relief valve, Pressure relief valve, Gate valves. Bio-taps & Stop valve, Self closing valve, Flush valve, Mixing valve etc.		
	1.4	Sanitary fixtures & Building drainage system Building sanitary fittings – water closets, flushing appliances, urinals, washbasins, flushing cisterns, principles of building drainage, traps & their types, Capacity & sizes of pipes, soil pipe, waste pipe, rain water pipe, Installation of pipes, testing of pipes etc.		
2.	WATER PROOFING TREATMENT			04
	2.1	Introduction, material required for water proofing and its specification.		
	2.2	Procedure of Water proofing of water closets and bathrooms.		
	2.3	Terrace and basement water proofing, precautions to be taken while water proofing.		
3.	TERMITE PROOFING			02
	3.1	Introduction, general principles of termite proofing.		
	3.2	Methods of termite proofing.		
	3.3	Material used in termite proofing treatment.		
4.	DAMP PROOFING			02
	4.1	Sources of dampness & its effects.		
	4.2	Material used for damp proofing.		
	4.3	Methods of damp – proofing. Damp proofing treatment in buildings such as basements, floors, walls etc.		
5.	ELECTRICAL WIRING			05
	5.1	Electrical wiring methods, Cleat wiring, Batten wiring, Wooden casing, Capping wiring, Conduit (metal & PVC), surface & concealed conduits.		
	5.2	PVC casing, capping.		
	5.3	Location of switch room, brief introduction to miniature circuit breaker(MCB) and earth leakage circuit breaker(ELCB)		
	5.4	Types of switch boards (Metal/wooden etc).		
6.	FIRE PROTECTION			05
	6.1	Fire protection requirement for multi storied building.		
	6.2	Fire detection – Manual Fire alarm system, Automatic fire alarm system.		
	6.3	Fire Extinguishing system – Manual fire extinguishing equipment, Fire Hydrants, Wet riser system (typical arrangement of wet riser –		

		cum - down comer for Aptt, houses above 15m but not exceeding 24m in height).		
7.	LIFTS & ESCALATORS			06
	7.1	Location of lifts.		
	7.2	Types of lifts – Passenger lift, Goods lift, Hydraulic lift, Cable borne lift.		
	7.3	Typical Cross Section of lift room.		
	7.4	Overview of Escalators.		
	7.5	Advantages of Escalators as compared to lifts.		
Total			---	32

B. LIST OF PRACTICALS/LABORATORY ASSIGNMENTS:

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
1.	Practical on joining P.V.C./G.I. Pipes & fittings/Models and writing report on the process.	06
2.	Practical based on sanitary fittings like, traps, wash basin & water closet fittings.	06
3.	Prepare drawing for water supply. Layout plan for Flat scheme G+2 showing various details:- Service pipe, communication pipe, consumer pipe, water meter, rain water pipes etc.	08
4.	Prepare drawing for drainage - line plan for Flat scheme G+2 showing various details: - Inspection chambers, sewage pipes, traps, man holes etc.	08
5.	Study of one pipe, two pipe plumbing system for residential building.	06
6.	Visit to a swimming pool to study the various systems therein & write a report on the same.	06
7.	Prepare a sketch book showing sketches of various types of joints in pipes, types of valves, sanitary fixtures etc.	06
8.	Draw a typical arrangement for wet riser – cum – downcomer for Aptt.	06
9.	Draw plan and Section of lift room showing details.	06
10.	Visit to a building site for study of different types of electrical casings, meter boards, meter room & prepare a report on the same.	06
Total		64

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work shall be done.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. Lecture method
2. Improved lecture method.
3. Q & A technique.
4. Case study
5. Field visit

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Hand books/Manuals/Journals.
2. **NON PRINT :** PPT / Transperencies / Charts/Models

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Water Supply & Sanitary Engg.	G.S.Birdi	

2.	Water Supply & Sanitary Engg.	S.C. Rangawala	
3.	Building Construction	Sushil Kumar, Standard Publication	8180141683
4.	National Building Code 2005	Bureau of Indian Standards, New Delhi	
5.	Building Construction	S.K. Sharma, S.Chand & Company	0861862910
6.	Sandeep Mantri	A to Z of practical building and its management, Mantri Institute of Development & research, Pune.	978-81-85594-86-6
7.	Prof.S.M. Patil	Building services, Patil Publication & Goregaon, Mumbai.	

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Prof.R.N.Giradkar	H.O.D. Civil Engg.	G.P.Nagpur
2.	Dr.(Mrs)R.A.Wankhade	Lecturer in Civil Engineering	G.P.Nagpur
3.	Prof.R.M.Walke	Lecturer in Civil Engineering	G.P.Nagpur
4.	Prof. A.W.Pawde	Lecturer in Civil Engineering	G.P.Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

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COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE 1408****COURSE TITLE : SEMINAR (CIVIL ENGINEERING)****PREREQUISITE : 90 CREDITS****TEACHING SCHEME: TH: - NIL - ; TU: - NIL - ; PR*: 02 ; TOTAL CREDITS: 02****(1 CREDIT = 1 CLOCK HR.) * 02 CREDITS FOR SEMINAR****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL / PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	--	--	--	--	50@	—	50
MIN.	--	--	--	--	20	—	---

(# - External & Internal Assessment ; @ - Internal Assessment only)

TIME ALLOTTED FOR TERM EXAM : - NOT APPLICABLE -**TIME ALLOTTED FOR PROGRESSIVE TEST : - NOT APPLICABLE -****❖ RATIONALE:-**

The students working in Civil Engineering field need to develop some additional skills and competencies to deliver their duties more effectively, efficiently, and confidently. They need to develop soft skills like presentation, literature survey, report writing, team building, leadership, etc. The course helps in inculcating the above skills.

❖ OBJECTIVES:-

The student will be able to:

- Carryout literature survey
- Carryout market survey
- Explore data and information through internet surfing
- Develop presentation skill.

❖ SKILLS:-

Following skills will be developed in students:

Intellectual Skills-

1. Analytical ability and logical thinking
2. Ability to identify, and define, the problem.
3. Teamwork and leadership.
4. To plan and manage time, task, and other resources
5. To present the report of work done.

Motor Skills-

1. To conduct market survey/internet surfing, etc.
2. To use computer for report writing and presentation.

CONTENTS:-**A. SEMINAR:**

SR. NO.	CHAPTER
1	SEMINAR:
	The students in group or individually in consultation with guide/faculty will carry out literature/market survey to select seminar topic. Scope and detailed content of the seminar shall be decided by the faculty. The students will prepare brief report of their work and present before the audience as per the directives of the faculty. The suggestive topics/ problems for the seminar may be from the following areas: - Building construction system - Surveying - Construction materials - Transportation Engineering - Irrigation Engineering - Environmental Engineering - Building Services - Any other topic from Civil Engineering.

B. ASSIGNMENT:

S. No.	ASSIGNMENT	Hrs.
1	The assignment shall consist of a brief and stage wise report of work done by the student during the entire term.	32
	TOTAL	32

❖ ASSESSMENT:

Continuous assessment of assignments and work done.

C. REFERENCE & TEXT BOOKS:

- 1) Handbooks and reference books of civil engineering.
- 2) Civil engineering magazines.
- 3) Relevant IS codes.
- 4) PWD handbooks.
- 5) Literature available on civil engineering websites, and other sources.
- 6) National Building code 2005

D LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. R. N Giradkar	H.O.D. Civil Engineering	Govt. polytechnic, Nagpur
2.	Shri. R. M. Walke	Lecturer, Civil Engineering	Govt. polytechnic, Nagpur
3.	Shri. A. W. Pawde	Lecturer, Civil Engineering	Govt. polytechnic, Nagpur
4.	Shri. V.B.Dhait	Lecturer, Civil Engineering	Govt. polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : CE 1409 \$****COURSE TITLE : PROJECT (CIVIL)****PREREQUISITE : 100 CREDITS AND CE1408****TEACHING SCHEME: TH :00; TU :00; PR :04; TOTAL CREDITS: 04 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	--	--	--	NIL	75@	50#	125
MIN.	--	--	--	---	30	20	--

(# - External & Internal Assessment ; @ - Internal Assessment only , \$ - Award of class course)**TIME ALLOTTED FOR TERM EXAM : --****TIME ALLOTTED FOR PROGRESSIVE TEST : --****❖ RATIONALE :**

Civil Engineer is concerned with the basic needs of living beings such as shelter, water and environment. He has to supervise the construction of buildings and structures for irrigation, transportation, water supply and sanitary system etc.

Apart from supervising construction and maintenance of civil engineering works a diploma technician has to carry out survey, collect, analyze and synthesize the data. He has also to refer handbooks, I.S.Codes and design the small structures on the basis of knowledge of different subjects. Due to changing scenario the role of diploma technician is becoming more prominent and has to acquire professional abilities and develop confidence to face civil engineering problems.

This subject is intended to apply civil engineering principles, rules and regulations to solve a real life problem and to provide a feasible solution. For this he will collect data through survey work and contacting various resources and prepare drawings and write a detailed project report .

The project and seminar activities will provide students the exposure to handle real life problems and their solutions and prepare him to enter in the world of work.

❖ OBJECTIVES :**After completing this course students will –**

- Collect the information for a given project.
- Apply principles, theorems and bye-laws in the project planning and design.
- Interpret and analyze the data.
- Develop professional abilities such as persuasion, confidence, perseverance and communication skill.
- Develop presentation skill.

❖ SKILLS :

1. Decide and collect data for projects.
2. Read and interpret the drawing, data.
3. Design the components.

CONTENTS :**A. THEORY : Not Applicable****B. LIST OF PRACTICALS/LABORATORY EXPERIENCES/ASSIGNMENTS:**

S.No.	Title of Practical/Lab.Work/Assignments	Hrs.
	LIST OF CIVIL ENGINEERING PROJECTS: Following are the suggested topics for Civil Engg. Project 1) K.T. Weir 2) Lift Irrigation scheme. 3) Micro irrigation –Drip/Sprinkler Irrigation. 4) Junction planning for city roads/planning for roads for congested area/parking Studies etc. 5) Water shed development of small catchments. 6) Rain water harvesting for domestic or public building. 12) Solid waste management. 13) Hospital waste disposal. 14) Recycling of resources. 15) Manufacturing of Pre-cast concrete products. 17) Non-conventional sources of energy. 18) Concrete pipe manufacturing unit. 19) Advance construction techniques. 22) Planning and design of small water treatment plant for given data. 23) Planning and design of water supply scheme for given lay out. 24) Planning and design of small sewage treatment plant for given data. 25) Planning and design of sanitary scheme for given lay out. 26) Any other civil engineering project The project report shall preferably be in the following format: • Topic and objectives • Collection of data, required survey work • Management and construction procedure • Resources scheduling and networking • Design details if any • Required drawing set • Utility to society if any • Conclusion •	64
	Total	64

❖ **ASSESSMENT OF LABORATORY EXPERIENCES/ASSIGNMENTS :**

Continuous assessment of Term Work and Term end oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. **Lecture method**
2. **Improved lecture method.**
3. **Q & A technique.**
4. **Demonstration**
5. **Case study**
6. **Seminars**
7. **Field visit**

❖ **SUGGESTED LEARNING RESOURCES :**

1. **PRINT :** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transperencies / Charts / Models
- C. **SPECIFICATION TABLE : Not applicable**

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	National Building code	----	----
2.	I.S.Code	----	----
3.	PWD Handbook	----	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. R. N Giradkar	H.O.D. Civil Enginnering	Govt. polytechnic, Nagpur
2.	Shri. R. M. Walke	Lecturer, Civil Enginnering	Govt. polytechnic, Nagpur
3.	Shri. A. W. Pawde	Lecturer, Civil Enginnering	Govt. polytechnic, Nagpur
4.	Shri. V. B. Dhait	Lecturer, Civil Enginnering	Govt. polytechnic, Nagpur

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COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES.****COURSE CODE : AM 1401****COURSE TITLE : DESIGN OF STEEL STRUCTURES****PREREQUISITE : AM1303****TEACHING SCHEME: TH :02; TU: 00 ; PR :04; TOTAL CREDITS: 06 (Hrs/Week)****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	50@	25@	175
MIN.	32	--	40	---	20	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only)**TIME ALLOTTED FOR TERM EXAM : 04 HRS.****TIME ALLOTTED FOR PROGRESSIVE TEST : 01 HR.****RATIONALE:-**

Steel structures are widely used in the construction of industrial building, workshops, railway bridges, Railway platforms and similar other structures. This subject is based on concept covered in Applied Mechanics, Mechanics of structure and theory of structure. The applications are being made in designing the component members. The subject will help students in carrying out constructions and inspection of works effectively, which happens to be a major activity of technicians. The reading and interpretation of structural drawing skill is required to be developed.

Following of I.S code recommendations and use of design aids will help them in understanding supervision aspects.

OBJECTIVES:-

The student will be able to :-

1. Read & interpret the structural drawing.
2. Understand basic principles of design of steel structure.
3. Design the different members.
4. Use IS-800-1984 in design.
5. Develop skill of Designing Steel structure components.

SKILLS:-

The student should be able to acquired following skills:-

1. Skill of Designing Steel structure components
2. Skill of reading & understanding steel structural drawings.
3. Skill of effective supervision of steel structure works at site.

CONTENTS :**A. THEORY :**

S.NO.	CHAPTER		MARKS	HOURS
1	TYPES OF SECTIONS USED IN STEEL STRUCTURES		04	02
	1.1	Types of structural steel sections, Relevant I.S codes for steel structures, Different grades of steel and their strengths, Advantages and		

		disadvantages of steel as a construction material, Different loads on steel structures, Tubular section.		
2	RIVETED, BOLTED AND WELDED JOINTS		12	05
2.1		Types of rivets and bolts. Types of riveted/bolted joints, Failure modes of riveted joints, strength of rivet, strength of plate, Rivet value, Efficiency of Riveted joint. Design criteria of bolted joints, high-tension bolts and bearing type joints.		
2.2		Design of bolted joint subjected to axial load, chain riveting, diamond riveting, minimum and maximum pitch of rivets used in structural frame.		
2.3		Concept of welded joints, Advantages and disadvantages of welded joints, classification of welds, Types of welded joints.		
2.4		Size of fillet weld, throat thickness, minimum size of welds, stresses developed in weld.		
2.5		Strength of welded joint, Design of welded joints and connections for symmetrical and unsymmetrical members carrying axial loads. Design of joint in a structural frame.		
3	TENSION MEMBER		12	04
3.1		Types of steel sections, Load carrying capacity of tension member, permissible stresses		
3.2		Net sectional area for plates and angles.		
3.3		Analysis and design of axially loaded tension member.		
3.4		Introduction to lug angle and tension splice		
4	COMPRESSION MEMBER		08	04
4.1		Types of steel sections Load carrying capacity of compression member, Definition of Effective length; Radius of gyration, Slenderness ratio and their limit, Simple and built up Compression member.		
4.2		Effective lengths for struts		
4.3		Analysis and design of compression member		
5	COLUMN AND COLUMN BASES		12	05
5.1		Simple and built up column. Effective lengths for column		
5.2		Analysis and Design of axially loaded columns		
5.3		Design of slab base and Gusseted base for axially loaded column.		
5.4		Introduction to lacing and battens (No problems)		
6	BEAM AND BEAM CONNECTIONS		12	05
6.1		Design of simply supported simple and Built up Beams (compression flange laterally restrained) for bending moment, check for shear and deflection, web buckling, web crippling.		
6.2		Types of connections, Beam to Beam, Beam to column (Framed connections only)		
6.3		Design of member connections.		
7	ROOF TRUSSES		12	04
7.1		Important terms related to truss, common types of steel roof trusses for different spans		
7.2		Calculations of Dead load, live load, wind load.		
7.3		Design of members of roof truss, Design of angle purlin, Design of connections		
7.4		Introduction to tubular trusses, merits and demerits		
7.5		Roofing materials-PVC, Asbestos cement sheets and Galvanized iron		

		sheets. Self weight, strength, advantages and disadvantages.		
8	PLASTIC THEORY		03	01
	8.1	Introduction, Assumptions in plastic theory, Plastic hinge, Plastic moment or collapse moment, Collapse load, Load factor, Shape factor		
9	PRE-ENGINEERED STRUCTURES		05	02
	9.1	Introduction to pre-engineered structures.		
	9.2	Concept, advantages and disadvantages of pre-engineered structures.		
	9.3	Applications and erection methodology.		
		TOTAL	80	32

B. TERM WORK:

(Term work shall consist of following lab work/assignment/visit report. Oral is based on TW)

SR. No.	Topic		Hrs.
I	SKETCH BOOK – It shall consist of five plates, which shall include important information of clauses from I.S codes, typical sketches of component in steel structures.		10
II	The term work shall consist of Design and Drawing of a factory shed with R.C.C slab supported on steel beams (Drawing on two A1 size sheets).		
	A	Drawing index plan and showing column positions	04
	b	Load calculations	06
	c	Design of secondary and main beams	10
	d	Design of columns and column bases	10
	e	Design of connections	08
	f	Drawing and detailing of different components of steel structures	16
	OR		
	The term work shall consist of design and drawing of a factory shed with roof truss. (Drawing on two A1 size sheets).		
	A	Drawing index plan and selection of roof truss	04
	b	Load calculations	10
	c	Analysis of roof truss by graphical method and load combinations	16
	d	Design of different components including support of roof truss	12
	e	Drawing and detailing of all components of roof truss with details of connections	12
		TOTAL	64

❖ **ASSESSMENT OF LABORATORY EXPERIMENTS:**

Continuous assessment of Term Work and oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

1. Lecture method
2. Assignments
3. Q & A technique.
4. Demonstration

SUGGESTED LEARNING RESOURCES :

1. **PRINT:** Text books/Reference books/Manuals/Journals.
2. **NON PRINT :** CDs / PPT / Transparencies / Charts / Models
- C. **SPECIFICATION TABLE :**

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Types of sections used in steel structures	06	04	02	--	06
2.	Riveted, bolted and welded joints	18	04	02	12	18
3.	Tension member	18	02	04	12	18
4.	Compression member	12	02	02	8	12
5.	Column and column bases	18	02	04	12	18
6.	Beam and beam connections	18	04	02	12	18
7.	Roof trusses	18	04	02	12	18
8.	Plastic theory	04	02	02	-	04
9.	Pre-engineered structures	08	02	02	04	08
Total		120	24	20	76	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Design of steel structure	L.S.Negi, Tata Mgraw Hill	0074623053
2.	Design of steel structure	Vazarani & Ratwani, Khanna publishers	
3	Design of steel structure	Dr.Ramchandra & Virendra Gehlot Scientific Publisher	9788172336547
4	Design of steel structure	S.K.Duggal, Tata Mc Graw Hill Publishing, Delhi	0070260680
5	Design of steel structure	Arya Ajmani New Chand & Brothers, Roorkee	
6	IS 800, IS 875 and Steel Tables	BIS	

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Y. K. CHANDARANA	HOD Applied Mechanics Dept.	Govt. Polytechnic, Nagpur
2.	R.N.NIBUDEY	Lecturer in Applied Mechanics Dept.	Govt. Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM

PROGRAMME : **DIPLOMA IN CIVIL ENGINEERING**

LEVEL NAME : **APPLIED TECHNOLOGY COURSES.**

COURSE CODE : **AM 1402 ^(S)**

COURSE TITLE : **DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES**

PREREQUISITE : **AM1305**

TEACHING SCHEME: **TH :02; PR :04; TOTAL CREDITS: 06 (Hrs/Week)**

(1 CREDIT = 1 CLOCK HR.)

EVALUATION SCHEME:

MARKS	THEORY			TUTORIAL/PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	80	20	100	NIL	25@	25#	150
MIN.	32	--	40	---	10	10	---

(# - External & Internal Assessment ; @ - Internal Assessment only , \$ - Award of class course)

TIME ALLOTTED FOR TERM EXAM : **04 HRS.**

TIME ALLOTTED FOR PROGRESSIVE TEST : **01 HR.**

❖ **RATIONALE:-**

Reinforced concrete material is widely used in the construction of residential building, public buildings and other civil engineering works. Principles of designing reinforced concrete structures are based on the concepts covered in Mechanics of structures and theory of structures. The properties of concrete have applications in designing components of Reinforced cement concrete Building. The basic principles of designing simple structure in Reinforced cement concrete shall help students in carrying out construction and supervision effectively which happens to be a major activity of technicians. The reading and interpretation of structural drawings is the basic skill required to be developed. The use of design aids is another ability to be possessed by technicians. It is therefore essential to provide adequate experience to students of reading structural drawings, following IS code requirements, using design aids in Limit state Method.

❖ **OBJECTIVES:-**

The student will be able to :-

1. Read & interpret the structural drawing.
2. Understand the basic principles of design of reinforced concrete sections.
3. Design the different members.
4. Understand principles and method of prestressing
5. Understand earthquake resistant criteria in design of structure.
6. Use IS-456, IS-875

❖ **SKILLS:-**

The student should be able to acquired following skills:-

1. Skill of designing RCC components.
2. Skill of reading & understanding structural drawings.
3. Skill of effective supervision of R.C.C. works at site.

CONTENTS :**A. THEORY :**

SR. NO.	CHAPTER		MARKS	HOURS
1.	INTRODUCTION TO WORKING STRESS METHOD			
1	1.1	Concept, Assumptions, Permissible Stresses in Concrete & Steel, Stress & Strain Distribution Diagrams, Moment of Resistance of Singly Reinforced Beam (No Numericals).	04	02
II	LIMIT STATE METHOD			
2	SINGLY REINFORCED BEAM		08	03
	2.1	Introduction of limit state method, Analysis of singly Reinforced beam.		
	2.2	Design of singly Reinforced beam.		
3	DOUBLY REINFORCED BEAM		08	03
	3.1	Analysis of Doubly Reinforced Beam.		
	3.2	Design of Doubly Reinforced Beam		
4	T- BEAM & L-BEAM		10	04
	4.1	Analysis of T-Beam, Introduction to L beams (Problems on T-Beam with neutral axis within flange & no problems on L-beam).		
	4.2	Design of T-Beam (Problems on T-Beam with neutral axis within flange & no problems on L-beam).		
5	SHEAR REINFORCEMENT & DEVELOPMENT LENGTH		08	03
	5.1	Design of shear reinforcement and check for Development length		
6	SLAB		12	05
	6.1	One way slab - simply supported, continuous, cantilever		
	6.2	Two way slab (simply supported with free corners) Design by I.S code coefficients.		
7	DESIGN OF DOGLEGGED STAIRCASE		06	02
	7.1	Effective span of staircase		
	7.2	Load on staircase		
	7.3	Design of Doglegged staircase		
8	COLUMN		08	03
	8.1	Concept of long and short columns.		
	8.2	Analysis of short column viz. Square, Rectangular, circular (only axially loaded).		
	8.3	Design of short column viz. Square, Rectangular, circular (only axially loaded).		
	8.4	I.S. code recommendation for longitudinal and lateral steel.		
	8.5	Minimum eccentricity in column.		
9	COLUMN FOOTING		08	03
	9.1	Design of square footing for square, Rectangular column, check for shear. (uniform depth only)		
10	PRESTRESSED CONCRETE		04	02
	10.1	Concept of prestressing methods of pre-tensioning & post-tensioning.		
	10.2	Advantages & Disadvantages.		
11	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (IS: 1893 & IS: 13920)		04	02
	11.1	Definitions of - centre of mass, centre Rigidity, Damping, Epicentre,		

	Focus, Intensity of earthquake, Magnitude of earthquake, Liquefaction, Response spectrum, earthquake zoning of India.		
11.2	Assumptions made in earthquake resistant design of structure		
11.3	Introduction to ductile detailing of reinforced concrete elements		
TOTAL		80	32

B. TERM WORK: (Term work shall consist of following lab work/assignment/visit report.

Oral is based on TW)

SR. No.	Topic	Hrs.
I	Sketchbook based on concept of limit state method, IS code provisions & typical reinforcement details of R.C. sections. (5 plates)	10
II	The term work shall consist of Design and Drawing of a R.C.C. residential building. (Drawing on two A1 size sheets).	
a	Drawing key plan and showing positions of columns & beams.	02
b	Design of one way simply supported , continuous, cantilever & two way slabs.	06
c	Design of singly reinforced, doubly reinforced & T- beams.	08
d	Design of columns and columns footings.	06
e	Design of Dog legged staircase.	02
f	A set of structural drawings shall consist of two A1 size sheets. Drawing shall normally contain key plan, structural plan showing positions of columns & column footings. Typical c/s and longitudinal section of beams, slabs, column, footings, staircase & bar bending schedule of reinforcement.	30
TOTAL		64

❖ **ASSESSMENT OF LABORATORY EXPERIMENTS:**

Continuous assessment of Term Work and Term and oral examination.

❖ **SUGGESTED IMPLEMENTATION STRATEGIES :**

- Lecture method**
- Assignments**
- Q & A technique.**
- Demonstration**

SUGGESTED LEARNING RESOURCES :

- PRINT :** Text books/Reference books/Manuals/Journals.
- NON PRINT :** CDs / PPT / Transperencies / Charts / Models

C. SPECIFICATION TABLE :

Chapter No.	Title of Chapter	Marks (1.5 x Marks allotted to chapter)	Distribution of Marks			
			Knowledge	Comprehension	Application	Total
1.	Introduction to Working stress method.	6	4	2		6

2.	Singly reinforced beam.	12	2	2	8	12
3.	Doubly reinforced beam.	12	2	2	8	12
4.	T- beam & L- beam.	15	2	3	10	15
5.	Shear reinforcement & Development length.	12	2	2	8	12
6.	Slab.	18	2	2	14	18
7.	Design of Dog legged stairs.	9	2	1	6	9
8.	Column.	12	2	2	8	12
9.	Column footing.	12	2	2	8	12
10.	Prestressed concrete	6	4	2		6
11.	Criteria for earthquake resistant design of structures (IS: 1893 & IS: 13920)	6	4	2		6
Total		120	28	22	70	120

D. REFERENCE & TEXT BOOKS:

S.N.	Title	Author, Publisher, Edition and Year Of publication	ISBN Number
1.	Limit state design of reinforced cement concrete	A.K.Jain. Nem Chand & Bros	----
2.	Limit state design of reinforced cement concrete	Shah & Karve. Pune Vidhyarthi griha	----
3	Limit state design of reinforced cement concrete	Shah & Kale. Tata Mc Graw Hill, New Delhi	----
4	Prestressed Concrete	Ramamrutham. Dhanpatrai Publications	8187433922
5	IS-456, IS-875, IS-13920, IS-1893, SP-34, SP-16.	BIS	----
6	Hand book of Limit state design	Shah and Karve, SP16.	----

E. LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Y. K. CHANDARANA	HOD Applied Mechanics Dept.	Govt. Polytechnic, Nagpur
2.	R. D. DONGARWAR	Lecturer in Applied Mechanics Dept.	Govt. Polytechnic, Nagpur

(Member Secretary PBOS)

(Chairman PBOS)

GOVERNMENT POLYTECHNIC, NAGPUR.

(An Autonomous Institute of Govt. of Maharashtra)

COURSE CURRICULUM**PROGRAMME : DIPLOMA IN CIVIL ENGINEERING****LEVEL NAME : APPLIED TECHNOLOGY COURSES****COURSE CODE : AM 1403 ^(S)****COURSE TITLE : PROJECT (STRUCTURE)****PREREQUISITE : 100 CREDITS and CE1408****TEACHING SCHEME: TH: - NIL - ; TU: - NIL - ; PR*: 04 ; TOTAL CREDITS: 04****(1 CREDIT = 1 CLOCK HR.)****EVALUATION SCHEME:**

MARKS	THEORY			TUTORIAL / PRACTICAL			TOTAL
	TERM EXAM	PROG TEST	TOTAL	PRACT EXAM	TERM WORK	ORAL EXAM	
MAX.	--	--	--	--	75@	50#	125
MIN.	--	--	--	--	30	20	---

(# - External & Internal Assessment ; @ - Internal Assessment only; \$ - Award of class course)

TIME ALLOTTED FOR TERM EXAM : - NOT APPLICABLE -**TIME ALLOTTED FOR PROGRESSIVE TEST : - NOT APPLICABLE -****❖ RATIONALE:-**

The students working in Civil Engineering field need to develop some additional skills and competencies to deliver their duties more effectively, efficiently, and confidently. The civil engineer need to solve problems which need knowledge and skills of civil engineering or inter disciplinary type. The project works helps to inculcate and enhance these additional qualities and skills in the students to solve real life problems and to provide feasible solution.

❖ SKILLS:-

Following skills will be developed in students:

Intellectual Skills-

1. Analytical ability and logical thinking
2. Ability to identify, define, and solve the problem
3. Teamwork and leadership
4. To plan and manage time, task, and other resources
5. Skill of comparison, selection, application, and drawing conclusion and interpretation.

Motor Skills-

1. To prepare drawing
2. To use computer softwares for analysis and design of structures
3. To conduct different tests on building materials in laboratory and in field

❖ OBJECTIVES:-

The student will be able to:

1. Carryout literature survey
2. Carryout market survey
3. Explore data and information through internet surfing
4. Develop professional abilities such as persuasion, confidence, perseverance, and communication
5. Develop presentation skill.

❖ CONTENTS:-

B. PROJECT :

SR. NO.	CHAPTER
1	PROJECT & SEMINAR:
	A group of 6 to 8 students in consultation with guide identify and define problem for the project based on seminar work carried out in previous term. Scope and detailed content of the project shall be decided by the project guide and students considering technical knowledge, competency, resources available and other physical constraints. The suggestive topics/ problems for the project may be from the following areas: - Manual/ computerized analysis and design of structure. - Concrete mix design with different permutations and combinations. - Testing and analysis of soil and soil properties in laboratory. - Testing and analysis of soil properties in field. - Testing and analysis of other building materials. - NDT of structures.

B. TERM WORK:

S. No.	Title of Practical / Lab. Work / Assignments
1	The term-work shall consist of a detailed project report which may include: • Introduction, scope, and objective of the project. • Procedure followed. • Analysis and design. • End result. • Comparison, selection, and conclusion. • Further scope. • Separate drawing sheets shall be prepared if needed.
Total Hours for activities A and B: 64 Hrs.	

❖ ASSESSMENT OF PROJECT / TERM WORK:

Continuous assessment of Project and Term Work.

C. REFERENCE & TEXT BOOKS:

- 1) Handbooks and reference books of civil engineering
- 2) Civil engineering magazines
- 3) Relevant IS codes
- 4) PWD handbooks
- 5) STAAD PRO, STRUDS, SAP and other design softwares.

D LIST OF EXPERTS & TEACHERS WHO CONTRIBUTED FOR THIS CURRICULUM:

S.N.	Name	Designation	Institute / Industry
1.	Shri. Y. K. Chandarana	Head of the Department Applied Mechanics	Govt. polytechnic, Nagpur.

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