Curriculum

of

Diploma Programme

in

Civil Engineering

State Board of Technical Education (SBTE)
Bihar

Semester – III

Teaching & Learning Scheme

Board of Study	Course Codes	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2415301	**Basic Surveying** (CE, AE)	3	-	4	2	9	6
	2415302	**Concrete Technology**	3	-	4	2	9	6
	2415303	**Strength of Material for Civil Engg.**	3	-	4	2	9	6
	2415304	**Building Construction & Material**	3	-	4	2	9	6
	2415305	**Water Resource Engg.**	2	1	-	2	5	4
	2415306	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	2	2	4	2
Total			**14**	**1**	**18**	**12**	**45**	**30**

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - III

Assessment Scheme

Board of Study	Course Codes	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2415301	**Basic Surveying** (CE, AE)	30	70	20	30	20	30	200
	2415302	**Concrete Technology**	30	70	20	30	20	30	200
	2415303	**Strength of Material for Civil Engg.**	30	70	20	30	20	30	200
	2415304	**Building Construction & Material**	30	70	20	30	20	30	200
	2415305	**Water Resource Engg.**	30	70	20	30	-	-	150
	2415306	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	10	15	10	15	50
Total			**150**	**350**	**110**	**165**	**90**	**135**	**1000**

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

A) Course Code : **2415301(T2415301/P2415301/S2415301)**

B) Course Title : Basic Surveying (CE, AE)

C) Pre-requisite Course(s) : Basic Geometry

D) Rationale :

Surveying is the science and art of taking all necessary measurements to identify the relative location of points or physical and cultural elements above, on, or under the surface of the earth, and to display them in a useful manner. The theodolite, compass, auto-level, chains, tapes, levelling staff, total station, etc., are all essential surveying equipment. Surveying includes both: the time spent in the field and in the office. This is because all necessary distance, angle, direction, elevation, location, area, and volume measurements are obtained in the field and then calculated back at the office. Surveying is done to produce a map that depicts the relative locations of the various features on the earth's surface. The map is created to a scale that seems appropriate. This subject is essential for students to have information on the field and its topography to prepare maps or drawings; for any civil or architectural work. This course will help the students to get familiar with various surveying instruments and will help improve their understanding of the topography of the building site. This course will provide an opportunity to develop skills in surveying at the primary level. The data gathered from surveying helps establish planning and design to determine the best course of action. To understand the techniques of surveying, a student must carefully understand the use of various surveying instruments used in the field.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in the classroom/laboratory/workshop/ field/industry.

After completion of the course, the students will be able to-

CO-1 Undertake the relevant type of survey for the given purpose in the given situation.

CO-2 Apply the necessary correction to the linear measurements recorded in the field book.

CO-3 Conduct chain and compass traverse survey in the given field.

CO-4 Draw the contour map of the given terrain using the relevant levelling instrument.

CO-5 Use a digital planimeter to measure the area of the given figure or shape.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415301**	Basic Surveying	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415301**	Basic Surveying	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: *T2415301*

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
TSO 1a Propose the relevant type of survey in the given situation. TSO 1b Explain the basic principles of surveying in the given type of survey. TSO 1c Select the relevant scale for the given situation.	**Unit-1.0 Overview and Classification of Survey** 1.1 Survey-Purpose and Use: Types of surveying- Primary and Secondary, Classification: Plane, Geodetic. Cadastral, Hydrographic, and Aerial. 1.2 Principles of Surveying 1.3 Scales: Engineer's scale, Representative Fraction (RF), diagonal scale, and Vernier Scale.	**CO1**
TSO 2.a Draw the perpendicular offsets on the main chain line in the given situation. TSO 2b. Draw the schematic diagram showing the details such as the Baseline, check line, and Tie line including Main Survey Station. TSO2c. Use the relevant method of ranging in chain survey. TSO2d. Explain the type of error and correction required in the chain survey. TSO2e. Compute the area of a given field using the principle of triangulation.	**Unit-2.0 Chain Survey** 2.1 Instruments used in chain survey: Metric Chain, Tapes, Arrow, ranging rod, Line ranger, Offset rod, Open cross-staff, Optical square. 2.2 Chain survey Station, Baseline, Check line, Tie line, Offset, Tie Station. 2.3 Ranging Direct and Indirect Ranging, Method of chaining, obstacles in chaining. 2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error, Principles of triangulation. 2.5 Types of offsets: Perpendicular and Oblique, Conventional Signs, Recording of measurements in a field book.	**CO2**
TSO3a. Perform the relevant Traverse survey for the given situation. TSO3b.Distinguish between True Meridian and Magnetic Meridian TSO 3c. Convert the whole circle bearing to a reduced bearing and vice versa. TSO 3d Calculate the included angles of a closed traverse after applying suitable corrections. TSO 3e Draw a labeled diagram of a Prismatic Compass. TSO 3f Determine the correct bearing from the given observed bearing. TSO 3g Adjust the closing error of the traverse for the given data.	**Unit-3.0 Compass Survey** 3.1 Compass Traversing-open, closed Traverse. 3.2 Technical Terms: Geographic/True Meridians, Magnetic Meridians, and Bearings, Whole Circle Bearing system and Reduced Bearing system and examples on the conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination. 3.3 Components of Prismatic Compass and their functions, Methods of using Prismatic Compass- Temporary adjustments and observing bearings. 3.4 Local attraction, Methods of correction of observed bearings - Correction at station and correction to included angles. 3.5 Methods of plotting a traverse and closing error, Graphical adjustment of closing error	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
TSO4a. Explain the given basic terms used in the levelling and contouring. TSO4b. Explain the temporary adjustment of the dumpy level. TSO 4d. Calculate the Reduced Level of given point using Rise and Fall method. TSO 4e. Choose levelling operation for the given situation. TSO 4f Explain the Characteristics of the given contour lines along with their uses. TSO 4g Recognize the nature of terrain from the given contour map.	**Unit-4.0 Levelling and contouring** **4.1** Basic Terms: Level surface, Horizontal and vertical surface, Datum, Bench Mark - Permanent, Temporary, Arbitrary. Reduced Level, Rise, Fall, Back sight, Fore sight, Intermediate sight, Change point, Height of instrument, Line of collimation. 4.2 Types of levels: Dumpy, Tilting, and Auto level, Temporary adjustments of Level. 4.3 Types of Levelling Staff: Self-reading staff and Target staff, Reduction of level by Height of Instrument Method, and Rise and Fall Method. 4.4 Levelling Types: Simple, Differential, Fly, Profile, and Reciprocal Levelling. 4.5 Contour, contour intervals, horizontal equivalent, Uses of contour maps, Characteristics of contours, Methods of Contouring-Direct and indirect	**CO4**
TSO5a.Draw the labeled diagram of the digital planimeter to show its components. TSO5b.Describe the Procedure of measuring a given area with the help of a planimeter TSO 5c. Compute the volume of the reservoir using the given contour map.	**Unit-5.0 3D Measurement of Area and Volume** 5.1 Components and use of Digital planimeter. 5.2 Measurement of the area using a digital planimeter. 5.3 Measurement of the volume of the reservoir from the contour map.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P*2415301*

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Numbers
LSO1.1. Perform ranging and chaining operation in different field conditions	1.	Measure the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2
LSO2.1. Perform reciprocal ranging for the given situation.	2.	Perform reciprocal ranging and measure the distance between two stations.	CO2
LSO3.1. Determine the area of the given open field.	3.	Determine the area of open field using chain and cross staff survey.	CO2
LSO4.1. Measure the fore bearing and back bearing of given survey lines using a Prismatic compass.	4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass.	CO2, CO3
LSO5.1. Measure fore bearing and back bearing of a closed traverse and after applying correction in the bearings, measure the included angle for the given situation.	5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction.	CO2, CO3
LSO6.1. Undertake Survey Project for the given situation.	6.	Undertake **Survey Project** with chain and compass for closed traverse for minimum 5 sides around a building.	CO2, CO3
LSO7.1. Plot a traverse on an A1 size imperial drawing sheet for the survey project.	7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Numbers
LSO8.1. Undertake simple levelling operation for determining the reduced level of given points.	8.	Undertake simple levelling using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO9.1. Undertake differential levelling operation for determining the reduced level of given points.	9.	Undertake differential levelling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and levelling staff.	CO2, CO4
LSO10.1. Undertake fly levelling for the given situation.	10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO11.1. Undertake a survey project to plot a contour map for the given situation.	11.	Undertake **Survey Project** for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4
LSO12.1. Measure the area of the given irregular figure using a digital planimeter.	12.	Measure the area of the irregular figure using a Digital planimeter	CO5

L) Suggested Term Work and Self Learning: *S2415301* Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Prepare and sketch a list of tools and equipment used in chain and tape survey.
2. Explain with diagram the use of optical square, prism square and cross staff.
3. Describe with the help of neat sketch prismatic compass and surveyors' compass.
4. Identify errors and their corrective measures in compass survey.
5. Explain local attraction in compass surveying.
6. Explain methods to detect and eliminate local attraction.
7. Describe dumpy level with neat sketch.
8. Describe with sketches the characteristics of contour.

b. Micro Projects:

1. Undertake an internet survey to collect information on survey instruments available in the market with specifications.
2. Carry out a comparative study of the following survey instruments of different make and brands: Auto level and Dumpy Level.
3. Measure the area of the municipal wards and the area of the city from the ward-wise map of the city using a digital planimeter.
4. Determine the Reduced Levels (RLs) of the existing structures like lintels, chajja, slab, and beam.
5. Download specifications for prismatic compass, dumpy level, auto level, and digital planimeter using the internet.
6. Perform a reconnaissance survey for alignment of the road.
7. Collect and interpret contour maps of different terrains available with various authorities.
8. Construct and measure the given length using a Diagonal scale from a given map.

c. Other Activities: Calculate the quantity of earthwork to construct the road with the help of levelling diagram.

1. **Seminar Topics**:
   a. Scales and their importance used in Surveying
   b. Local attraction in compass surveying
   c. Triangulation: A method of measuring the area of a given field
   d. Meridian and Bearings used in compass surveying
   e. Contours and Types of Terrain
   f. Digital Planimeter and Area Measurement
   g. Conduction of a survey for the given city

2. **Self – Learning topics**:
   - Classification of the survey based on the nature of the field and based on the object of the survey.
   - Comparison between surveyor and prismatic compass.
   - Study of variation of earth's magnetic field and Declination.
   - Study of modern instruments used in leveling.
   - Study of toposheets and calculate catchment areas

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory, and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate CO attainment.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/ Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro-projects	Other Activities*		
CO-1	15 %	10%	15%	15%	20%	15%	15%
CO-2	15%	20%	20%	15%	20%	15%	20%
CO-3	25%	25%	25%	25%	20%	25%	25%
CO-4	35%	30 %	30%	30%	20%	35%	30%
CO-5	10%	15%	10%	15%	20%	10%	10%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) **Suggested Specification Table for End Semester Theory Assessment:** Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant Cos Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & Above (A)
Unit-1.0 Overview and classification of survey	06	CO1	08	2	2	4

Unit-2.0 chain survey	08	CO2	14	4	4	6
Unit-3.0 Compass survey	12	CO3	18	6	6	6
Unit-4.0 Leveling and Contouring	16	CO4	20	6	6	8
Unit-5.0 Measurement of Area and volume	06	CO5	10	2	4	4
Total Marks	**48**	**-**	**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Numbers	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Measure the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2	50	40	10
2.	Perform reciprocal ranging and measure the distance between two stations.	CO2	50	40	10
3.	Determine the area of open field using chain and cross staff survey.	CO2	50	40	10
4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass	CO2, CO3	50	40	10
5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction	CO2, CO3	60	30	10
6.	Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building	CO2, CO3	60	30	10
7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3	50	40	10
8.	Undertake simple leveling using dumpy level/ Auto level and leveling staff.	CO2, CO4	60	30	10
9.	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff.	CO2, CO4	60	30	10
10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4	60	30	10
11.	Undertake Survey Project for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4	40	50	10
12.	Measure the area of the irregular figure using a Digital planimeter	CO5	70	20	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared by the course teacher for each experiment/practical to assess the student's performance.

P) Suggested instructional / Implementation Strategies: Different Instructional / Implementation Strategies may be appropriately selected, as per their requirement of the content/outcome. Some of them are Improved Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs, etc**.**

Q) List of Major Laboratory Equipment, Tools, and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1	Steel Tapes 30 meter	Made of steel as per IS Specifications	1,2,3
2	Engineer's Chain	made of M.S. 100-foot survey chain with 100inks solid brass handles &link	1,2,3
3	Metallic Tape 20 /30metre	Good quality	1,2,3
4	Ranging Rod Steel	Ranging Rod Steel 6' Length 2 Meter (Straight / Folding / Screw Type	1,2,3
5	Chain 30 meter	made of M.S. with 100 links and solid brass handles	1,2,3
6	Chain 20 meter	made of M.S. with 100 links and solid brass handles	1,2,3
7	Optical square Indian	Circular type, made of brass, fitted with double reflecting mirror right and lift to 90 degree	1,2,3
8	Prismatic Compass	Made of Brass, Size 100mm dia. As Per I.S.I. Specification	4,5,6,7
9	Open type Cross staff	Size 4”, Open Type having four vanes at right angles.	1, 4,5,6,7
10	Dumpy level 300 mm	Telescopic Length Size 12", Erect Image. Internal Focusing, Fitted with compass	8,9,10
11	Levelling staff 4 meter	Made of a Fully Aluminum body, telescopic type in Three sections. I.S.I. Specifications No IS:1779- 1961	8,9,10
12	Tilting level	Size 178mm /7” Internal focusing, anti-reflection coated optics.	8,9,10
13	Planimeter	Standard	12

R) Suggested Learning Resources:

(a) Books

S. No	Titles	Author (s)	Publisher and Edition with ISBN
1	Surveying 1	Dr BC Punmia, Ashok Kumar Jain, Dr. Arun Kumar Jain	Seventeenth Edition, Laxmi publication ISBN-10 9788170088530 ISBN-13 978-8170088530
2	Surveying and Leveling	A K Arora	17th Edition, Standard book house ASIN: B08GY78N55 ISBN-13: 9788189401238
3	Surveying and Leveling	S K Duggal	5th edition, TMG publication ISBN-10: 9353167523 ISBN-13: 978-132110255

4	Surveying and Leveling	R Agor	Limited edition, Khanna publication ISBN-10: 8174092358 ISBN-13: 978-174092359
5	प्रारंभिक सर्वेक्षण – I	Gurucharan Singh	Published year 2017, Standard publishers distributers Delhi ISBN: 9788180141751

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in
2. https://archive.nptel.ac.in/courses/
3. https://youtu.be/chhuq_t40rY
4. https://yputube/Z4yHHX8NO
5. https://sbte.bihar.gov.in/moodle/

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(b) Others:

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A) Course Code : 2415302(T2415302/P2415302/S2415302)

B) Course Title : Concrete Technology

C) Pre-requisite Course(s) :

D) Rationale :

Concrete is the versatile material used for civil engineering constructions, therefore knowledge of concrete and its constituents is important for a diploma civil engineer. Concrete is used for the construction of structural as well as non-structural elements like beams, columns, foundations, slabs, etc. Understanding the properties of concrete ingredients, concreting operations, modified concrete, Quality Control of concrete in different weather condition with proper knowledge of admixture and its practical applications as recommended by Indian Standard Code should be known for a diploma civil engineer. Therefore, this course deals with requisite knowledge required at construction site by a Junior Engineer and built up foundation for upcoming courses of higher semesters.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/industry.

After completion of the course, the students will be able to-

CO-1 Select the relevant type of cement for different site conditions.
CO-2 Use the relevant type aggregate for the given concrete works.
CO-3 Conduct the relevant type of tests on the given sample of concrete mix.
CO-4 Design the relevant concrete mix as per desired specification.
CO-5 Suggest relevant admixture for the different concreting situations.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415302**	Concrete Technology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415302**	Concrete Technology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415302

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe the manufacturing process of cement. TSO 1b. Explain the process involved in setting of cement. TSO 1c. Explain the physical properties of cement. TSO 1d. Describe the procedure for testing physical properties of cement. TSO 1e. Explain the types of cement with their application. TSO 1f. Explain the storage of cement with its effect on strength of cement.	**Unit-1.0 Cement** 1.1 Introduction of cement, manufacturing process of cement (Wet & Dry process). 1.2 Composition of cement, effects of various constituent of cement on its properties, Bouge's compound and their significance, Hydration of cement. 1.3 Physical properties of cement: fineness, standard consistency, setting time, compressive strength and soundness. 1.4 Testing of cement: Field and Laboratory tests- fineness test, standard consistency test, setting time test, compressive strength test and soundness test. 1.5 Types of cement with I.S. Specifications and field applications: Ordinary Portland cement (33 grades, 43 grades or 43-S grade and 53 grades OPC), Portland pozzolana cement, Portland slag cement, Rapid hardening cement, Sulphate resisting cement, Low heat cement, High alumina cement, White cement. 1.6 Storage of cement and its effect on the properties of cement.	**CO1**
TSO 2a. Classify aggregates based on source, size and shape. *TSO 2b*. Explain various properties of fine and coarse aggregate. *TSO 2c*. Describe the requirements of good aggregates for making concrete. *TSO 2d*. Explain the grading and zoning of aggregates based on relevant IS code. *TSO 2e.* Determine strength of aggregate using the relevant laboratory tests.	**Unit-2.0 Aggregates** 2.1 Aggregates: Sources of aggregate, Classification according to source, size and shape. 2.2 Properties of fine and coarse aggregates: size, shape, surface texture, specific gravity, bulk density, moisture content, surface moisture, water absorption, strength, soundness. 2.3 Bulking of fine aggregate, Parameters for good aggregate. 2.4 Grading and Zoning of fine and coarse aggregates as per IS code. Fineness Modulus of fine and coarse aggregate. 2.5 Crushing value, impact value and abrasion value of coarse aggregates with Indian standard specification.	**CO2**
TSO 3a. Explain the concreting operations with a flow chart. *TSO 3b*. Describe the water cement ratio with its	**Unit-3.0 Concrete** 3.1 Introduction to Concrete, Concreting Operations (Batching, mixing, transportation, placing,	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
significance. TSO 3c. Explain the workability of concrete with its various method of determination. *TSO 3d.* Explain the various properties of hardened concrete. *TSO 3e.* Explain the various methods of Non-Destructive test of hardened concrete.	compaction, curing and finishing of concrete), Necessity of supervision for concreting operations. 3.2 Grades of concrete (ordinary, standard and high strength concrete) as per IS 456, Water cement ratio and its significance. 3.3 Properties & testing of fresh concrete: Workability, Cohesiveness, Segregation, Bleeding and Harshness; Determination of Workability by Slump test, Compaction factor test and Vee-Bee Consistometer test; Range values of workability requirements for different types of concrete works. 3.4 Properties & testing of hardened concrete: Compressive strength, Flexural strength, Durability, Shrinkage, Impermeability and Fire resistance; Determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results. 3.5 Non-Destructive Testing (NDT) of hardened concrete: Purpose of NDT, methods of NDT-Rebound hammer test and Ultra pulse velocity test only.	
TSO 4a. Explain the procedure of mix design of concrete as per relevant IS code. *TSO 4b*. Describe the selection criteria for formwork for the given type of concreting works. *TSO 4c.* Explain methods for filling of construction joints by selecting appropriate filler materials.	**Unit-4.0 Mix Design, Formwork and Joint** 4.1 Concrete Mix Design: objective, methods of mix design, the study of procedural steps of mix design as per IS 10262:2019. (With example of M20/M25/M30 Grade) 4.2 Formworks of concreting: Different types of formworks for columns, beams and slabs, Materials used for formworks, Requirement of good formwork, stripping time for removal of formworks as per the provision of IS 456:2000. 4.3 Construction joints: Types of Joints, Materials used for filling joints, Method of joining.	**CO4**
TSO 5a. Suggest relevant type of admixtures for the given concreting condition. *TSO 5b*. Propose the type of special concrete based on its application. *TSO 5c.* Suggest the precautions to be taken for concreting in different weather conditions.	**Unit-5.0 Admixture in Concrete, Special Concrete and Extreme Weather Concreting** 5.1 Admixture in Concrete: Purpose, Types of chemical and mineral admixtures such as accelerating admixtures, retarding admixtures, water reducing admixtures, super plasticizers, air entraining admixtures, fly ash, silica fume, and slag. 5.2 Special Concrete: Properties, advantages and limitations of the following types of special concrete- Ready mix concrete, Fiber reinforced concrete, Self-compacting concrete, High-performance concrete, Lightweight concrete, Geopolymer concrete. 5.3 Extreme weather concreting: Effects of cold and hot weather on concrete, Precautions to be taken while concreting in cold and hot weather conditions.	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415302

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1. Determine the fineness of the given cement.	1.	Determine the fineness of the given cement by Sieving as per IS: 4031 (Part 1)-1996 or Blaine's air permeability apparatus as per IS: 4031 (Part 2)- 1999.	**CO1**
LSO2.1. Determine the consistency of the given cement.	2.	Determine the standard consistency of the given cement using Vicats apparatus as per IS: 4031 (Part 4)- 1988.	**CO1**
LSO3.1. Determine the setting time of the given cement.	3.	Determine the setting time of the given cement using Vicats apparatus as per IS: 4031 (Part 5)- 1988.	**CO1**
LSO4.1. Determine the compressive strength of the given cement.	4.	Determine the compressive strength of the given cement as per IS: 4031 (Part 6) - 1988.	**CO1**
LSO5.1. Determine the soundness of the given cement.	5.	Determine the soundness of the given cement by Le-chatelier method as per IS: 4031 (Part 3)- 1988.	**CO1**
LSO6.1. Determine the size, grading and fineness modulus of the given fine and coarse aggregate.	6.	Determine the size, grading and fineness modulus of the given fine and coarse aggregates as per IS: 2386 (Part I) – 1963.	**CO2**
LSO7.1. Determine the flakiness index and elongation index of the given coarse aggregate.	7.	Determine the flakiness index and elongation index of the given coarse aggregate as per IS: 2386 (Part I) - 1963.	**CO2**
LSO8.1. Determine the silt content in given sand.	8.	Determine the silt content in given sand as per IS: 2386 (Part II) - 1963.	**CO2**
LSO9.1. Determine the bulking of given sand.	9.	Determine the bulking of given sand as per IS: 2386 (Part III)- 1963.	**CO2**
LSO10.1 Determine the bulk density of given fine and coarse aggregates.	10.	Determine the bulk density of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	**CO2**
LSO11.1 Determine the water absorption of the given fine and coarse aggregates.	11.	Determine the water absorption of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	**CO2**
LSO12.1 Determine the impact value of the given coarse aggregate.	12.	Determine the impact value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO13.1 Determine the crushing value of the given coarse aggregate.	13.	Determine the crushing value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO14.1 Determine the abrasion value of the given coarse aggregate.	14.	Determine the abrasion value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO15.1 Determine the workability of the given concrete mix.	15.	Determine workability of the given concrete mix by slump test/compaction factor test/flow table/Vee-Bee consistometer method as per IS: 1199-1959.	**CO3, CO4, CO5**
LSO16.1 Determine the compressive strength of the given concrete mix.	16.	Determine the compressive strength of the given concrete mix at 7 days and 28 days of curing as per IS: 516-1959.	**CO3, CO4, CO5**
LSO17.1 Asses the durability of the given concrete.	17.	Asses the durability of the given concrete using Rapid Chloride Penetration test (RCPT) as per ASTM C 1202 /Permeability test as per IS: 3085-1965.	**CO3, CO4, CO5**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO18.1 Determine the strength of the hardened concrete by NDT test.	18.	Determine the strength of the hardened concrete by NDT tests such as Ultrasonic Pulse Velocity test as per IS: 13311 (Part 1)-1992/ Rebound Hammer test as per IS: 13311 (Part 2)-1992.	**CO3, CO4, CO5**

L) Suggested Term Work and Self Learning: S2415302 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Explain the constituent parts of ordinary Portland cement with the significance of Bouge's compounds.
2. Explain the hydration of Bogue's compound with the significance of hydration products.
3. Justify the significance of size of aggregates in determining the strength of the concrete.
4. Calculate the fineness modulus of a given aggregate sample using following data: -Retained weights in gram on IS Sieve 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, 150 µm and Pan are 10, 120, 230, 240, 282, 105 and 13 respectively.
5. Interpret the relationship between the moisture content and the change in volume of fine, medium and coarse aggregate to explain the phenomenon of bulking with relevant sketch.
6. Explain the significance of w/c ratio with reference to the graph of w/c ratio vs compressive strength of concrete.
7. Suggest the degree of workability for the following: (a) Building concrete, (b) Mass concrete, (c) Pumpable concrete and (d) Tremie concrete.
8. Write the procedure of mix design of concrete with reference to the provisions laid in IS 10262: 2019.
9. Explain the effect of cold weather on the setting and hardening property of concrete.
10. Explain the types of chemical admixtures with its purpose and usage.

b. Micro Projects:

1. Collect the information about types of cement available in your nearby market and prepare a comparative statement on their specification.
2. Prepare a report by performing the field tests on the given sample of cement to check its quality.
3. Prepare a report by performing classification of coarse aggregate based on source, size, shape, surface texture and surface moisture.
4. Prepare a report by performing the sieve analysis on given fine aggregates to find its zone.
5. Prepare a report by performing the sieve analysis on given coarse aggregates to find its nominal size and grade.
6. Prepare mix design of given grade of concrete and assess its properties based on Indian Standard method IS 10262:2019.
7. Prepare a report by performing non-destructive test on given existing structure stating its strength, durability and serviceability.

c. Other Activities:

1. Seminar Topics:
    - Carbon footprint of cement.

- Supplementary cementitious materials (SCMs).
- Geopolymer concrete.
- Alkali activated binders.
- Extreme weather concreting.
- Fibers used as reinforcement in concrete

2. Visits: Visit of construction sites to collect detailed information about ingredients of concrete mix, observe concreting operation, observe formwork, scaffoldings and joints in concrete, observe quality check used for fresh concrete.

3. Self-learning topics:

- Cement chemistry.
- Concrete mix design.
- Mechanical properties of concrete.
- Durability issues in concrete.
- Admixtures in concrete.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	12%	15%	15%	15%	20%	15%	10%
CO-2	24%	20%	15%	15%	20%	20%	20%
CO-3	14%	15%	25%	25%	20%	25%	30%
CO-4	30%	30%	30%	30%	20%	25%	30%
CO-5	20%	20%	15%	15%	20%	15%	10%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Cement	08	CO1	12	4	6	2
Unit-2.0 Aggregates	08	CO2	14	4	4	6
Unit-3.0 Concrete	10	CO3, CO4	12	4	4	4
Unit-4.0 Mix Design, Formwork and Joint	14	CO3, CO4	20	4	6	10
Unit-5.0 Admixture in concrete, Special Concrete and Extreme Weather Concreting	08	CO4, CO5	12	4	4	4
Total Marks	**48**	**-**	**70**	**20**	**24**	**26**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the fineness of the given cement by Sieving as per IS: 4031 (Part 1)-1996 or Blaine's air permeability apparatus as per IS: 4031 (Part 2)- 1999.	CO1	40	50	10
2.	Determine the standard consistency of the given cement using Vicats apparatus as per IS: 4031 (Part 4)- 1988.	CO1	40	50	10
3.	Determine the setting time of the given cement using Vicats apparatus as per IS: 4031 (Part 5)- 1988.	CO1	40	50	10
4.	Determine the compressive strength of the given cement as per IS: 4031 (Part 6) - 1988.	CO1	40	50	10
5.	Determine the soundness of the given cement by Le-chatelier method as per IS: 4031 (Part 3)- 1988.	CO1	40	50	10
6.	Determine the size, grading and fineness modulus of the given fine and coarse aggregates as per IS: 2386 (Part I) – 1963.	CO2	40	50	10
7.	Determine the flakiness index and elongation index of the given coarse aggregate as per IS: 2386 (Part I) - 1963.	CO2	40	50	10
8.	Determine the silt content in given sand as per IS: 2386 (Part II) - 1963.	CO2	40	50	10
9.	Determine the bulking of given sand as per IS: 2386 (Part III)- 1963.	CO2	40	50	10
10.	Determine the bulk density of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	CO2	40	50	10
11.	Determine the water absorption of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
12.	Determine the impact value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
13.	Determine the crushing value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
14.	Determine the abrasion value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
15.	Determine workability of the given concrete mix by slump test/compaction factor test/flow table/Vee-Bee consistometer method as per IS: 1199-1959.	CO3, CO4, CO5	40	50	10
16.	Determine the compressive strength of the given concrete mix at 7 days and 28 days of curing as per IS: 516-1959.	CO3, CO4, CO5	40	50	10
17.	Asses the durability of the given concrete using Rapid Chloride Penetration test (RCPT) as per ASTM C 1202 /Permeability test as per IS: 3085-1965.	CO3, CO4, CO5	40	50	10
18.	Determine the strength of hardened concrete by NDT tests such as Ultrasonic Pulse Velocity test as per IS: 13311 (Part 1)-1992/ Rebound Hammer test as per IS: 13311 (Part 2)-1992.	CO3, CO4, CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/ practical to assess the student performance.

P) Suggested Instructional/ Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
1.	90 μm IS Sieve	90 μm IS Sieve with pan and lid, Balance and Brush as per the requirement of IS: 4031 (Part 1)- 1996	1
2.	Blaine's air permeability apparatus	Blaine's air permeability apparatus with all accessories as per the requirement of IS : 4031 (Part 2)- 1999	1
3.	Le-chatelier flask	Le-chatelier flask for determination of specific gravity of cement as per the requirement of IS: 4031 (Part 11)-1988.	1
4.	Vicats apparatus with all accessories	Vicats apparatus with all accessories to determine the consistency, initial and final setting times as per the requirement of IS 4031 (Part 4):1988 and IS 4031 (Part 5): 1988	2,3
5.	Vibration Machine with all accessories	Vibrating Machine for making cement mortar cube of 70.6 mm as per the requirements of IS: 10080-1982	4

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
6.	70.6 mm Cube Moulds	70.6 mm cube moulds for preparation of cement mortar cubes for compressive strength tests, made of steel/cast iron, with ISI certification mark and as per the requirements of IS : 10086 – 1982.	4
7.	Curing Tank	Temperature and Humidity controlled Curing Tank for curing of cement mortar or concrete cubes for determination of compressive strength at certain ages.	4, 16
8.	Compression Testing Machine 2000 kN Capacity	Compression Testing Machine, Capacity 2000 KN confirming to the requirement of IS: 14858-2000, IS: 4031 (Part 6)-1988, IS: 516-1959 and IS : 2386 (Part IV)-1963.	4, 13, 16
9.	Le-Chatelier test apparatus	Le-Chatelier test apparatus: set of 06 moulds with weight, glass plates, complete in all to determine soundness of cement as per the requirements of IS : 4031 (Part 3)-1988.	5
10.	Water Bath	Water bath capable of containing immersed Le-Chatelier moulds with specimens and of raising their temperature from 27 ± 2°C to boiling in 27 ± 3 minutes as per the requirements of IS : 4031 (Part 3)-1988.	5
11.	Electronic Balance/ Scale (300 g, 500g, 1 kg, 5 kg, 10 kg, 15 kg, 20 kg max capacity)	Electronic Balance/ Scale (300 g, 500g, 1 kg, 5 kg, 10 kg, 15 kg, 20 kg max capacity) with battery backup and as per the requirement of IS: 4031 (Part 1 to 6) and other tests.	All
12.	Digital Platform Balance, Min 100 kg Capacity with Battery back up	Digital Platform Balance, Min 100 kg Capacity with Battery back up	All
13.	IS Sieve set (200 mm diameter)	Brass Test Sieves of diameter 200 mm: - 4.75 mm, 3.35 mm, 2.36 mm, 2 mm, 1.70 mm, 1.18 mm, 1 mm, 600 micron, 500 microns, 425 microns, 300 microns, 150 microns, 90 microns, 75 microns with pan and lid confirming to IS: 460-1962 and the requirement of IS:2386 (Part 1)-1963, IS:383-2016 and IS : 650-1991.	6
14.	IS Sieve set (300 mm/450 mm diameter)	Brass or GI Test Sieves of diameter 300 mm or 450 mm: - 160 mm, 80 mm, 63 mm, 50 mm, 40 mm, 31.5 mm, 25 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75 mm, 2.36 mm with pan and lid confirming to IS: 460-1962 and the requirement of IS:2386 (Part 1)-1963, IS:383-2016	6
15.	Thickness gauge and Elongation gauge	Thickness gauge and Elongation gauge as per the requirements of IS: 2386 (Part I) - 1963	7
16.	250 ml, 1000 ml graduated glass cylinder	250 ml, 1000 ml graduated glass cylinder	8,9
17.	Cylindrical Metal Measure	Cylindrical Metal Measure of 3, 15- and 30-liters Capacity with tamping rod as per the requirement of IS 2386 (Part III):1963	10
18.	Water absorption test apparatus for aggregates larger than 10 mm or between 40 mm and 10 mm	Water absorption test apparatus for aggregates larger than 10 mm or between 40 mm and 10 mm as per the requirement of IS 2386 (Part III):1963.	11
19.	Oven	A well-ventilated oven, thermostatically controlled, to maintain a temperature of 100 to 110% as per the requirement of IS 2386 (Part I to IV):1963 and other tests.	11

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
20.	Vessel for Water absorption test of aggregates between smaller than 10 mm	Vessel for Water absorption test of aggregates between smaller than 10 mm as per the requirement of IS 2386 (Part III):1963	11
21.	Aggregate Impact Test Machine	Aggregate Impact Test Machine as per the requirements of IS : 2386 (Part IV)-1963.	12
22.	Aggregate Crushing Test Apparatus	Aggregate Crushing Test Apparatus as per the requirements of IS: 2386 (Part IV)-1963.	13
23.	Los Angeles Abrasion Testing Machine	Los Angeles Abrasion Testing Machine as per the requirements of IS: 2386 (Part IV)-1963.	14
24.	Slump Test apparatus	Slump Test apparatus as per the requirements of IS: 1199-1959	15
25.	Compaction factor test apparatus	Compaction factor test apparatus as per the requirements of IS: 1199-1959	15
26.	Flow table test apparatus	Flow table test apparatus as per the requirements of IS: 1199-1959	15
27.	Vee-Bee Consistometer	Vee-Bee Consistometer as per the requirements of IS: 1199-1959	15
28.	150 mm cubes mould and Beam mould of 150*150*700 mm.	150 mm cube moulds for preparation of concrete cubes for compressive strength tests, and Beam mould for flexural test made of steel/cast iron, with ISI certification mark and as per the requirements of IS : 10086 – 1982.	16
29.	Vibrating Table Tray Type	Vibrating Table Tray Type for compacting concrete in 150 mm cube moulds as per the requirements of IS: 2514 – 1963.	16
30.	Concrete Mixer Machine	Tilting drum type concrete mixer machine for mechanical mixing of concrete ingredients as per the requirements of IS: 1791 – 1985.	16
31.	Rapid Chloride Penetration Test apparatus	Rapid Chloride Penetration Test apparatus as per the requirements of ASTM C 1202.	17
32.	Permeability Test apparatus	Permeability Test apparatus as per the requirements of IS: 3085-1965.	17
33.	Ultrasonic Pulse Velocity Test apparatus	Ultrasonic Pulse Velocity Test apparatus as per the requirements of IS: 13311 (Part 1)-1992.	18
34.	Rebound Hammer	Rebound Hammer as per the requirements of IS: 13311 (Part 2)-1992.	18
35.	Miscellaneous Tools	Trowel, spatula, Non-porous platform for mixing of cement paste or mortar, Poking Rod, Measuring Cylinder, 1000 ml Beaker, stopwatch, Tempering Rod, Tray, Scoop, Funnel, Filter paper, 1% salt solution	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Concrete Technology	Gambhir, M.L.	Tata McGraw Hill Publishing Co. Ltd., New Delhi, 5th Edition, 2017, ISBN-13: 978-1-259-06255-1
2.	Concrete Technology	Shetty, M.S.	S Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi-110055, 8th Edition, 2019, ISBN, : 978-8-121-90003-4
3.	Concrete Technology	Santhakumar ,A. R.	Oxford University Press, New Delhi, 2nd Edition, 2018, ISBN-13: 978-0-195-67153-7
4.	Concrete Technology	Neville, A. M. and Brooks, J.J.	Pearson Education Pvt. Ltd., New Delhi, 2nd Edition, 2010, ISBN 978-0-273-73219-8
5.	Properties of Concrete	Neville A. M.	Pearson Education Pvt. Ltd., New Delhi, 5th Edition, 2012, ISBN 978-8131791073
6.	Laboratory Manual in Concrete Technology	Sood, H., Kulkarni P. D., Mittal L. N.	CBS Publishers, New Delhi, 1st Edition, 2016, ISBN: 9788123909417

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/105102012
2. https://nptel.ac.in/courses/105104030
3. https://nptel.ac.in/courses/105106176
4. https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
5. https://www.youtube.com/watch?v=gySKrFFswWE&list=PLwOk-xIeY47meXa-poHe6Iy_q-urnNv1e

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS : 4031 (Part 1 to 14)- Method of physical tests on hydraulic cement.
2. IS 383: 2016 Specification for coarse and fine aggregates from natural sources for concrete.
3. IS: 456-2000 Code for practice for plain and reinforced concrete.
4. IS 10262: 2019 Concrete Mix Proportioning — Guidelines.

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A) Course Code **:2415303(T2415303/P2415303/S2415303)**

B) Course Title **:** Strength of Material for Civil Engg.

C) Pre-requisite Course(s) **:** Engineering Mechanics

D) Rationale **:**

Strength is an important property of construction materials for selecting materials depending on nature of work, quality of material and economic conditions for providing maximum safety in designing different structures. This course has been designed to develop requisite competencies and skills in students so that they can be acquainted with the concept of loads and their consequences and how different kinds of loadings can be withstood by different kinds of members with some specific materials.

E) Course Outcomes (COs): After completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/industry.

After completion of the course, the students will be able to-

CO-1 Articulate practical applications of moment of inertia of symmetrical and unsymmetrical structural sections.
CO-2 Analyze structural behavior of materials under various loading conditions.
CO-3 Compute the principal stresses on an object at a given loading condition.
CO-4 Interpret shear force and bending moment diagrams for various types of determinate beams and loading conditions.
CO-5 Determine the bending and shear stresses in beams under different loading conditions.
CO-6 Analyze the given truss using analytical methods.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low(1) and No mapping(-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415303**	Strength of Material for Civil Engg.	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment(TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415303**	Strength of Material for Civil Engg.	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415303

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number (s)
TSO 1a. compare the properties of different cross-sectional shapes in terms of their Moment of Inertia, Radius of Gyration, and Section Modulus. TSO 1b. Calculate Moment of inertia about a given axis using Parallel and Perpendicular axes theorem. TSO 1c. Calculate the MOI of a given lamina about a given reference axis.	**Unit –1: Moment of Inertia (MOI)** 1.1 Definition of Moment of Inertia of plane lamina, Radius of gyration, Section modulus, Parallel and Perpendicular axes theorems, Moment of Inertia of Rectangle, square, circle, semi-circle, quarter circle and triangle section. 1.2 M.I. of symmetrical and unsymmetrical I-section, Channel section, T-section, Angle section, Hollow section and built-up section about centroidal axes and any other reference axis.	**CO1**
TSO 2a. Explain the concept of rigid, elastic and plastic body TSO 2b Label the given properties of material on stress strain curve. TSO 2c Explain Hooks law using stress strain curve TSO 2d. Interpret the properties of material based on its modulus of elasticity TSO 2e. Classify the types of the stresses induced in the given body in the given situation. TSO2f. Draw the stress strain curve for mild steel by notifying the critical points on the curve. TSO 2g. Explain the behavior of given material based of given Mechanical Properties. TSO 2h Calculate the longitudinal stress and strain for the given section under axial loading pattern. TSO 2i. Calculate temperature stresses and Strain in the given condition. TSO 2j. Establish the relationship between given elastic constants.	**Unit – 2: Simple Stresses and Strains** 2.1 Definition of Rigid, Elastic and Plastic bodies. Definition of stress, strain, elasticity, Hooke's law, Elastic limit, Modulus of elasticity. 2.2 Type of Stress-Normal, Direct, Bending and Shear and nature of stresses i.e., Tensile and Compressive stresses. 2.3 Standard stress strain curve for Mild steel bar under tension, Yield stress, Proof stress, Ultimate stress, Strain at various critical points. 2.4 Definition of various Mechanical Properties-Elasticity, Plasticity, Ductility, Brittleness, Hardness, Stiffness, Toughness, Malleability, Creep, Fatigue. 2.5 Deformation of body due to axial force and self-weight (of uniform and tapered sections), forces applied at intermediate sections, maximum and minimum stress induced composite section under axial loading. 2.6 Concept of temperature stresses and strain. Longitudinal, lateral and shear strain, Modulus of Rigidity, Poisson's ratio, uniaxial, Biaxial and tri-axial stresses, volumetric strain, change in volume, Bulk modulus (Introduction only). Relation between modulus of elasticity, modulus of rigidity and bulk modulus.	**CO1, CO2**
TSO 3a. Calculate Normal & shear stress at a given inclined plane. TSO 3b Describe the significance of principal planes and principal stresses in determining the failure conditions of materials	**Unit-3: Principal Stresses and Principal Planes** 3.1 Concept of stress transformation. 3.2 Definition of Principal Plane & Principal stress. 3.3 Principal Plane & Stress due to uniaxial and bi-	**CO3, CO4**

TSO 3c. Identify the Principal Plane from infinite planes of a given element. TSO 3d. Calculate the Principal Stress in a given loading condition using analytical method. TSO 3e. Describe the elements of Mohr's circle for a given stressed element.	axial stress system & due to state of simple shear (Analytical method). 3.4 Introduction to Mohr's Circle with simple numerical problems.	
TSO 4a. Classify the types of Supports, beams and loads. TSO4b.Explain shear force and bending moment at a given section of a beam. TSO 4c. Derive the relationship between load, shear force and bending moment. TSO 4d. Locate the points of contraflexure in a given Beam. TSO 4e. Draw SF and BM Diagrams for a determinate beam subjected to different combinations of point load, UDL and couple.	**Unit-4: Shear Force (SF) and Bending Moment (BM)** 4.1 Types of Supports, Beams and Loads. 4.2 Concept and definition of shear force and bending moment, Relation between load, shear force and bending moment. 4.3 Shear force and bending moment diagram for determinate beam subjected to point loads, uniformly distributed loads (UDL) and couple, point of contra flexure.	**CO3, CO4**
TSO5a.Explain the concept of pure bending with its assumptions. TSO 5b. Describe the nature & distribution of bending stress for a given section under different loading conditions. TSO 5c. Calculate the Moment of resistance and Bending stress at a point of a given section of beam. TSO 5d. Calculate the ratio of maximum & average shear stress for a circular or rectangular section using shear stress equation. TSO 5e. Draw shear stress distribution diagram for a given geometrical section.	**Unit-5: Bending and Shear Stresses in Beams** 5.1 Concept of pure bending, assumptions, flexural equation, bending stresses and their nature, bending stress distribution diagram. 5.2 Concept of Moment of resistance (MOR) and simple numerical problems using flexural equation. 5.3 Shear stress equation, relation between maximum and average shear stress for rectangular and circular section. 5.4 Shear stress distribution diagram for angle sections, channel section, I-section, T section. Simple numerical problems based on shear equation.	**CO4, CO5**
TSO 6a Explain the concepts of frames and trusses and their role in structural engineering TSO 6b Suggest suitable type of frame for given loading condition TSO6cIdentify perfect/imperfect and redundant/deficient truss. TSO 6d. Analyze given truss structure using appropriate method.	**Unit -6: Analysis of Trusses** 6.1 Definition of frames and trusses, Classification of truss, perfect, imperfect, redundant and deficient truss, relation between members and joints, assumption in analysis. 6.2 Method of joint, method of section to find nature of forces.	**CO6**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs)and List of Practical: P2415303

Practical/ Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1. Compare experimentally determined MOI of flywheel with theoretical value of the same.	1.	Determine the moment of inertia of a flywheel.	CO1
LSO2.1. Identify different components of UTM along with functions of each component.	2.	Study different components of Universal Testing Machine (UTM).	CO2
LSO 3.1. Determine yield strength, ultimate strength, fracture strength and percentage elongation of given steel specimen in tension.	3.	Perform Tension test on Mild steel/HYSD as per IS 1608.	CO2
LSO4.1. Determine compressive strength of given steel specimen.	4.	Conduct compression test on Mild steel piece using Universal Testing Machine (UTM).	CO2
LSO5.1. Find out flexural strength of wooden beam.	5.	Conduct Flexural test on timber beam on rectangular section in both orientations as per IS:2408.	CO5
LSO6.1. Find out shear strength of a given specimen.	6.	Perform the shear strength test on a given specimen.	CO5
LSO7.1. Determine impact strength of a given specimen using Izod Impact testing Machine.	7.	Perform Izod Impact test on a given specimen.	CO2
LSO8.1. Determine impact strength of a given specimen using Charpy impact testing Machine.	8	Perform Charpy Impact test on metal specimen.	CO2
LSO9.1. Determine Hardness Number of a given specimen using Brinell hardness testing Machine.	9	Perform Brinell hardness test on metal specimen.	CO2
LSO10.1. Determine hardness of a given specimen using Rockwell hardness testing machine.	10	Perform Rockwell hardness test on metal specimen.	CO2
LSO11.1. Distinguish different types of truss.	11	Prepare model of different types of truss.	CO6
LSO12.1. Identify the critical points for shear force and bending moment for a simply supported beam	12	To draw shear force and bending moment diagram for a simply supported beam under point and distributed loads.	CO4
LSO13.1. Identify the elements of Mohr circle to calculate principal stress by locating principal plane.	13	To determine Principal stresses and its location using Mohr's circle method.	CO3

L) Suggested Term Work and Self Learning: **S2415303** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/ Problems/ Numerical/ Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Design the length of a broad -gauge railway sleeper such that it has the minimum bending moment.
2. Collect information and present in tabular form, values of different engineering properties of five standard building materials.
3. Prepare a report on different machine components subjected to uniaxial and bi-axial stress system.
4. Prepare an excel sheet to calculate SFD and BMD in a simply supported beam and cantilever beam.
5. Prepare a model of simple bridge truss.

c. Other Activities:

1. Seminar Topics:

(a) Comparison of moment of inertia of various built-up sections used in construction works.
(b) Comparison of various construction materials from day-to-day life in accordance to their mechanical properties.
(c) A report on study of types of stress and strain.
(d) Methods of increasing the flexural strength of timber beam.
(e) Study of types of trusses used in construction works.

2. **Self-learning topics**:

- Select appropriate shape, type and material of member from day to day situation for various type of stress and strain.
- Correlate the actual field condition about various member subjected to different types of loading.
- Study the mode of failures due to flexure and shear from field situations and prepare a report.
- Visit site/design office to collect the data from day to day situations for different types of structures under given loading.
- Search the software on the course content and prepare the report stating their applications.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

Cos	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	10%	17%	15%	10%	10%	10%	16%
CO-2	20%	12%	10%	20%	25%	40%	17%
CO-3	15%	19%	15%	20%	-	10%	17%
CO-4	25%	17%	20%	25%	30%	10%	17%
CO-5	20%	16%	20%	-	20%	20%	17%
CO-6	10%	19%	20%	25%	15%	10%	16%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & above(A)
Unit-1.0 Moment of Inertia (MOI)	8	CO1	12	4	4	4
Unit-2.0 Simple stresses and strains	6	CO2	9	3	3	3
Unit-3.0 Principal stresses and Principal planes	9	CO3	13	4	4	5
Unit-4.0 Shear force (SF) and Bending moment (BM)	8	CO4	12	3	4	5
Unit-5.0 Bending and Shear stresses in beams	8	CO5	11	3	3	5
Unit -6.0 Analysis of Trusses	9	CO6	13	3	4	6
Total Marks	**48**	**-**	**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant Cos Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the moment of inertia of a flywheel.	CO1	30	60	10
2.	Study different components of Universal Testing Machine (UTM).	CO2	40	50	10
3.	Perform Tension test on Mild steel/HYSDas per IS 1608.	CO2	30	60	10
4.	Conduct compression test on Mild steel piece using Universal Testing Machine (UTM).	CO2	30	60	10
5.	Perform the shear strength test on a given specimen.	CO5	30	60	10
6.	Perform Izod Impact test on a given specimen.	CO2	30	60	10
7.	Perform CharpyImpact test on metal specimen.	CO2	40	50	10
8.	Perform Brinell hardness test on metal specimen.	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant Cos Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
9.	Perform Rockwell hardness test on metal specimen.	CO2	40	50	10
10.	Prepare model of different types of truss.	CO6	30	60	10
11.	To draw shear force and bending moment diagram for a simply supported beam under point and distributed loads.	CO4	30	60	10
12.	To determine Principal stresses and its location using Mohr's circle method.	CO3	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Universal testing machine	Capacity 1000 kN, 600 kN, 400 kN. Analog type/ digital type	3, 4
2.	Shear strength testing machine	Conforming to IS 1828-1975 shall also conform to the requirements of Grade 10.	
3.	Izod Impact testing machine	Conforming to IS 1977	7
4.	Charpy Impact testing machine	Conforming to IS 1757	8
5.	Brinell hardness testing machine	Conforming to IS 2281:2005	9
6.	Rockwell hardness testing machine	Conforming to IS 1586 (Part 2) : 2012	10
7.	Accessories: Vernier caliper, meter scale, weighing balance, weights, punch, file, hammer, screw drivers, pliers and flywheel		All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	A text book of strength of materials	Dr. R.K. Bansal	Laxmi Publication (6th edition) ISBN-13:978-8131808146 ISBN-10:9788131808146
2.	Mechanics of Materials	Gere and Timoshenko	CBS Publishers (2th edition) ISBN-13:978-8123908946 ISBN-10:9788123908946
3.	Strength of materials	Er. R.K. Rajput	S Chand publishing (6th edition) ISBN-13:978-9385401367 ISBN-10:9789385401367
4.	Strength of materials	Ramamrutham	Dhanpat Rai Publishing Company (16th edition) ISBN-13:978-8187433545 ISBN-10:818743354X
5.	Strength of materials	R.S. Khurmi	S Chand (G/L) &Company Ltd. (23rd edition) ISBN-13:978-8121905336 ISBN-10:8121905338
6.	SMTS-1 Strength of materials	Dr. B.C. Punmia Er. Ashok kumar Jain Dr. arunkumar Jain	Laxmi publication (10th edition) ISBN-13:978-8131809259 ISBN-10:8131809250

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105108/
2. https://www.youtube.com/watch?v=RXbqFrlXPl0
3. https://www.youtube.com/watch?v=ufd-CJj8Jxs
4. https://www.youtube.com/playlist?list=PL9RcWoqXmzaLlfmNg2Ku1SdZtvXnYrLbc
5. https://www.youtube.com/playlist?list=PL27C4A6AEA552F9E6

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS 1977 - Izod Impact test.
2. IS 1757 - Charpy Impact test.
3. IS 2281:2005 - Brinell hardness test.
4. IS 1586 (Part 2): 2012 - Rockwell hardness test.
5. IS 1828-1975 - Shear strength testing machine.

******

A) Course Code : 2415304(T2415304/P2415304/S2415304)

B) Course Title : Building Construction and Material

C) Pre- requisite Course(s) : Class 10th level basic knowledge

D) Rationale :

The construction of buildings and structures relies on having a thorough understanding of building materials. Without this knowledge it would not be possible to build safe, efficient and long-lasting buildings, structures and dwellings. This course provides an over-view of the basic properties of wide range of building materials available to Civil Engineers for various usages. Students also learn the standard testing procedures of construction materials as per provision of various IS Codes. Besides this student also learn about construction of brick and stone masonry, plastering, damp proofing its requirements and methods of construction, need and significance of ventilation, methods of insulation, construction equipment.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to:

CO-1 Select suitable materials for a given building construction project.
CO-2 Use the modern construction materials for a given construction conditions.
CO-3 Explain various components & their functions of a given building structure.
CO-4 identify relevant type of foundation for a given building structure.
CO-5 Supervise various activities of a given building construction project.
CO6 Select suitable horizontal & vertical components of a given building construction project.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415304**	Building Construction and Material	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		Total Marks (TA+TWA+LA)
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415304**	Building Construction and Material	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415304

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO1.1 Describe the term, "Stone as Building Material" with its classifications. TSO1.2 Explain the various methods of manufacturing of bricks TSO 1.3 Select suitable aggregates for a given construction work TSO 1.4 Conduct various tests on bricks in the laboratory as per IS code provisions	**Unit 1- Stones, Aggregate and Bricks** 1.1 **Stones:** Stone as building material – Classification of Stones, Deterioration and Preservation of stone work 1.2 **Aggregates:** Aggregates- Classification, Characteristics, Grading of Aggregates, **Bricks:** – Classification – Manufacturing of clay bricks, Tests on bricks – (Dimension- Compressive Strength – Water Absorption – Efflorescence)	**CO1**
TSO 2.1 Select suitable type of cement for a given construction work. TSO 2.2 Classify lime based on its properties. TSO 2.3 Conduct various tests on cement in laboratory. TSO 2.4 Suggest suitable mortar based on its application in the construction site	**Unit 2- Lime, Cement and Mortar** **2.1 Lime:** Lime – Properties and Classification **2.2 Cement:** Cement, Ingredients, Manufacturing of Cement, Types of Cement, Test on Cement (Consistency test, Initial and Final Setting Time, Soundness, Compressive Strength) **2.3 Mortar:** Mortar, Classification and properties of Mortar	**CO1**
TSO 3.1 Classify various types of timber based on its properties. TSO 3.2 Identify defects in a given timber. TSO3.3 Differentiate between ferrous material & non-ferrous metals. TSO 3.4 Suggest suitable type of modern construction material based on its application.	**Unit 3- Timber and Modern Materials** **3.1 Timber:** Timber, Classification, Structure of Timber, Properties of Timber, Characteristics of Good Timber, Defects in Timber, Advantage and Disadvantage of Timber as an engineering material **3.2 Modern Materials:** Glass, Ferrous and Non-Ferrous Metals, Ceramics Geotextile and Geomembrane, Fiber glass reinforced plastic	**CO1, CO2**
TSO4.1 Classify a given building based on NBC code provisions. TSO4.2 Enlist component parts of a given building. TSO4.3 Explain the functions of various components of a given building structure. TSO4.4 Differentiate between the load bearing and framed structure.	**Unit 4- Building Components:** 4.1 **Classification of Buildings** as per National Building Code Group A to I, as per Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure. 4.2 **Building Components** – Building Components and their Function, Substructure - Foundation, Plinth, and Plinth Filling Superstructure- Walls, Partition wall, Cavity Wall, Sill, Lintel, Doors and windows, Floor, roof, Column Beams and Parapet	**CO3, CO4**
TSO 5.1 Demonstrate lay out of a given building in the field using centerline method. TSO 5.2 Suggest suitable type of foundation for a given structure. TSO 5.3 Explain various terms used in brick masonry work.	**Unit 5- Sub-Structure and Super Structure** **5.1 Job Layout and Excavation:** Site clearance, Preparing job Layout, Layout for Load Bearing Structure and Framed Structure by Center Line and Face Line Method, Precautions, Excavation for Foundation, Earthwork for Embankment, Material	**CO4, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5.4 Explain different types of bond in brick masonry with neat sketches TSO 5.5 Compare the Stone masonry construction with Brick masonry construction. TSO 5.6 Discuss quality control aspects in the brick masonry works.	for Plinth Filling. Tools and Plants Used for Earthwork **5.2 Sub-Structure**: Foundation-Function of Foundation Types of Foundation- Shallow Foundation, Stepped Footing, Wall Footing, Column Footing, Isolated and Combined Column Footing, Raft Foundation, Grillage Foundation. Deep Foundation-Pile Foundation, classification based on materials and functions, Well foundation and Caissons. **5.3 Super-Structure:** Brick masonry: Terms used in brick masonry- header, stretcher, closer, quoins, course, face, back, hearting, bat bond, joints, lap, frog line, level and plumb Bonds in brick masonry- header bond, stretcher bond, English bond and Flemish bond. Requirements of good brick masonry, Junctions in brick masonry and their purpose and procedure. Precautions to be observed in Brick Masonry Construction Comparison between stone masonry and Brick Masonry.	
TSO 6.1 Demonstrate with sketches various components of horizontal communication. TSO 6.2 Suggest suitable types of doors and windows for a given building plan. TSO 6.3 Demonstrate fixing of various types of doors & windows using the relevant fixture and fasteners. TSO 6.4 Suggest suitable type of staircase for a given building structure. TSO 6.5 Explain the parameters that need to take into consideration while designing the staircase.	**Unit 6: Building Communication and Ventilation** **6.1 Horizontal Communication**: Doors- Components of Doors, Fully Paneled situation with sketches. Doors, Partly Paneled and Glazed Doors, Flush Doors, Collapsible Doors, Rolling Shutters, Revolving Doors, Glazed Doors. Sizes of Door recommended by BIS. **6.2 Windows**: Component of windows, Types of Windows-Fully Paneled. Partly Paneled and Glazed, wooden, Steel, Aluminum windows, Sliding Windows, Louvered Window, Bay window. Corner Dormer window, Skylight. Sizes of Windows recommended by BIS. Ventilators, Cement Grills **6.3 Vertical** Communication**:** Stair Case, Ramps, Lift. Elevators and Escalators.	**CO6**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415304

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1a. Determine the grading of fine aggregate for the given civil engineering work LSO 1b. Calculate the specific gravity of given type of fine aggregate. LSO 1c. Analyze the bulk density of given fine aggregate for compacted and loose state.	1.	**Test on Fine Aggregate-** 1. Determination of Grading of Fine Aggregate 2. Determination of specific gravity of fine aggregate 3. Determination of Compacted and loose bulk density of fine aggregate	CO1, CO5

LSO 2a. Calculate the impact value of coarse aggregate. LSO 2b. Determine the elongation and flakiness index of the coarse aggregate. LSO2c. Determine the crushing value of coarse aggregate.	2.	**Test on Coarse Aggregate-** 1. Determination of impact value of coarse aggregate. 2. Determination of Elongation index and flakiness index 3. Determination of crushing value of coarse aggregate	CO1, CO5
LSO 3a. Find the Normal consistency of cements. LSO 3b. Determine the initial and final setting time of given sample of cement LSO 3c. Test the given cement sample for the compressive strength	3.	**Test on Cement-** 1. Determination of Normal consistency of cement 2. Determination of Initial and Final setting time of cement **3.** Determination of compressive strength of cement sample	CO1, CO5
LSO 4a. Compare the compressive strength of given samples of the bricks. LSO 4b. Carry out the absorption test on bricks to Identify its class. LSO4c. Find the Efflorescence of given sample of brick.	4.	**Test on Bricks: -** 1. Determination of compressive strength of bricks 2. Determination of water absorption of bricks 3. Determination of Efflorescence of Bricks	CO1, CO5

L) **Suggested Term Work and Self Learning**: **S2415304** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Perform a activity by collection of different types of stones and write their properties.
2. Identify different types of cement as per availability at nearby location.
3. Prepare a sketchbook consisting of different types of staircases used in building construction.
4. Collect relevant information of recent technologies in manufacturing the cement of various grades and prepare a report on it.
5. Identify the reasons of seepage through the walls of the building and suggest the suitable remedial measures to address it and submit a report.
6. Prepare a summary report with reference to content in any one part of National Building Code.
7. Check different construction activities by visiting a nearby site as per the check list provided.

b. Micro Projects:

- Fly ash bricks
- Strength of different types of bricks
- Physical and chemical properties of cements
- Commercially available timber

c. Other Activities:

1. Seminar Topics:
   - Rain water harvesting
   - Foundation for high rise buildings
   - Quality control aspects in building construction works.
   - Different types of stair cases used in building structure
   - Modern & green building construction materials
2. Visits: Visit nearby building construction project & Prepare report of visit with special comments on material used.

3. Self- learning topics:
    - Different types of stones for different work.
    - Cement for hydroelectric project

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO 1	15%	10%	15%	15%	15%	30%	35%
CO 2	15%	20%	15%	15%	15%	30%	35%
CO 3	20%	20%	20%	20%	15%	40%	30%
CO 4	15%	15%	25%	25%	15%	-	-
CO 5	15%	20%	15%	15%	20%	-	-
CO 6	20%	15%	10%	10%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit 1- Stones, Aggregate and Bricks	06	CO1	08	2	2	4
Unit 2- Lime, Mortar and Cement	10	CO1	14	4	4	6
Unit 3- Timber and Modern Materials	10	CO1, CO2,	14	4	4	6
Unit 4- Building Components	06	CO3, CO4	10	3	3	4
Unit 5- Sub-Structure and Super Structure	10	CO4, CO5	14	4	4	6
Unit 6: Building Communication and Ventilation	06	CO6	10	3	3	4
Total Marks	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determination of Grading of Fine Aggregate	CO1, CO5	30	60	10
2.	Determination of specific gravity of fine aggregate	CO1, CO5	40	50	10
3.	Determination of Compacted and loose bulk density of fine aggregate	CO1, CO5	30	60	10
4.	Determination of impact value of coarse aggregate.	CO1, CO5	30	60	10
5.	Determination of Elongation index and flakiness index	CO1, CO5	30	60	10
6.	Determination of crushing value of coarse aggregate	CO1, CO5	30	60	10
7.	Determination of Normal consistency of cement	CO1, CO5	30	60	10
8.	Determination of Initial and Final setting time of cement	CO1, CO5	40	50	10
9.	Determination of compressive strength of cement sample	CO1, CO5	40	50	10
10.	Determination of compressive strength of bricks and blocks	CO1, CO5	40	50	10
11.	Determination of water absorption of bricks	CO1, CO5	30	60	10
12.	Determination of Efflorescence of Bricks	CO1, CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ ImplementationStrategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Sieves	4.75 mm, 10 mm, 20 mm, 40 mm, 80 mm, for coarse aggregates, 2.36 mm, 1.18 mm, 600 microns, 150 microns, for fine aggregates.	All
2.	Weigh Machine	Not less than 3kg and accurate upto 0.5gm, Oven, Pycnometer of about 1 litre capacity, Tray, Air tight container, filter paper.	All
3.	Balance, tamping rod, Shovel, Calibration equipment	Balance weigh not less than 3kg, Tamping rod of 16mm dia nad 600mm length, A cylindrical metal measure, preferably provided with the handles, A piece of plate glass, preferably at least 6mm thick and 25mm larger than the diameter of the measure to be calibrated.	1, 2,3, 4, 6, 7, 8, 9
4.	weighing machine, cylindrical steel cup, metal hammer, Tamping rod	Weighing Machine 45 to 60kg, A cylindrical steel cup of internal diameter 102 mm, depth 50 mm and minimum thickness 6.3 mm. metal hammer weighing 13.5 to 14.0 kg, Tamping rod 10 mm in diameter and 230 mm long, rounded at one end.	4
5.	Standard thickness and length gauge.	Thermostatically controlled oven with capacity up to *250* °C., Standard thickness and length gauge	5
6.	steel cylinder, cylindrical metal, Dial gauge	Steel cylinder 15 cm diameter with plunger and base plate, A compression testing machine, cylindrical metal measure of sufficient rigidity to retain its from under rough usage and of 11.5cm diameter and 18cm height, Dial gauge	6, 7, 8
7.	Vicat apparatus, Gauging trowel, Stop watch	Vicat apparatus confirming IS: 5513-1976, Gauging trowel confirming IS:10086-1982, Stop watch	7, 8
8	Vibration Machine, Cube Mould, Poking rod, Gauging Trowel, Standard Weights, Graduated Glass Cylinders, non-porous plate UTM Machine	The vibration machine should be as per the standard IS 10080 – 1982, Mould to be used in this test should conform to IS 10080 – 1982, Size of cube mould – 70.6 mm. Poking rod should be as per the standard IS 10080 – 1982, Gauging trowel should comprise the blade of length 100-150 mm. it should have straight edges. Its weight should be 210 ± 10 g, Glass cylinders with a capacity of 150-200 ml are required, permissible variation shall be ± 1 ml,	9, 10
9	Ventilated oven, weighing balance, sample of whole brick	Ventilated oven, weighing balance, sample of whole brick	10, 11, 12

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	A Text-Book of Building Construction	S.P.Bindra and S.P.Arora	Dhanpat Rai Publication, Delhi Edition 2013, ISBN: 9788189928803
2.	Building Materials and Construction	Jena and Sahu,	Tata Mc. Graw Hill (2017). ISBN-10: 9339220625 ISBN-13: 978-9339220624
3.	Materials for Civil and Construction Engineers	Mamlouk and Zaniewski	Pearson
4.	Construction Materials	D.N. Ghosh	Tata McGraw Hill, New Delhi

5.	P.C. Varghese	Building Materials	PHI learning, New Delhi
6.	Building Construction	B. C. Punmia	Laxmi Publication

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/124105013
2. https://www.vlab.co.in/broad-area-civil-engineering
3. https://www.youtube.com/watch?v=EIDXE28_8eQ&list=PL8BA090E69BF01BC2

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Engineers Hand book
2. Building Material Handbook
3. Lab Manuals

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A) Course Code : 2415305(T2415305/S2415305)

B) Course Title : Water Resources Engineering

C) Pre- requisite Course(s) :

D) Rationale :

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

E) Course Outcomes (COs): In we are working in the field of irrigation Engg. we should know how much water is going into the ground from where the plants can take their water If we are concerned about the water resources we should know how much water is going into the river so that we can control the floods or we can avoid the lack of water for irrigation other area

After completion of the course, the students will be able to-

CO 1 Compute the hydrological parameters using relevant method in the given situation

CO-2 Estimate the crop water requirement of the command area to determine the capacity of canal.

CO-3 Suggest the relevant type of Dam for the given purpose in the given situation.

CO-4 Select the relevant method of irrigation in a given situation.

CO-5 Propose the relevant type of diversion headwork for the given site conditions.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415305**	Water resources engineering	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415305**	Water Resources engineering	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

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J) Theory Session Outcomes (TSOs) and Units: T2415305

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the term, "hydrological cycle". *TSO 1b. Classify the* rain gauges on the basis of nature of rainfall. *TSO 1c. C*alculate average rainfall using the relevant method of estimation. *TSO 1d.* Explain the terms, "Runoff" along with the factors affecting the runoff *TSO 1e.* Calculate maximum flood discharge using the relevant method with given data.	**Unit-1.0 Introduction to Hydrology** 1.1 Hydrology: Definition and Hydrological cycle. 1.2 Rain Gauge: Symon's rain gauge, automatic rain gauge. 1.3 Methods of calculating average rainfall: Arithmetic mean, Isohyet, and Theissen polygon method. 1.4 Runoff, Factors affecting Run off, Computation of run off. 1.5 Maximum Flood Discharge measurement: Rational and empirical methods, Simple numerical problems.	**CO1**
TSO 2a. Classify the different methods of irrigation. TSO 2b. Define the terms, "GCA, CCA, Crop period, base period, Duty, Delta, intensity of irrigation" TSO 2c Calculate water requirement of the given crop with given data. TSO 2d. Apply the relevant method of assessment for irrigation water.	**Unit-2.0 Crop Water Requirement** 2.1 Irrigation and its classification. • Surface irrigation • Subsurface irrigation 2.2 Crop Water requirement: Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA,intensity of irrigation, factors affecting duty, Problems on water requirement and capacity of canal. 2.3 Methods of application of irrigation water and its assessment. • Sprinkler irrigation • Drip irrigation 2.4 Area capacity curve.	**CO2**
TSO 3a. Suggest the relevant type of Dam in the given situation TSO 3b Classify the dams along with its components. TSO 3c. Explain the functions of an earthen dam. TSO 3d. Explain the method of construction of earthen dam. TSO 3e. Explain the causes of failure of earth dam. TSO 3f. Suggest the relevant preventive measure to protect the dam from the failure.	**Unit-3.0 Dam and Spillway** 3.1 Dams and its classification: Earthen dams and Gravity dams (masonry and concrete). 3.2 Earthen Dams – Components with function, typical cross section, seepage through embankment and foundation and its control. 3.3 Methods of construction of earthen dam, types of failure of earthen dam and preventive measures.	**CO3**

TSO 3e. Draw the labelled sketch of a Gravity dam section to show the various forces acting on it. TSO 2f. Justify the need of the spillway at the given location in the dam section	3.4 Gravity Dams – Forces acting on dam, Theoretical and practical profile, typical cross section, drainage gallery, joints in gravity dam, concept of high dam and low dam. 3.5 Spillways-Definition, function, location, types and components, Energy dissipator	
*TSO 4a. Explain the term, "*Bandhara irrigation" with the help of layout sketch. *TSO 4b.* Explain the importance site selection in the design of percolation tank. *TSO 4c.* Explain the concept of lift irrigation w.r.t. layout, its components and functions. TSO 4d. Justify the need of sprinkler in drip irrigation. TSO 4e. Describe the method of well irrigation with its advantage and disadvantage.	**Unit-4.0 Minor and Micro Irrigation** 4.1 Bandhara irrigation: Layout, components, construction and working, solid and open bandhara. 4.2 Percolation Tanks – Need, selection of site. 4.3 Lift irrigation Scheme-Components and their functions, Lay out. 4.4 Drip and Sprinkler Irrigation- Need, components and Layout. 4.5 Well irrigation: types and yield of wells, advantages and disadvantages of well irrigation	**CO4**
TSO 5a. Explain the term, "weir" with its classification. TSO 5b. Draw the labelled Layout of diversion head work. TSO 5c. Explain the given layout of a barrage. TSO 5e. Differentiate between weir section and barrage. TSO 5f. Design most economical section for the given canal. TSO 5g. Justify the need of lining the canal with its advantages. TSO 5h. Suggest relevant type of drainage Work based on the given site condition. TSO 5i. Explain canal regulators along with falls & outlets.	**Unit-5.0 Diversion Head Work and Canal** 5.1 Weirs – components, parts, types 5.2 Diversion head works – Layout, components and their function. 5.3 Barrages – components and their functions. Difference between weir and Barrage. 5.4 Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth, Design of most economical canal section. 5.5 Canal lining - Purpose, material used and its properties, advantages. Cross Drainage works- Aqueduct, siphon aqueduct, super passage, level crossing. 5.6 Canal regulators- Head regulator, Cross regulator, Escape, Falls and Outlets.	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

(L) Suggested Term Work and Self Learning: S2415305 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in linewith the targeted COs.

Any six of the following:

1. Collect data and drawings of various dam structures in Bihar State from various sources.
2. Draw inference from designs/above drawings and data.
3. Prepare presentations on given topics.
4. Calculate average rainfall for the given area using arithmetic mean method.
5. Calculate average rainfall for the given area using Isohyet Theissen polygon method

6. Estimate crop water requirement for the given data.
7. Calculate control levels for the given data for the given reservoir.
8. Draw the theoretical and practical profile of the given gravity dam section.
9. Prepare a maintenance report for any major/minor irrigation project site in the vicinity of your area, based on field visit.
10. Prepare summary of the technical details of any existing water resource project in the vicinity of your area.
11. Draw a labeled sketch of the given diversion head works and CD works.

b. Micro Projects:

Any one of the following.

1. Design and Analysis of Micro Irrigation System for a Small-Scale Farm
2. Design of Sprinkler Irrigation Systems for uniform and optimum Distribution of water
3. Design of Rainwater Harvesting system for a building structure in urban/rural area.
4. Feasibility Study with Design of a Small-Scale Dam for Water Supply and Irrigation Purposes
5. Environmental Impact Analysis for Biodiversity Conservation in the Vicinity of a Dam Project
6. Prepare a brief report of cropping pattern, for the given minor irrigation project in your district with reference to growth in yield, increase in command and culturable area and economic status of the concern people.
7. Conduct internet survey for Water shed management project (s) in the Bihar State with a detailed report of it.
8. Prepare a detailed report of visit to a recently executed rain water harvesting project in your vicinity.
9. Prepare a brief report on applications of remote sensing and GIS in water resource engineering with relevant examples.

c. Other Activities:

1. Seminar Topics:

   Any one of the following
   - Rain water harvesting
   - Utility of dam & spillway
   - Micro irrigation system.
   - Rain Gauges and its Applications
   - Applications of remote sensing and GIS in water resource engineering

2. Visits: Visit nearby Dam/Weir/Barrage etc. Prepare report of visit with special comments on discharge of water, material used.
3. Self- learning topics:
   - Forms of precipitation.
   - Evaporation -- process, measurement, and estimation.
   - Water Management
   - Dam Safety and Maintenance

(M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/ performance of each student in each of these designed activities is to be used to calculate **CO attainment.**

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	15%	20%	-	-
CO-2	15%	15%	10%	15%	20%	-	-
CO-3	25%	20%	15%	25%	20%	-	-
CO-4	25%	25%	30%	30%	20%	-	-
CO-5	20%	25%	30%	15%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

(N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Numbers	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Hydrology	06	CO1	10	3	3	4
Unit-2.0 Crop Water Requirement	08	CO2	10	3	3	4
Unit-3.0 Dam and Spillway	10	CO3	14	4	4	6
Unit-4.0 Minor and Micro Irrigation	12	CO4	18	4	4	10
Unit-5.0 Diversion head work and canal	12	CO5	18	6	6	6
Total Marks	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

(O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

(P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

(Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

(R) Suggested Learning Resources:

(a) Books:

S. No	Titles	Author(s)	Publisher and Edition with ISBN
1.	Irrigation and hydraulic structure	S. K. Garg	Khanna publisher, New Delhi ISBN 81-7409-047-9
2.	Irrigation engineering and water power engineering	B.C.Punmia	Laxmi Publication, Delhi ISBN 13: 9788131807637
3.	Engineering Hydrology	K. Subramanya	McGraw Hill Education ISBN 13: 9789383286539
4.	Irrigation Engineering	R.K Sharma T.K Sharma	S Chand Publications ISBN 13: 9788121921282
5.	Irrigation Engineering	N.N Basak	McGraw Hill Education ISBN 13:978-0074635384
6.	Water Resource Engineering	Piyush Goyal	Vayu Education of India ISBN 13: 978-9382174462

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/105/104/105104103/
2. https://nptel.ac.in/courses/105105110
3. https://www.youtube.com/watch?v=tW2w14YIQ98
4. htttp://www.imd.gov.in
5. https://onlinecourses.nptel.ac.in/noc21_ag08/preview
6. https://expertcivil.com/diversion-headworks/

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS:4410-Part-V-1982-Canals
2. IS:4410-Part-VI-1983-Reservoirs
3. IS:4410-Part-VII-1983-Dams
4. Lab Manuals

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A) Course Code : 2415306 (P2415306/S2415306)

B) Course Title : Summer Internship -I (Common For all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- **CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- **CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- **CO-4** Identify the probable job function and job position in their relevant programme of study.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2415306	Summer Internship -I	-	-	02	02	04	02

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2415306	Summer Internship -I	-	-	10	15	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Suggested Instructional/Implementation Strategies: Mentors/ Coordinators/ Teachers need to plan and implement the summer internship in their respective programme as per the outcome expected from the programme. However in general, summer internship would help in exploring and exposing

the student to the below mentioned dimensions of the world of work. These dimensions can further be explored in depth as per the need and advancement in respective programmes in later stages. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the whole to part approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the specific diploma programme and then teaching the related concepts ('Part') of the same in subsequent semesters.

- Industrial Layout
- Organizational Structure
- Corporate Communications
- Strategic, Rolling and Developmental plans
- Maintenance Procedures
- Inventory Control and Management System
- Purchase and Store Procedures
- Major Machinery, Tools, Equipment, Devices, Software, Control System etc.
- Product Development, Manufacturing, Packaging and Delivery
- Project Management
- Operation and Maintenance
- Warehouse Management
- Assembly Line
- Quality Assurance and Testing Cell
- Process/ Software Development/ Fabrication/ Construction Work Management
- Testing and Quality Assurance Practices
- Total quality management
- Calliberation and Certification practices
- Safety Practices
- Industrial Acts
- Industrial Grievances
- Behavioural Aspects
- Conduction of Meetings and Discussions
- Sales and Marketing Strategies
- Forecasting and Target Setting
- Production Planning and Control
- Storage Retrieved and Material handling Practices
- Automation and Control Facilities
- Enterprise Resource Planning (ERP)
- Supply Chain
- Customer Satisfaction Strategies
- Finance and Accounts
- Research and Development
- Promotion and Capacity Building Schemes
- Reduce, Reuse and Recycling Efforts and Policies
- Recognitions and Rewards
- After Sale Services
- Promotional Avenues
- Social Corporate responsibilities

J) Assessment of Summer Internship -I

S. No.	Criteria of Assessment	% of Weightage
1.	Maintaining the log book after having exposure to different types of industry/ world of work	15
2.	Preparing the list of job functions and job positions of relevant programme	20
3.	Identify the probable enterprise/ startup for futuristic planning	15
4.	Report writing of summer internship as per the prescribed format	30
5.	Presentation of Report	20
Total		**100**

Note: S. no. 1 to 3 shall be considered for progressive assessment. While S. No. 4 & 5 shall be considered for end term assessment

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A) Course Code : **2415301(T2415301/P2415301/S2415301)**

B) Course Title : Basic Surveying (CE, AE)

C) Pre-requisite Course(s) : Basic Geometry

D) Rationale :

Surveying is the science and art of taking all necessary measurements to identify the relative location of points or physical and cultural elements above, on, or under the surface of the earth, and to display them in a useful manner. The theodolite, compass, auto-level, chains, tapes, levelling staff, total station, etc., are all essential surveying equipment. Surveying includes both: the time spent in the field and in the office. This is because all necessary distance, angle, direction, elevation, location, area, and volume measurements are obtained in the field and then calculated back at the office. Surveying is done to produce a map that depicts the relative locations of the various features on the earth's surface. The map is created to a scale that seems appropriate. This subject is essential for students to have information on the field and its topography to prepare maps or drawings; for any civil or architectural work. This course will help the students to get familiar with various surveying instruments and will help improve their understanding of the topography of the building site. This course will provide an opportunity to develop skills in surveying at the primary level. The data gathered from surveying helps establish planning and design to determine the best course of action. To understand the techniques of surveying, a student must carefully understand the use of various surveying instruments used in the field.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in the classroom/laboratory/workshop/ field/industry.

After completion of the course, the students will be able to-

CO-1 Undertake the relevant type of survey for the given purpose in the given situation.

CO-2 Apply the necessary correction to the linear measurements recorded in the field book.

CO-3 Conduct chain and compass traverse survey in the given field.

CO-4 Draw the contour map of the given terrain using the relevant levelling instrument.

CO-5 Use a digital planimeter to measure the area of the given figure or shape.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415301**	Basic Surveying	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415301**	Basic Surveying	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: *T2415301*

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
TSO 1a Propose the relevant type of survey in the given situation. TSO 1b Explain the basic principles of surveying in the given type of survey. TSO 1c Select the relevant scale for the given situation.	**Unit-1.0 Overview and Classification of Survey** 1.1 Survey-Purpose and Use: Types of surveying- Primary and Secondary, Classification: Plane, Geodetic. Cadastral, Hydrographic, and Aerial. 1.2 Principles of Surveying 1.3 Scales: Engineer's scale, Representative Fraction (RF), diagonal scale, and Vernier Scale.	**CO1**
TSO 2.a Draw the perpendicular offsets on the main chain line in the given situation. TSO 2b. Draw the schematic diagram showing the details such as the Baseline, check line, and Tie line including Main Survey Station. TSO2c. Use the relevant method of ranging in chain survey. TSO2d. Explain the type of error and correction required in the chain survey. TSO2e. Compute the area of a given field using the principle of triangulation.	**Unit-2.0 Chain Survey** 2.1 Instruments used in chain survey: Metric Chain, Tapes, Arrow, ranging rod, Line ranger, Offset rod, Open cross-staff, Optical square. 2.2 Chain survey Station, Baseline, Check line, Tie line, Offset, Tie Station. 2.3 Ranging Direct and Indirect Ranging, Method of chaining, obstacles in chaining. 2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error, Principles of triangulation. 2.5 Types of offsets: Perpendicular and Oblique, Conventional Signs, Recording of measurements in a field book.	**CO2**
TSO3a. Perform the relevant Traverse survey for the given situation. TSO3b.Distinguish between True Meridian and Magnetic Meridian TSO 3c. Convert the whole circle bearing to a reduced bearing and vice versa. TSO 3d Calculate the included angles of a closed traverse after applying suitable corrections. TSO 3e Draw a labeled diagram of a Prismatic Compass. TSO 3f Determine the correct bearing from the given observed bearing. TSO 3g Adjust the closing error of the traverse for the given data.	**Unit-3.0 Compass Survey** 3.1 Compass Traversing-open, closed Traverse. 3.2 Technical Terms: Geographic/True Meridians, Magnetic Meridians, and Bearings, Whole Circle Bearing system and Reduced Bearing system and examples on the conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination. 3.3 Components of Prismatic Compass and their functions, Methods of using Prismatic Compass- Temporary adjustments and observing bearings. 3.4 Local attraction, Methods of correction of observed bearings - Correction at station and correction to included angles. 3.5 Methods of plotting a traverse and closing error, Graphical adjustment of closing error	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
TSO4a. Explain the given basic terms used in the levelling and contouring. TSO4b. Explain the temporary adjustment of the dumpy level. TSO 4d. Calculate the Reduced Level of given point using Rise and Fall method. TSO 4e. Choose levelling operation for the given situation. TSO 4f Explain the Characteristics of the given contour lines along with their uses. TSO 4g Recognize the nature of terrain from the given contour map.	**Unit-4.0 Levelling and contouring** **4.1** Basic Terms: Level surface, Horizontal and vertical surface, Datum, Bench Mark - Permanent, Temporary, Arbitrary. Reduced Level, Rise, Fall, Back sight, Fore sight, Intermediate sight, Change point, Height of instrument, Line of collimation. 4.2 Types of levels: Dumpy, Tilting, and Auto level, Temporary adjustments of Level. 4.3 Types of Levelling Staff: Self-reading staff and Target staff, Reduction of level by Height of Instrument Method, and Rise and Fall Method. 4.4 Levelling Types: Simple, Differential, Fly, Profile, and Reciprocal Levelling. 4.5 Contour, contour intervals, horizontal equivalent, Uses of contour maps, Characteristics of contours, Methods of Contouring-Direct and indirect	**CO4**
TSO5a.Draw the labeled diagram of the digital planimeter to show its components. TSO5b.Describe the Procedure of measuring a given area with the help of a planimeter TSO 5c. Compute the volume of the reservoir using the given contour map.	**Unit-5.0 3D Measurement of Area and Volume** 5.1 Components and use of Digital planimeter. 5.2 Measurement of the area using a digital planimeter. 5.3 Measurement of the volume of the reservoir from the contour map.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P*2415301*

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Numbers
LSO1.1. Perform ranging and chaining operation in different field conditions	1.	Measure the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2
LSO2.1. Perform reciprocal ranging for the given situation.	2.	Perform reciprocal ranging and measure the distance between two stations.	CO2
LSO3.1. Determine the area of the given open field.	3.	Determine the area of open field using chain and cross staff survey.	CO2
LSO4.1. Measure the fore bearing and back bearing of given survey lines using a Prismatic compass.	4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass.	CO2, CO3
LSO5.1. Measure fore bearing and back bearing of a closed traverse and after applying correction in the bearings, measure the included angle for the given situation.	5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction.	CO2, CO3
LSO6.1. Undertake Survey Project for the given situation.	6.	Undertake **Survey Project** with chain and compass for closed traverse for minimum 5 sides around a building.	CO2, CO3
LSO7.1. Plot a traverse on an A1 size imperial drawing sheet for the survey project.	7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Numbers
LSO8.1. Undertake simple levelling operation for determining the reduced level of given points.	8.	Undertake simple levelling using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO9.1. Undertake differential levelling operation for determining the reduced level of given points.	9.	Undertake differential levelling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and levelling staff.	CO2, CO4
LSO10.1. Undertake fly levelling for the given situation.	10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO11.1. Undertake a survey project to plot a contour map for the given situation.	11.	Undertake **Survey Project** for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4
LSO12.1. Measure the area of the given irregular figure using a digital planimeter.	12.	Measure the area of the irregular figure using a Digital planimeter	CO5

L) Suggested Term Work and Self Learning: *S2415301* Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Prepare and sketch a list of tools and equipment used in chain and tape survey.
2. Explain with diagram the use of optical square, prism square and cross staff.
3. Describe with the help of neat sketch prismatic compass and surveyors' compass.
4. Identify errors and their corrective measures in compass survey.
5. Explain local attraction in compass surveying.
6. Explain methods to detect and eliminate local attraction.
7. Describe dumpy level with neat sketch.
8. Describe with sketches the characteristics of contour.

b. Micro Projects:

1. Undertake an internet survey to collect information on survey instruments available in the market with specifications.
2. Carry out a comparative study of the following survey instruments of different make and brands: Auto level and Dumpy Level.
3. Measure the area of the municipal wards and the area of the city from the ward-wise map of the city using a digital planimeter.
4. Determine the Reduced Levels (RLs) of the existing structures like lintels, chajja, slab, and beam.
5. Download specifications for prismatic compass, dumpy level, auto level, and digital planimeter using the internet.
6. Perform a reconnaissance survey for alignment of the road.
7. Collect and interpret contour maps of different terrains available with various authorities.
8. Construct and measure the given length using a Diagonal scale from a given map.

c. Other Activities: Calculate the quantity of earthwork to construct the road with the help of levelling diagram.

1. **Seminar Topics**:
   a. Scales and their importance used in Surveying
   b. Local attraction in compass surveying
   c. Triangulation: A method of measuring the area of a given field
   d. Meridian and Bearings used in compass surveying
   e. Contours and Types of Terrain
   f. Digital Planimeter and Area Measurement
   g. Conduction of a survey for the given city

2. **Self – Learning topics**:
   - Classification of the survey based on the nature of the field and based on the object of the survey.
   - Comparison between surveyor and prismatic compass.
   - Study of variation of earth's magnetic field and Declination.
   - Study of modern instruments used in leveling.
   - Study of toposheets and calculate catchment areas

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory, and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate CO attainment.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/ Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro-projects	Other Activities*		
CO-1	15 %	10%	15%	15%	20%	15%	15%
CO-2	15%	20%	20%	15%	20%	15%	20%
CO-3	25%	25%	25%	25%	20%	25%	25%
CO-4	35%	30 %	30%	30%	20%	35%	30%
CO-5	10%	15%	10%	15%	20%	10%	10%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) **Suggested Specification Table for End Semester Theory Assessment:** Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant Cos Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & Above (A)
Unit-1.0 Overview and classification of survey	06	CO1	08	2	2	4

Unit-2.0 chain survey	08	CO2	14	4	4	6
Unit-3.0 Compass survey	12	CO3	18	6	6	6
Unit-4.0 Leveling and Contouring	16	CO4	20	6	6	8
Unit-5.0 Measurement of Area and volume	06	CO5	10	2	4	4
Total Marks	**48**	**-**	**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Numbers	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Measure the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2	50	40	10
2.	Perform reciprocal ranging and measure the distance between two stations.	CO2	50	40	10
3.	Determine the area of open field using chain and cross staff survey.	CO2	50	40	10
4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass	CO2, CO3	50	40	10
5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction	CO2, CO3	60	30	10
6.	Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building	CO2, CO3	60	30	10
7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3	50	40	10
8.	Undertake simple leveling using dumpy level/ Auto level and leveling staff.	CO2, CO4	60	30	10
9.	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff.	CO2, CO4	60	30	10
10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4	60	30	10
11.	Undertake Survey Project for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4	40	50	10
12.	Measure the area of the irregular figure using a Digital planimeter	CO5	70	20	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared by the course teacher for each experiment/practical to assess the student's performance.

P) Suggested instructional / Implementation Strategies: Different Instructional / Implementation Strategies may be appropriately selected, as per their requirement of the content/outcome. Some of them are Improved Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs, etc**.**

Q) List of Major Laboratory Equipment, Tools, and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1	Steel Tapes 30 meter	Made of steel as per IS Specifications	1,2,3
2	Engineer's Chain	made of M.S. 100-foot survey chain with 100inks solid brass handles &link	1,2,3
3	Metallic Tape 20 /30metre	Good quality	1,2,3
4	Ranging Rod Steel	Ranging Rod Steel 6' Length 2 Meter (Straight / Folding / Screw Type	1,2,3
5	Chain 30 meter	made of M.S. with 100 links and solid brass handles	1,2,3
6	Chain 20 meter	made of M.S. with 100 links and solid brass handles	1,2,3
7	Optical square Indian	Circular type, made of brass, fitted with double reflecting mirror right and lift to 90 degree	1,2,3
8	Prismatic Compass	Made of Brass, Size 100mm dia. As Per I.S.I. Specification	4,5,6,7
9	Open type Cross staff	Size 4”, Open Type having four vanes at right angles.	1, 4,5,6,7
10	Dumpy level 300 mm	Telescopic Length Size 12", Erect Image. Internal Focusing, Fitted with compass	8,9,10
11	Levelling staff 4 meter	Made of a Fully Aluminum body, telescopic type in Three sections. I.S.I. Specifications No IS:1779- 1961	8,9,10
12	Tilting level	Size 178mm /7” Internal focusing, anti-reflection coated optics.	8,9,10
13	Planimeter	Standard	12

R) Suggested Learning Resources:

(a) Books

S. No	Titles	Author (s)	Publisher and Edition with ISBN
1	Surveying 1	Dr BC Punmia, Ashok Kumar Jain, Dr. Arun Kumar Jain	Seventeenth Edition, Laxmi publication ISBN-10 9788170088530 ISBN-13 978-8170088530
2	Surveying and Leveling	A K Arora	17th Edition, Standard book house ASIN: B08GY78N55 ISBN-13: 9788189401238
3	Surveying and Leveling	S K Duggal	5th edition, TMG publication ISBN-10: 9353167523 ISBN-13: 978-132110255

4	Surveying and Leveling	R Agor	Limited edition, Khanna publication ISBN-10: 8174092358 ISBN-13: 978-174092359
5	प्रारंभिक सर्वेक्षण – I	Gurucharan Singh	Published year 2017, Standard publishers distributers Delhi ISBN: 9788180141751

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in
2. https://archive.nptel.ac.in/courses/
3. https://youtu.be/chhuq_t40rY
4. https://yputube/Z4yHHX8NO
5. https://sbte.bihar.gov.in/moodle/

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(b) Others:

****

A) Course Code : 2415302(T2415302/P2415302/S2415302)

B) Course Title : Concrete Technology

C) Pre-requisite Course(s) :

D) Rationale :

Concrete is the versatile material used for civil engineering constructions, therefore knowledge of concrete and its constituents is important for a diploma civil engineer. Concrete is used for the construction of structural as well as non-structural elements like beams, columns, foundations, slabs, etc. Understanding the properties of concrete ingredients, concreting operations, modified concrete, Quality Control of concrete in different weather condition with proper knowledge of admixture and its practical applications as recommended by Indian Standard Code should be known for a diploma civil engineer. Therefore, this course deals with requisite knowledge required at construction site by a Junior Engineer and built up foundation for upcoming courses of higher semesters.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/industry.

After completion of the course, the students will be able to-

CO-1 Select the relevant type of cement for different site conditions.
CO-2 Use the relevant type aggregate for the given concrete works.
CO-3 Conduct the relevant type of tests on the given sample of concrete mix.
CO-4 Design the relevant concrete mix as per desired specification.
CO-5 Suggest relevant admixture for the different concreting situations.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415302**	Concrete Technology	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415302**	Concrete Technology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415302

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe the manufacturing process of cement. TSO 1b. Explain the process involved in setting of cement. TSO 1c. Explain the physical properties of cement. TSO 1d. Describe the procedure for testing physical properties of cement. TSO 1e. Explain the types of cement with their application. TSO 1f. Explain the storage of cement with its effect on strength of cement.	**Unit-1.0 Cement** 1.1 Introduction of cement, manufacturing process of cement (Wet & Dry process). 1.2 Composition of cement, effects of various constituent of cement on its properties, Bouge's compound and their significance, Hydration of cement. 1.3 Physical properties of cement: fineness, standard consistency, setting time, compressive strength and soundness. 1.4 Testing of cement: Field and Laboratory tests- fineness test, standard consistency test, setting time test, compressive strength test and soundness test. 1.5 Types of cement with I.S. Specifications and field applications: Ordinary Portland cement (33 grades, 43 grades or 43-S grade and 53 grades OPC), Portland pozzolana cement, Portland slag cement, Rapid hardening cement, Sulphate resisting cement, Low heat cement, High alumina cement, White cement. 1.6 Storage of cement and its effect on the properties of cement.	**CO1**
TSO 2a. Classify aggregates based on source, size and shape. *TSO 2b*. Explain various properties of fine and coarse aggregate. *TSO 2c*. Describe the requirements of good aggregates for making concrete. *TSO 2d*. Explain the grading and zoning of aggregates based on relevant IS code. *TSO 2e.* Determine strength of aggregate using the relevant laboratory tests.	**Unit-2.0 Aggregates** 2.1 Aggregates: Sources of aggregate, Classification according to source, size and shape. 2.2 Properties of fine and coarse aggregates: size, shape, surface texture, specific gravity, bulk density, moisture content, surface moisture, water absorption, strength, soundness. 2.3 Bulking of fine aggregate, Parameters for good aggregate. 2.4 Grading and Zoning of fine and coarse aggregates as per IS code. Fineness Modulus of fine and coarse aggregate. 2.5 Crushing value, impact value and abrasion value of coarse aggregates with Indian standard specification.	**CO2**
TSO 3a. Explain the concreting operations with a flow chart. *TSO 3b*. Describe the water cement ratio with its	**Unit-3.0 Concrete** 3.1 Introduction to Concrete, Concreting Operations (Batching, mixing, transportation, placing,	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
significance. TSO 3c. Explain the workability of concrete with its various method of determination. *TSO 3d.* Explain the various properties of hardened concrete. *TSO 3e.* Explain the various methods of Non-Destructive test of hardened concrete.	compaction, curing and finishing of concrete), Necessity of supervision for concreting operations. 3.2 Grades of concrete (ordinary, standard and high strength concrete) as per IS 456, Water cement ratio and its significance. 3.3 Properties & testing of fresh concrete: Workability, Cohesiveness, Segregation, Bleeding and Harshness; Determination of Workability by Slump test, Compaction factor test and Vee-Bee Consistometer test; Range values of workability requirements for different types of concrete works. 3.4 Properties & testing of hardened concrete: Compressive strength, Flexural strength, Durability, Shrinkage, Impermeability and Fire resistance; Determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results. 3.5 Non-Destructive Testing (NDT) of hardened concrete: Purpose of NDT, methods of NDT-Rebound hammer test and Ultra pulse velocity test only.	
TSO 4a. Explain the procedure of mix design of concrete as per relevant IS code. *TSO 4b*. Describe the selection criteria for formwork for the given type of concreting works. *TSO 4c.* Explain methods for filling of construction joints by selecting appropriate filler materials.	**Unit-4.0 Mix Design, Formwork and Joint** 4.1 Concrete Mix Design: objective, methods of mix design, the study of procedural steps of mix design as per IS 10262:2019. (With example of M20/M25/M30 Grade) 4.2 Formworks of concreting: Different types of formworks for columns, beams and slabs, Materials used for formworks, Requirement of good formwork, stripping time for removal of formworks as per the provision of IS 456:2000. 4.3 Construction joints: Types of Joints, Materials used for filling joints, Method of joining.	**CO4**
TSO 5a. Suggest relevant type of admixtures for the given concreting condition. *TSO 5b*. Propose the type of special concrete based on its application. *TSO 5c.* Suggest the precautions to be taken for concreting in different weather conditions.	**Unit-5.0 Admixture in Concrete, Special Concrete and Extreme Weather Concreting** 5.1 Admixture in Concrete: Purpose, Types of chemical and mineral admixtures such as accelerating admixtures, retarding admixtures, water reducing admixtures, super plasticizers, air entraining admixtures, fly ash, silica fume, and slag. 5.2 Special Concrete: Properties, advantages and limitations of the following types of special concrete- Ready mix concrete, Fiber reinforced concrete, Self-compacting concrete, High-performance concrete, Lightweight concrete, Geopolymer concrete. 5.3 Extreme weather concreting: Effects of cold and hot weather on concrete, Precautions to be taken while concreting in cold and hot weather conditions.	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415302

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1. Determine the fineness of the given cement.	1.	Determine the fineness of the given cement by Sieving as per IS: 4031 (Part 1)-1996 or Blaine's air permeability apparatus as per IS: 4031 (Part 2)- 1999.	**CO1**
LSO2.1. Determine the consistency of the given cement.	2.	Determine the standard consistency of the given cement using Vicats apparatus as per IS: 4031 (Part 4)- 1988.	**CO1**
LSO3.1. Determine the setting time of the given cement.	3.	Determine the setting time of the given cement using Vicats apparatus as per IS: 4031 (Part 5)- 1988.	**CO1**
LSO4.1. Determine the compressive strength of the given cement.	4.	Determine the compressive strength of the given cement as per IS: 4031 (Part 6) - 1988.	**CO1**
LSO5.1. Determine the soundness of the given cement.	5.	Determine the soundness of the given cement by Le-chatelier method as per IS: 4031 (Part 3)- 1988.	**CO1**
LSO6.1. Determine the size, grading and fineness modulus of the given fine and coarse aggregate.	6.	Determine the size, grading and fineness modulus of the given fine and coarse aggregates as per IS: 2386 (Part I) – 1963.	**CO2**
LSO7.1. Determine the flakiness index and elongation index of the given coarse aggregate.	7.	Determine the flakiness index and elongation index of the given coarse aggregate as per IS: 2386 (Part I) - 1963.	**CO2**
LSO8.1. Determine the silt content in given sand.	8.	Determine the silt content in given sand as per IS: 2386 (Part II) - 1963.	**CO2**
LSO9.1. Determine the bulking of given sand.	9.	Determine the bulking of given sand as per IS: 2386 (Part III)- 1963.	**CO2**
LSO10.1 Determine the bulk density of given fine and coarse aggregates.	10.	Determine the bulk density of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	**CO2**
LSO11.1 Determine the water absorption of the given fine and coarse aggregates.	11.	Determine the water absorption of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	**CO2**
LSO12.1 Determine the impact value of the given coarse aggregate.	12.	Determine the impact value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO13.1 Determine the crushing value of the given coarse aggregate.	13.	Determine the crushing value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO14.1 Determine the abrasion value of the given coarse aggregate.	14.	Determine the abrasion value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	**CO2**
LSO15.1 Determine the workability of the given concrete mix.	15.	Determine workability of the given concrete mix by slump test/compaction factor test/flow table/Vee-Bee consistometer method as per IS: 1199-1959.	**CO3, CO4, CO5**
LSO16.1 Determine the compressive strength of the given concrete mix.	16.	Determine the compressive strength of the given concrete mix at 7 days and 28 days of curing as per IS: 516-1959.	**CO3, CO4, CO5**
LSO17.1 Asses the durability of the given concrete.	17.	Asses the durability of the given concrete using Rapid Chloride Penetration test (RCPT) as per ASTM C 1202 /Permeability test as per IS: 3085-1965.	**CO3, CO4, CO5**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO18.1 Determine the strength of the hardened concrete by NDT test.	18.	Determine the strength of the hardened concrete by NDT tests such as Ultrasonic Pulse Velocity test as per IS: 13311 (Part 1)-1992/ Rebound Hammer test as per IS: 13311 (Part 2)-1992.	**CO3, CO4, CO5**

L) Suggested Term Work and Self Learning: S2415302 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Explain the constituent parts of ordinary Portland cement with the significance of Bouge's compounds.
2. Explain the hydration of Bogue's compound with the significance of hydration products.
3. Justify the significance of size of aggregates in determining the strength of the concrete.
4. Calculate the fineness modulus of a given aggregate sample using following data: -Retained weights in gram on IS Sieve 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, 150 µm and Pan are 10, 120, 230, 240, 282, 105 and 13 respectively.
5. Interpret the relationship between the moisture content and the change in volume of fine, medium and coarse aggregate to explain the phenomenon of bulking with relevant sketch.
6. Explain the significance of w/c ratio with reference to the graph of w/c ratio vs compressive strength of concrete.
7. Suggest the degree of workability for the following: (a) Building concrete, (b) Mass concrete, (c) Pumpable concrete and (d) Tremie concrete.
8. Write the procedure of mix design of concrete with reference to the provisions laid in IS 10262: 2019.
9. Explain the effect of cold weather on the setting and hardening property of concrete.
10. Explain the types of chemical admixtures with its purpose and usage.

b. Micro Projects:

1. Collect the information about types of cement available in your nearby market and prepare a comparative statement on their specification.
2. Prepare a report by performing the field tests on the given sample of cement to check its quality.
3. Prepare a report by performing classification of coarse aggregate based on source, size, shape, surface texture and surface moisture.
4. Prepare a report by performing the sieve analysis on given fine aggregates to find its zone.
5. Prepare a report by performing the sieve analysis on given coarse aggregates to find its nominal size and grade.
6. Prepare mix design of given grade of concrete and assess its properties based on Indian Standard method IS 10262:2019.
7. Prepare a report by performing non-destructive test on given existing structure stating its strength, durability and serviceability.

c. Other Activities:

1. Seminar Topics:
    - Carbon footprint of cement.

- Supplementary cementitious materials (SCMs).
- Geopolymer concrete.
- Alkali activated binders.
- Extreme weather concreting.
- Fibers used as reinforcement in concrete

2. Visits: Visit of construction sites to collect detailed information about ingredients of concrete mix, observe concreting operation, observe formwork, scaffoldings and joints in concrete, observe quality check used for fresh concrete.

3. Self-learning topics:

- Cement chemistry.
- Concrete mix design.
- Mechanical properties of concrete.
- Durability issues in concrete.
- Admixtures in concrete.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	12%	15%	15%	15%	20%	15%	10%
CO-2	24%	20%	15%	15%	20%	20%	20%
CO-3	14%	15%	25%	25%	20%	25%	30%
CO-4	30%	30%	30%	30%	20%	25%	30%
CO-5	20%	20%	15%	15%	20%	15%	10%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Cement	08	CO1	12	4	6	2
Unit-2.0 Aggregates	08	CO2	14	4	4	6
Unit-3.0 Concrete	10	CO3, CO4	12	4	4	4
Unit-4.0 Mix Design, Formwork and Joint	14	CO3, CO4	20	4	6	10
Unit-5.0 Admixture in concrete, Special Concrete and Extreme Weather Concreting	08	CO4, CO5	12	4	4	4
Total Marks	**48**	**-**	**70**	**20**	**24**	**26**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the fineness of the given cement by Sieving as per IS: 4031 (Part 1)-1996 or Blaine's air permeability apparatus as per IS: 4031 (Part 2)- 1999.	CO1	40	50	10
2.	Determine the standard consistency of the given cement using Vicats apparatus as per IS: 4031 (Part 4)- 1988.	CO1	40	50	10
3.	Determine the setting time of the given cement using Vicats apparatus as per IS: 4031 (Part 5)- 1988.	CO1	40	50	10
4.	Determine the compressive strength of the given cement as per IS: 4031 (Part 6) - 1988.	CO1	40	50	10
5.	Determine the soundness of the given cement by Le-chatelier method as per IS: 4031 (Part 3)- 1988.	CO1	40	50	10
6.	Determine the size, grading and fineness modulus of the given fine and coarse aggregates as per IS: 2386 (Part I) – 1963.	CO2	40	50	10
7.	Determine the flakiness index and elongation index of the given coarse aggregate as per IS: 2386 (Part I) - 1963.	CO2	40	50	10
8.	Determine the silt content in given sand as per IS: 2386 (Part II) - 1963.	CO2	40	50	10
9.	Determine the bulking of given sand as per IS: 2386 (Part III)- 1963.	CO2	40	50	10
10.	Determine the bulk density of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	CO2	40	50	10
11.	Determine the water absorption of the given fine and coarse aggregates as per IS: 2386 (Part III) -1963.	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
12.	Determine the impact value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
13.	Determine the crushing value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
14.	Determine the abrasion value of the given coarse aggregate as per IS: 2386 (Part IV)-1963.	CO2	40	50	10
15.	Determine workability of the given concrete mix by slump test/compaction factor test/flow table/Vee-Bee consistometer method as per IS: 1199-1959.	CO3, CO4, CO5	40	50	10
16.	Determine the compressive strength of the given concrete mix at 7 days and 28 days of curing as per IS: 516-1959.	CO3, CO4, CO5	40	50	10
17.	Asses the durability of the given concrete using Rapid Chloride Penetration test (RCPT) as per ASTM C 1202 /Permeability test as per IS: 3085-1965.	CO3, CO4, CO5	40	50	10
18.	Determine the strength of hardened concrete by NDT tests such as Ultrasonic Pulse Velocity test as per IS: 13311 (Part 1)-1992/ Rebound Hammer test as per IS: 13311 (Part 2)-1992.	CO3, CO4, CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/ practical to assess the student performance.

P) Suggested Instructional/ Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
1.	90 μm IS Sieve	90 μm IS Sieve with pan and lid, Balance and Brush as per the requirement of IS: 4031 (Part 1)- 1996	1
2.	Blaine's air permeability apparatus	Blaine's air permeability apparatus with all accessories as per the requirement of IS : 4031 (Part 2)- 1999	1
3.	Le-chatelier flask	Le-chatelier flask for determination of specific gravity of cement as per the requirement of IS: 4031 (Part 11)-1988.	1
4.	Vicats apparatus with all accessories	Vicats apparatus with all accessories to determine the consistency, initial and final setting times as per the requirement of IS 4031 (Part 4):1988 and IS 4031 (Part 5): 1988	2,3
5.	Vibration Machine with all accessories	Vibrating Machine for making cement mortar cube of 70.6 mm as per the requirements of IS: 10080-1982	4

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
6.	70.6 mm Cube Moulds	70.6 mm cube moulds for preparation of cement mortar cubes for compressive strength tests, made of steel/cast iron, with ISI certification mark and as per the requirements of IS : 10086 – 1982.	4
7.	Curing Tank	Temperature and Humidity controlled Curing Tank for curing of cement mortar or concrete cubes for determination of compressive strength at certain ages.	4, 16
8.	Compression Testing Machine 2000 kN Capacity	Compression Testing Machine, Capacity 2000 KN confirming to the requirement of IS: 14858-2000, IS: 4031 (Part 6)-1988, IS: 516-1959 and IS : 2386 (Part IV)-1963.	4, 13, 16
9.	Le-Chatelier test apparatus	Le-Chatelier test apparatus: set of 06 moulds with weight, glass plates, complete in all to determine soundness of cement as per the requirements of IS : 4031 (Part 3)-1988.	5
10.	Water Bath	Water bath capable of containing immersed Le-Chatelier moulds with specimens and of raising their temperature from 27 ± 2°C to boiling in 27 ± 3 minutes as per the requirements of IS : 4031 (Part 3)-1988.	5
11.	Electronic Balance/ Scale (300 g, 500g, 1 kg, 5 kg, 10 kg, 15 kg, 20 kg max capacity)	Electronic Balance/ Scale (300 g, 500g, 1 kg, 5 kg, 10 kg, 15 kg, 20 kg max capacity) with battery backup and as per the requirement of IS: 4031 (Part 1 to 6) and other tests.	All
12.	Digital Platform Balance, Min 100 kg Capacity with Battery back up	Digital Platform Balance, Min 100 kg Capacity with Battery back up	All
13.	IS Sieve set (200 mm diameter)	Brass Test Sieves of diameter 200 mm: - 4.75 mm, 3.35 mm, 2.36 mm, 2 mm, 1.70 mm, 1.18 mm, 1 mm, 600 micron, 500 microns, 425 microns, 300 microns, 150 microns, 90 microns, 75 microns with pan and lid confirming to IS: 460-1962 and the requirement of IS:2386 (Part 1)-1963, IS:383-2016 and IS : 650-1991.	6
14.	IS Sieve set (300 mm/450 mm diameter)	Brass or GI Test Sieves of diameter 300 mm or 450 mm: - 160 mm, 80 mm, 63 mm, 50 mm, 40 mm, 31.5 mm, 25 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75 mm, 2.36 mm with pan and lid confirming to IS: 460-1962 and the requirement of IS:2386 (Part 1)-1963, IS:383-2016	6
15.	Thickness gauge and Elongation gauge	Thickness gauge and Elongation gauge as per the requirements of IS: 2386 (Part I) - 1963	7
16.	250 ml, 1000 ml graduated glass cylinder	250 ml, 1000 ml graduated glass cylinder	8,9
17.	Cylindrical Metal Measure	Cylindrical Metal Measure of 3, 15- and 30-liters Capacity with tamping rod as per the requirement of IS 2386 (Part III):1963	10
18.	Water absorption test apparatus for aggregates larger than 10 mm or between 40 mm and 10 mm	Water absorption test apparatus for aggregates larger than 10 mm or between 40 mm and 10 mm as per the requirement of IS 2386 (Part III):1963.	11
19.	Oven	A well-ventilated oven, thermostatically controlled, to maintain a temperature of 100 to 110% as per the requirement of IS 2386 (Part I to IV):1963 and other tests.	11

S. No	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
20.	Vessel for Water absorption test of aggregates between smaller than 10 mm	Vessel for Water absorption test of aggregates between smaller than 10 mm as per the requirement of IS 2386 (Part III):1963	11
21.	Aggregate Impact Test Machine	Aggregate Impact Test Machine as per the requirements of IS : 2386 (Part IV)-1963.	12
22.	Aggregate Crushing Test Apparatus	Aggregate Crushing Test Apparatus as per the requirements of IS: 2386 (Part IV)-1963.	13
23.	Los Angeles Abrasion Testing Machine	Los Angeles Abrasion Testing Machine as per the requirements of IS: 2386 (Part IV)-1963.	14
24.	Slump Test apparatus	Slump Test apparatus as per the requirements of IS: 1199-1959	15
25.	Compaction factor test apparatus	Compaction factor test apparatus as per the requirements of IS: 1199-1959	15
26.	Flow table test apparatus	Flow table test apparatus as per the requirements of IS: 1199-1959	15
27.	Vee-Bee Consistometer	Vee-Bee Consistometer as per the requirements of IS: 1199-1959	15
28.	150 mm cubes mould and Beam mould of 150*150*700 mm.	150 mm cube moulds for preparation of concrete cubes for compressive strength tests, and Beam mould for flexural test made of steel/cast iron, with ISI certification mark and as per the requirements of IS : 10086 – 1982.	16
29.	Vibrating Table Tray Type	Vibrating Table Tray Type for compacting concrete in 150 mm cube moulds as per the requirements of IS: 2514 – 1963.	16
30.	Concrete Mixer Machine	Tilting drum type concrete mixer machine for mechanical mixing of concrete ingredients as per the requirements of IS: 1791 – 1985.	16
31.	Rapid Chloride Penetration Test apparatus	Rapid Chloride Penetration Test apparatus as per the requirements of ASTM C 1202.	17
32.	Permeability Test apparatus	Permeability Test apparatus as per the requirements of IS: 3085-1965.	17
33.	Ultrasonic Pulse Velocity Test apparatus	Ultrasonic Pulse Velocity Test apparatus as per the requirements of IS: 13311 (Part 1)-1992.	18
34.	Rebound Hammer	Rebound Hammer as per the requirements of IS: 13311 (Part 2)-1992.	18
35.	Miscellaneous Tools	Trowel, spatula, Non-porous platform for mixing of cement paste or mortar, Poking Rod, Measuring Cylinder, 1000 ml Beaker, stopwatch, Tempering Rod, Tray, Scoop, Funnel, Filter paper, 1% salt solution	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Concrete Technology	Gambhir, M.L.	Tata McGraw Hill Publishing Co. Ltd., New Delhi, 5th Edition, 2017, ISBN-13: 978-1-259-06255-1
2.	Concrete Technology	Shetty, M.S.	S Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi-110055, 8th Edition, 2019, ISBN, : 978-8-121-90003-4
3.	Concrete Technology	Santhakumar ,A. R.	Oxford University Press, New Delhi, 2nd Edition, 2018, ISBN-13: 978-0-195-67153-7
4.	Concrete Technology	Neville, A. M. and Brooks, J.J.	Pearson Education Pvt. Ltd., New Delhi, 2nd Edition, 2010, ISBN 978-0-273-73219-8
5.	Properties of Concrete	Neville A. M.	Pearson Education Pvt. Ltd., New Delhi, 5th Edition, 2012, ISBN 978-8131791073
6.	Laboratory Manual in Concrete Technology	Sood, H., Kulkarni P. D., Mittal L. N.	CBS Publishers, New Delhi, 1st Edition, 2016, ISBN: 9788123909417

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/105102012
2. https://nptel.ac.in/courses/105104030
3. https://nptel.ac.in/courses/105106176
4. https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
5. https://www.youtube.com/watch?v=gySKrFFswWE&list=PLwOk-xIeY47meXa-poHe6Iy_q-urnNv1e

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS : 4031 (Part 1 to 14)- Method of physical tests on hydraulic cement.
2. IS 383: 2016 Specification for coarse and fine aggregates from natural sources for concrete.
3. IS: 456-2000 Code for practice for plain and reinforced concrete.
4. IS 10262: 2019 Concrete Mix Proportioning — Guidelines.

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A) Course Code **:2415303(T2415303/P2415303/S2415303)**

B) Course Title **:** Strength of Material for Civil Engg.

C) Pre-requisite Course(s) **:** Engineering Mechanics

D) Rationale **:**

Strength is an important property of construction materials for selecting materials depending on nature of work, quality of material and economic conditions for providing maximum safety in designing different structures. This course has been designed to develop requisite competencies and skills in students so that they can be acquainted with the concept of loads and their consequences and how different kinds of loadings can be withstood by different kinds of members with some specific materials.

E) Course Outcomes (COs): After completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/industry.

After completion of the course, the students will be able to-

CO-1 Articulate practical applications of moment of inertia of symmetrical and unsymmetrical structural sections.
CO-2 Analyze structural behavior of materials under various loading conditions.
CO-3 Compute the principal stresses on an object at a given loading condition.
CO-4 Interpret shear force and bending moment diagrams for various types of determinate beams and loading conditions.
CO-5 Determine the bending and shear stresses in beams under different loading conditions.
CO-6 Analyze the given truss using analytical methods.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low(1) and No mapping(-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415303**	Strength of Material for Civil Engg.	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment(TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415303**	Strength of Material for Civil Engg.	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415303

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number (s)
TSO 1a. compare the properties of different cross-sectional shapes in terms of their Moment of Inertia, Radius of Gyration, and Section Modulus. TSO 1b. Calculate Moment of inertia about a given axis using Parallel and Perpendicular axes theorem. TSO 1c. Calculate the MOI of a given lamina about a given reference axis.	**Unit –1: Moment of Inertia (MOI)** 1.1 Definition of Moment of Inertia of plane lamina, Radius of gyration, Section modulus, Parallel and Perpendicular axes theorems, Moment of Inertia of Rectangle, square, circle, semi-circle, quarter circle and triangle section. 1.2 M.I. of symmetrical and unsymmetrical I-section, Channel section, T-section, Angle section, Hollow section and built-up section about centroidal axes and any other reference axis.	**CO1**
TSO 2a. Explain the concept of rigid, elastic and plastic body TSO 2b Label the given properties of material on stress strain curve. TSO 2c Explain Hooks law using stress strain curve TSO 2d. Interpret the properties of material based on its modulus of elasticity TSO 2e. Classify the types of the stresses induced in the given body in the given situation. TSO2f. Draw the stress strain curve for mild steel by notifying the critical points on the curve. TSO 2g. Explain the behavior of given material based of given Mechanical Properties. TSO 2h Calculate the longitudinal stress and strain for the given section under axial loading pattern. TSO 2i. Calculate temperature stresses and Strain in the given condition. TSO 2j. Establish the relationship between given elastic constants.	**Unit – 2: Simple Stresses and Strains** 2.1 Definition of Rigid, Elastic and Plastic bodies. Definition of stress, strain, elasticity, Hooke's law, Elastic limit, Modulus of elasticity. 2.2 Type of Stress-Normal, Direct, Bending and Shear and nature of stresses i.e., Tensile and Compressive stresses. 2.3 Standard stress strain curve for Mild steel bar under tension, Yield stress, Proof stress, Ultimate stress, Strain at various critical points. 2.4 Definition of various Mechanical Properties-Elasticity, Plasticity, Ductility, Brittleness, Hardness, Stiffness, Toughness, Malleability, Creep, Fatigue. 2.5 Deformation of body due to axial force and self-weight (of uniform and tapered sections), forces applied at intermediate sections, maximum and minimum stress induced composite section under axial loading. 2.6 Concept of temperature stresses and strain. Longitudinal, lateral and shear strain, Modulus of Rigidity, Poisson's ratio, uniaxial, Biaxial and tri-axial stresses, volumetric strain, change in volume, Bulk modulus (Introduction only). Relation between modulus of elasticity, modulus of rigidity and bulk modulus.	**CO1, CO2**
TSO 3a. Calculate Normal & shear stress at a given inclined plane. TSO 3b Describe the significance of principal planes and principal stresses in determining the failure conditions of materials	**Unit-3: Principal Stresses and Principal Planes** 3.1 Concept of stress transformation. 3.2 Definition of Principal Plane & Principal stress. 3.3 Principal Plane & Stress due to uniaxial and bi-	**CO3, CO4**

TSO 3c. Identify the Principal Plane from infinite planes of a given element. TSO 3d. Calculate the Principal Stress in a given loading condition using analytical method. TSO 3e. Describe the elements of Mohr's circle for a given stressed element.	axial stress system & due to state of simple shear (Analytical method). 3.4 Introduction to Mohr's Circle with simple numerical problems.	
TSO 4a. Classify the types of Supports, beams and loads. TSO4b.Explain shear force and bending moment at a given section of a beam. TSO 4c. Derive the relationship between load, shear force and bending moment. TSO 4d. Locate the points of contraflexure in a given Beam. TSO 4e. Draw SF and BM Diagrams for a determinate beam subjected to different combinations of point load, UDL and couple.	**Unit-4: Shear Force (SF) and Bending Moment (BM)** 4.1 Types of Supports, Beams and Loads. 4.2 Concept and definition of shear force and bending moment, Relation between load, shear force and bending moment. 4.3 Shear force and bending moment diagram for determinate beam subjected to point loads, uniformly distributed loads (UDL) and couple, point of contra flexure.	**CO3, CO4**
TSO5a.Explain the concept of pure bending with its assumptions. TSO 5b. Describe the nature & distribution of bending stress for a given section under different loading conditions. TSO 5c. Calculate the Moment of resistance and Bending stress at a point of a given section of beam. TSO 5d. Calculate the ratio of maximum & average shear stress for a circular or rectangular section using shear stress equation. TSO 5e. Draw shear stress distribution diagram for a given geometrical section.	**Unit-5: Bending and Shear Stresses in Beams** 5.1 Concept of pure bending, assumptions, flexural equation, bending stresses and their nature, bending stress distribution diagram. 5.2 Concept of Moment of resistance (MOR) and simple numerical problems using flexural equation. 5.3 Shear stress equation, relation between maximum and average shear stress for rectangular and circular section. 5.4 Shear stress distribution diagram for angle sections, channel section, I-section, T section. Simple numerical problems based on shear equation.	**CO4, CO5**
TSO 6a Explain the concepts of frames and trusses and their role in structural engineering TSO 6b Suggest suitable type of frame for given loading condition TSO6cIdentify perfect/imperfect and redundant/deficient truss. TSO 6d. Analyze given truss structure using appropriate method.	**Unit -6: Analysis of Trusses** 6.1 Definition of frames and trusses, Classification of truss, perfect, imperfect, redundant and deficient truss, relation between members and joints, assumption in analysis. 6.2 Method of joint, method of section to find nature of forces.	**CO6**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs)and List of Practical: P2415303

Practical/ Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1. Compare experimentally determined MOI of flywheel with theoretical value of the same.	1.	Determine the moment of inertia of a flywheel.	CO1
LSO2.1. Identify different components of UTM along with functions of each component.	2.	Study different components of Universal Testing Machine (UTM).	CO2
LSO 3.1. Determine yield strength, ultimate strength, fracture strength and percentage elongation of given steel specimen in tension.	3.	Perform Tension test on Mild steel/HYSD as per IS 1608.	CO2
LSO4.1. Determine compressive strength of given steel specimen.	4.	Conduct compression test on Mild steel piece using Universal Testing Machine (UTM).	CO2
LSO5.1. Find out flexural strength of wooden beam.	5.	Conduct Flexural test on timber beam on rectangular section in both orientations as per IS:2408.	CO5
LSO6.1. Find out shear strength of a given specimen.	6.	Perform the shear strength test on a given specimen.	CO5
LSO7.1. Determine impact strength of a given specimen using Izod Impact testing Machine.	7.	Perform Izod Impact test on a given specimen.	CO2
LSO8.1. Determine impact strength of a given specimen using Charpy impact testing Machine.	8	Perform Charpy Impact test on metal specimen.	CO2
LSO9.1. Determine Hardness Number of a given specimen using Brinell hardness testing Machine.	9	Perform Brinell hardness test on metal specimen.	CO2
LSO10.1. Determine hardness of a given specimen using Rockwell hardness testing machine.	10	Perform Rockwell hardness test on metal specimen.	CO2
LSO11.1. Distinguish different types of truss.	11	Prepare model of different types of truss.	CO6
LSO12.1. Identify the critical points for shear force and bending moment for a simply supported beam	12	To draw shear force and bending moment diagram for a simply supported beam under point and distributed loads.	CO4
LSO13.1. Identify the elements of Mohr circle to calculate principal stress by locating principal plane.	13	To determine Principal stresses and its location using Mohr's circle method.	CO3

L) Suggested Term Work and Self Learning: **S2415303** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/ Problems/ Numerical/ Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Design the length of a broad -gauge railway sleeper such that it has the minimum bending moment.
2. Collect information and present in tabular form, values of different engineering properties of five standard building materials.
3. Prepare a report on different machine components subjected to uniaxial and bi-axial stress system.
4. Prepare an excel sheet to calculate SFD and BMD in a simply supported beam and cantilever beam.
5. Prepare a model of simple bridge truss.

c. Other Activities:

1. Seminar Topics:

(a) Comparison of moment of inertia of various built-up sections used in construction works.
(b) Comparison of various construction materials from day-to-day life in accordance to their mechanical properties.
(c) A report on study of types of stress and strain.
(d) Methods of increasing the flexural strength of timber beam.
(e) Study of types of trusses used in construction works.

2. **Self-learning topics**:

- Select appropriate shape, type and material of member from day to day situation for various type of stress and strain.
- Correlate the actual field condition about various member subjected to different types of loading.
- Study the mode of failures due to flexure and shear from field situations and prepare a report.
- Visit site/design office to collect the data from day to day situations for different types of structures under given loading.
- Search the software on the course content and prepare the report stating their applications.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

Cos	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	10%	17%	15%	10%	10%	10%	16%
CO-2	20%	12%	10%	20%	25%	40%	17%
CO-3	15%	19%	15%	20%	-	10%	17%
CO-4	25%	17%	20%	25%	30%	10%	17%
CO-5	20%	16%	20%	-	20%	20%	17%
CO-6	10%	19%	20%	25%	15%	10%	16%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA(Marks)		
				Remember (R)	Understanding (U)	Application & above(A)
Unit-1.0 Moment of Inertia (MOI)	8	CO1	12	4	4	4
Unit-2.0 Simple stresses and strains	6	CO2	9	3	3	3
Unit-3.0 Principal stresses and Principal planes	9	CO3	13	4	4	5
Unit-4.0 Shear force (SF) and Bending moment (BM)	8	CO4	12	3	4	5
Unit-5.0 Bending and Shear stresses in beams	8	CO5	11	3	3	5
Unit -6.0 Analysis of Trusses	9	CO6	13	3	4	6
Total Marks	**48**	**-**	**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant Cos Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the moment of inertia of a flywheel.	CO1	30	60	10
2.	Study different components of Universal Testing Machine (UTM).	CO2	40	50	10
3.	Perform Tension test on Mild steel/HYSDas per IS 1608.	CO2	30	60	10
4.	Conduct compression test on Mild steel piece using Universal Testing Machine (UTM).	CO2	30	60	10
5.	Perform the shear strength test on a given specimen.	CO5	30	60	10
6.	Perform Izod Impact test on a given specimen.	CO2	30	60	10
7.	Perform CharpyImpact test on metal specimen.	CO2	40	50	10
8.	Perform Brinell hardness test on metal specimen.	CO2	40	50	10

S. No.	Laboratory Practical Titles	Relevant Cos Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
9.	Perform Rockwell hardness test on metal specimen.	CO2	40	50	10
10.	Prepare model of different types of truss.	CO6	30	60	10
11.	To draw shear force and bending moment diagram for a simply supported beam under point and distributed loads.	CO4	30	60	10
12.	To determine Principal stresses and its location using Mohr's circle method.	CO3	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Universal testing machine	Capacity 1000 kN, 600 kN, 400 kN. Analog type/ digital type	3, 4
2.	Shear strength testing machine	Conforming to IS 1828-1975 shall also conform to the requirements of Grade 10.	
3.	Izod Impact testing machine	Conforming to IS 1977	7
4.	Charpy Impact testing machine	Conforming to IS 1757	8
5.	Brinell hardness testing machine	Conforming to IS 2281:2005	9
6.	Rockwell hardness testing machine	Conforming to IS 1586 (Part 2) : 2012	10
7.	Accessories: Vernier caliper, meter scale, weighing balance, weights, punch, file, hammer, screw drivers, pliers and flywheel		All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	A text book of strength of materials	Dr. R.K. Bansal	Laxmi Publication (6th edition) ISBN-13:978-8131808146 ISBN-10:9788131808146
2.	Mechanics of Materials	Gere and Timoshenko	CBS Publishers (2th edition) ISBN-13:978-8123908946 ISBN-10:9788123908946
3.	Strength of materials	Er. R.K. Rajput	S Chand publishing (6th edition) ISBN-13:978-9385401367 ISBN-10:9789385401367
4.	Strength of materials	Ramamrutham	Dhanpat Rai Publishing Company (16th edition) ISBN-13:978-8187433545 ISBN-10:818743354X
5.	Strength of materials	R.S. Khurmi	S Chand (G/L) &Company Ltd. (23rd edition) ISBN-13:978-8121905336 ISBN-10:8121905338
6.	SMTS-1 Strength of materials	Dr. B.C. Punmia Er. Ashok kumar Jain Dr. arunkumar Jain	Laxmi publication (10th edition) ISBN-13:978-8131809259 ISBN-10:8131809250

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105108/
2. https://www.youtube.com/watch?v=RXbqFrlXPl0
3. https://www.youtube.com/watch?v=ufd-CJj8Jxs
4. https://www.youtube.com/playlist?list=PL9RcWoqXmzaLlfmNg2Ku1SdZtvXnYrLbc
5. https://www.youtube.com/playlist?list=PL27C4A6AEA552F9E6

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS 1977 - Izod Impact test.
2. IS 1757 - Charpy Impact test.
3. IS 2281:2005 - Brinell hardness test.
4. IS 1586 (Part 2): 2012 - Rockwell hardness test.
5. IS 1828-1975 - Shear strength testing machine.

******

A) Course Code : 2415304(T2415304/P2415304/S2415304)

B) Course Title : Building Construction and Material

C) Pre- requisite Course(s) : Class 10th level basic knowledge

D) Rationale :

The construction of buildings and structures relies on having a thorough understanding of building materials. Without this knowledge it would not be possible to build safe, efficient and long-lasting buildings, structures and dwellings. This course provides an over-view of the basic properties of wide range of building materials available to Civil Engineers for various usages. Students also learn the standard testing procedures of construction materials as per provision of various IS Codes. Besides this student also learn about construction of brick and stone masonry, plastering, damp proofing its requirements and methods of construction, need and significance of ventilation, methods of insulation, construction equipment.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to:

CO-1 Select suitable materials for a given building construction project.
CO-2 Use the modern construction materials for a given construction conditions.
CO-3 Explain various components & their functions of a given building structure.
CO-4 identify relevant type of foundation for a given building structure.
CO-5 Supervise various activities of a given building construction project.
CO6 Select suitable horizontal & vertical components of a given building construction project.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415304**	Building Construction and Material	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		Total Marks (TA+TWA+LA)
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415304**	Building Construction and Material	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415304

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO1.1 Describe the term, "Stone as Building Material" with its classifications. TSO1.2 Explain the various methods of manufacturing of bricks TSO 1.3 Select suitable aggregates for a given construction work TSO 1.4 Conduct various tests on bricks in the laboratory as per IS code provisions	**Unit 1- Stones, Aggregate and Bricks** 1.1 **Stones:** Stone as building material – Classification of Stones, Deterioration and Preservation of stone work 1.2 **Aggregates:** Aggregates- Classification, Characteristics, Grading of Aggregates, **Bricks:** – Classification – Manufacturing of clay bricks, Tests on bricks – (Dimension- Compressive Strength – Water Absorption – Efflorescence)	**CO1**
TSO 2.1 Select suitable type of cement for a given construction work. TSO 2.2 Classify lime based on its properties. TSO 2.3 Conduct various tests on cement in laboratory. TSO 2.4 Suggest suitable mortar based on its application in the construction site	**Unit 2- Lime, Cement and Mortar** **2.1 Lime:** Lime – Properties and Classification **2.2 Cement:** Cement, Ingredients, Manufacturing of Cement, Types of Cement, Test on Cement (Consistency test, Initial and Final Setting Time, Soundness, Compressive Strength) **2.3 Mortar:** Mortar, Classification and properties of Mortar	**CO1**
TSO 3.1 Classify various types of timber based on its properties. TSO 3.2 Identify defects in a given timber. TSO3.3 Differentiate between ferrous material & non-ferrous metals. TSO 3.4 Suggest suitable type of modern construction material based on its application.	**Unit 3- Timber and Modern Materials** **3.1 Timber:** Timber, Classification, Structure of Timber, Properties of Timber, Characteristics of Good Timber, Defects in Timber, Advantage and Disadvantage of Timber as an engineering material **3.2 Modern Materials:** Glass, Ferrous and Non-Ferrous Metals, Ceramics Geotextile and Geomembrane, Fiber glass reinforced plastic	**CO1, CO2**
TSO4.1 Classify a given building based on NBC code provisions. TSO4.2 Enlist component parts of a given building. TSO4.3 Explain the functions of various components of a given building structure. TSO4.4 Differentiate between the load bearing and framed structure.	**Unit 4- Building Components:** 4.1 **Classification of Buildings** as per National Building Code Group A to I, as per Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure. 4.2 **Building Components** – Building Components and their Function, Substructure - Foundation, Plinth, and Plinth Filling Superstructure- Walls, Partition wall, Cavity Wall, Sill, Lintel, Doors and windows, Floor, roof, Column Beams and Parapet	**CO3, CO4**
TSO 5.1 Demonstrate lay out of a given building in the field using centerline method. TSO 5.2 Suggest suitable type of foundation for a given structure. TSO 5.3 Explain various terms used in brick masonry work.	**Unit 5- Sub-Structure and Super Structure** **5.1 Job Layout and Excavation:** Site clearance, Preparing job Layout, Layout for Load Bearing Structure and Framed Structure by Center Line and Face Line Method, Precautions, Excavation for Foundation, Earthwork for Embankment, Material	**CO4, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5.4 Explain different types of bond in brick masonry with neat sketches TSO 5.5 Compare the Stone masonry construction with Brick masonry construction. TSO 5.6 Discuss quality control aspects in the brick masonry works.	for Plinth Filling. Tools and Plants Used for Earthwork **5.2 Sub-Structure**: Foundation-Function of Foundation Types of Foundation- Shallow Foundation, Stepped Footing, Wall Footing, Column Footing, Isolated and Combined Column Footing, Raft Foundation, Grillage Foundation. Deep Foundation-Pile Foundation, classification based on materials and functions, Well foundation and Caissons. **5.3 Super-Structure:** Brick masonry: Terms used in brick masonry- header, stretcher, closer, quoins, course, face, back, hearting, bat bond, joints, lap, frog line, level and plumb Bonds in brick masonry- header bond, stretcher bond, English bond and Flemish bond. Requirements of good brick masonry, Junctions in brick masonry and their purpose and procedure. Precautions to be observed in Brick Masonry Construction Comparison between stone masonry and Brick Masonry.	
TSO 6.1 Demonstrate with sketches various components of horizontal communication. TSO 6.2 Suggest suitable types of doors and windows for a given building plan. TSO 6.3 Demonstrate fixing of various types of doors & windows using the relevant fixture and fasteners. TSO 6.4 Suggest suitable type of staircase for a given building structure. TSO 6.5 Explain the parameters that need to take into consideration while designing the staircase.	**Unit 6: Building Communication and Ventilation** **6.1 Horizontal Communication**: Doors- Components of Doors, Fully Paneled situation with sketches. Doors, Partly Paneled and Glazed Doors, Flush Doors, Collapsible Doors, Rolling Shutters, Revolving Doors, Glazed Doors. Sizes of Door recommended by BIS. **6.2 Windows**: Component of windows, Types of Windows-Fully Paneled. Partly Paneled and Glazed, wooden, Steel, Aluminum windows, Sliding Windows, Louvered Window, Bay window. Corner Dormer window, Skylight. Sizes of Windows recommended by BIS. Ventilators, Cement Grills **6.3 Vertical** Communication**:** Stair Case, Ramps, Lift. Elevators and Escalators.	**CO6**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415304

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1a. Determine the grading of fine aggregate for the given civil engineering work LSO 1b. Calculate the specific gravity of given type of fine aggregate. LSO 1c. Analyze the bulk density of given fine aggregate for compacted and loose state.	1.	**Test on Fine Aggregate-** 1. Determination of Grading of Fine Aggregate 2. Determination of specific gravity of fine aggregate 3. Determination of Compacted and loose bulk density of fine aggregate	CO1, CO5

LSO 2a. Calculate the impact value of coarse aggregate. LSO 2b. Determine the elongation and flakiness index of the coarse aggregate. LSO2c. Determine the crushing value of coarse aggregate.	2.	**Test on Coarse Aggregate-** 1. Determination of impact value of coarse aggregate. 2. Determination of Elongation index and flakiness index 3. Determination of crushing value of coarse aggregate	CO1, CO5
LSO 3a. Find the Normal consistency of cements. LSO 3b. Determine the initial and final setting time of given sample of cement LSO 3c. Test the given cement sample for the compressive strength	3.	**Test on Cement-** 1. Determination of Normal consistency of cement 2. Determination of Initial and Final setting time of cement **3.** Determination of compressive strength of cement sample	CO1, CO5
LSO 4a. Compare the compressive strength of given samples of the bricks. LSO 4b. Carry out the absorption test on bricks to Identify its class. LSO4c. Find the Efflorescence of given sample of brick.	4.	**Test on Bricks: -** 1. Determination of compressive strength of bricks 2. Determination of water absorption of bricks 3. Determination of Efflorescence of Bricks	CO1, CO5

L) **Suggested Term Work and Self Learning**: **S2415304** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Perform a activity by collection of different types of stones and write their properties.
2. Identify different types of cement as per availability at nearby location.
3. Prepare a sketchbook consisting of different types of staircases used in building construction.
4. Collect relevant information of recent technologies in manufacturing the cement of various grades and prepare a report on it.
5. Identify the reasons of seepage through the walls of the building and suggest the suitable remedial measures to address it and submit a report.
6. Prepare a summary report with reference to content in any one part of National Building Code.
7. Check different construction activities by visiting a nearby site as per the check list provided.

b. Micro Projects:

- Fly ash bricks
- Strength of different types of bricks
- Physical and chemical properties of cements
- Commercially available timber

c. Other Activities:

1. Seminar Topics:
   - Rain water harvesting
   - Foundation for high rise buildings
   - Quality control aspects in building construction works.
   - Different types of stair cases used in building structure
   - Modern & green building construction materials
2. Visits: Visit nearby building construction project & Prepare report of visit with special comments on material used.

3. Self- learning topics:
    - Different types of stones for different work.
    - Cement for hydroelectric project

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO 1	15%	10%	15%	15%	15%	30%	35%
CO 2	15%	20%	15%	15%	15%	30%	35%
CO 3	20%	20%	20%	20%	15%	40%	30%
CO 4	15%	15%	25%	25%	15%	-	-
CO 5	15%	20%	15%	15%	20%	-	-
CO 6	20%	15%	10%	10%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

Note:
- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit 1- Stones, Aggregate and Bricks	06	CO1	08	2	2	4
Unit 2- Lime, Mortar and Cement	10	CO1	14	4	4	6
Unit 3- Timber and Modern Materials	10	CO1, CO2,	14	4	4	6
Unit 4- Building Components	06	CO3, CO4	10	3	3	4
Unit 5- Sub-Structure and Super Structure	10	CO4, CO5	14	4	4	6
Unit 6: Building Communication and Ventilation	06	CO6	10	3	3	4
Total Marks	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determination of Grading of Fine Aggregate	CO1, CO5	30	60	10
2.	Determination of specific gravity of fine aggregate	CO1, CO5	40	50	10
3.	Determination of Compacted and loose bulk density of fine aggregate	CO1, CO5	30	60	10
4.	Determination of impact value of coarse aggregate.	CO1, CO5	30	60	10
5.	Determination of Elongation index and flakiness index	CO1, CO5	30	60	10
6.	Determination of crushing value of coarse aggregate	CO1, CO5	30	60	10
7.	Determination of Normal consistency of cement	CO1, CO5	30	60	10
8.	Determination of Initial and Final setting time of cement	CO1, CO5	40	50	10
9.	Determination of compressive strength of cement sample	CO1, CO5	40	50	10
10.	Determination of compressive strength of bricks and blocks	CO1, CO5	40	50	10
11.	Determination of water absorption of bricks	CO1, CO5	30	60	10
12.	Determination of Efflorescence of Bricks	CO1, CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ ImplementationStrategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Sieves	4.75 mm, 10 mm, 20 mm, 40 mm, 80 mm, for coarse aggregates, 2.36 mm, 1.18 mm, 600 microns, 150 microns, for fine aggregates.	All
2.	Weigh Machine	Not less than 3kg and accurate upto 0.5gm, Oven, Pycnometer of about 1 litre capacity, Tray, Air tight container, filter paper.	All
3.	Balance, tamping rod, Shovel, Calibration equipment	Balance weigh not less than 3kg, Tamping rod of 16mm dia nad 600mm length, A cylindrical metal measure, preferably provided with the handles, A piece of plate glass, preferably at least 6mm thick and 25mm larger than the diameter of the measure to be calibrated.	1, 2,3, 4, 6, 7, 8, 9
4.	weighing machine, cylindrical steel cup, metal hammer, Tamping rod	Weighing Machine 45 to 60kg, A cylindrical steel cup of internal diameter 102 mm, depth 50 mm and minimum thickness 6.3 mm. metal hammer weighing 13.5 to 14.0 kg, Tamping rod 10 mm in diameter and 230 mm long, rounded at one end.	4
5.	Standard thickness and length gauge.	Thermostatically controlled oven with capacity up to *250* °C., Standard thickness and length gauge	5
6.	steel cylinder, cylindrical metal, Dial gauge	Steel cylinder 15 cm diameter with plunger and base plate, A compression testing machine, cylindrical metal measure of sufficient rigidity to retain its from under rough usage and of 11.5cm diameter and 18cm height, Dial gauge	6, 7, 8
7.	Vicat apparatus, Gauging trowel, Stop watch	Vicat apparatus confirming IS: 5513-1976, Gauging trowel confirming IS:10086-1982, Stop watch	7, 8
8	Vibration Machine, Cube Mould, Poking rod, Gauging Trowel, Standard Weights, Graduated Glass Cylinders, non-porous plate UTM Machine	The vibration machine should be as per the standard IS 10080 – 1982, Mould to be used in this test should conform to IS 10080 – 1982, Size of cube mould – 70.6 mm. Poking rod should be as per the standard IS 10080 – 1982, Gauging trowel should comprise the blade of length 100-150 mm. it should have straight edges. Its weight should be 210 ± 10 g, Glass cylinders with a capacity of 150-200 ml are required, permissible variation shall be ± 1 ml,	9, 10
9	Ventilated oven, weighing balance, sample of whole brick	Ventilated oven, weighing balance, sample of whole brick	10, 11, 12

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	A Text-Book of Building Construction	S.P.Bindra and S.P.Arora	Dhanpat Rai Publication, Delhi Edition 2013, ISBN: 9788189928803
2.	Building Materials and Construction	Jena and Sahu,	Tata Mc. Graw Hill (2017). ISBN-10: 9339220625 ISBN-13: 978-9339220624
3.	Materials for Civil and Construction Engineers	Mamlouk and Zaniewski	Pearson
4.	Construction Materials	D.N. Ghosh	Tata McGraw Hill, New Delhi

5.	P.C. Varghese	Building Materials	PHI learning, New Delhi
6.	Building Construction	B. C. Punmia	Laxmi Publication

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/124105013
2. https://www.vlab.co.in/broad-area-civil-engineering
3. https://www.youtube.com/watch?v=EIDXE28_8eQ&list=PL8BA090E69BF01BC2

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Engineers Hand book
2. Building Material Handbook
3. Lab Manuals

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A) Course Code : 2415305(T2415305/S2415305)

B) Course Title : Water Resources Engineering

C) Pre- requisite Course(s) :

D) Rationale :

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

E) Course Outcomes (COs): In we are working in the field of irrigation Engg. we should know how much water is going into the ground from where the plants can take their water If we are concerned about the water resources we should know how much water is going into the river so that we can control the floods or we can avoid the lack of water for irrigation other area

After completion of the course, the students will be able to-

CO 1 Compute the hydrological parameters using relevant method in the given situation

CO-2 Estimate the crop water requirement of the command area to determine the capacity of canal.

CO-3 Suggest the relevant type of Dam for the given purpose in the given situation.

CO-4 Select the relevant method of irrigation in a given situation.

CO-5 Propose the relevant type of diversion headwork for the given site conditions.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Civil Engineering	**2415305**	Water resources engineering	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Civil Engineering	**2415305**	Water Resources engineering	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2415305

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the term, "hydrological cycle". *TSO 1b. Classify the* rain gauges on the basis of nature of rainfall. *TSO 1c. C*alculate average rainfall using the relevant method of estimation. *TSO 1d.* Explain the terms, "Runoff" along with the factors affecting the runoff *TSO 1e.* Calculate maximum flood discharge using the relevant method with given data.	**Unit-1.0 Introduction to Hydrology** 1.1 Hydrology: Definition and Hydrological cycle. 1.2 Rain Gauge: Symon's rain gauge, automatic rain gauge. 1.3 Methods of calculating average rainfall: Arithmetic mean, Isohyet, and Theissen polygon method. 1.4 Runoff, Factors affecting Run off, Computation of run off. 1.5 Maximum Flood Discharge measurement: Rational and empirical methods, Simple numerical problems.	**CO1**
TSO 2a. Classify the different methods of irrigation. TSO 2b. Define the terms, "GCA, CCA, Crop period, base period, Duty, Delta, intensity of irrigation" TSO 2c Calculate water requirement of the given crop with given data. TSO 2d. Apply the relevant method of assessment for irrigation water.	**Unit-2.0 Crop Water Requirement** 2.1 Irrigation and its classification. • Surface irrigation • Subsurface irrigation 2.2 Crop Water requirement: Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA,intensity of irrigation, factors affecting duty, Problems on water requirement and capacity of canal. 2.3 Methods of application of irrigation water and its assessment. • Sprinkler irrigation • Drip irrigation 2.4 Area capacity curve.	**CO2**
TSO 3a. Suggest the relevant type of Dam in the given situation TSO 3b Classify the dams along with its components. TSO 3c. Explain the functions of an earthen dam. TSO 3d. Explain the method of construction of earthen dam. TSO 3e. Explain the causes of failure of earth dam. TSO 3f. Suggest the relevant preventive measure to protect the dam from the failure.	**Unit-3.0 Dam and Spillway** 3.1 Dams and its classification: Earthen dams and Gravity dams (masonry and concrete). 3.2 Earthen Dams – Components with function, typical cross section, seepage through embankment and foundation and its control. 3.3 Methods of construction of earthen dam, types of failure of earthen dam and preventive measures.	**CO3**

TSO 3e. Draw the labelled sketch of a Gravity dam section to show the various forces acting on it. TSO 2f. Justify the need of the spillway at the given location in the dam section	3.4 Gravity Dams – Forces acting on dam, Theoretical and practical profile, typical cross section, drainage gallery, joints in gravity dam, concept of high dam and low dam. 3.5 Spillways-Definition, function, location, types and components, Energy dissipator	
*TSO 4a. Explain the term, "*Bandhara irrigation" with the help of layout sketch. *TSO 4b.* Explain the importance site selection in the design of percolation tank. *TSO 4c.* Explain the concept of lift irrigation w.r.t. layout, its components and functions. TSO 4d. Justify the need of sprinkler in drip irrigation. TSO 4e. Describe the method of well irrigation with its advantage and disadvantage.	**Unit-4.0 Minor and Micro Irrigation** 4.1 Bandhara irrigation: Layout, components, construction and working, solid and open bandhara. 4.2 Percolation Tanks – Need, selection of site. 4.3 Lift irrigation Scheme-Components and their functions, Lay out. 4.4 Drip and Sprinkler Irrigation- Need, components and Layout. 4.5 Well irrigation: types and yield of wells, advantages and disadvantages of well irrigation	**CO4**
TSO 5a. Explain the term, "weir" with its classification. TSO 5b. Draw the labelled Layout of diversion head work. TSO 5c. Explain the given layout of a barrage. TSO 5e. Differentiate between weir section and barrage. TSO 5f. Design most economical section for the given canal. TSO 5g. Justify the need of lining the canal with its advantages. TSO 5h. Suggest relevant type of drainage Work based on the given site condition. TSO 5i. Explain canal regulators along with falls & outlets.	**Unit-5.0 Diversion Head Work and Canal** 5.1 Weirs – components, parts, types 5.2 Diversion head works – Layout, components and their function. 5.3 Barrages – components and their functions. Difference between weir and Barrage. 5.4 Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth, Design of most economical canal section. 5.5 Canal lining - Purpose, material used and its properties, advantages. Cross Drainage works- Aqueduct, siphon aqueduct, super passage, level crossing. 5.6 Canal regulators- Head regulator, Cross regulator, Escape, Falls and Outlets.	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

(L) Suggested Term Work and Self Learning: S2415305 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in linewith the targeted COs.

Any six of the following:

1. Collect data and drawings of various dam structures in Bihar State from various sources.
2. Draw inference from designs/above drawings and data.
3. Prepare presentations on given topics.
4. Calculate average rainfall for the given area using arithmetic mean method.
5. Calculate average rainfall for the given area using Isohyet Theissen polygon method

6. Estimate crop water requirement for the given data.
7. Calculate control levels for the given data for the given reservoir.
8. Draw the theoretical and practical profile of the given gravity dam section.
9. Prepare a maintenance report for any major/minor irrigation project site in the vicinity of your area, based on field visit.
10. Prepare summary of the technical details of any existing water resource project in the vicinity of your area.
11. Draw a labeled sketch of the given diversion head works and CD works.

b. Micro Projects:

Any one of the following.

1. Design and Analysis of Micro Irrigation System for a Small-Scale Farm
2. Design of Sprinkler Irrigation Systems for uniform and optimum Distribution of water
3. Design of Rainwater Harvesting system for a building structure in urban/rural area.
4. Feasibility Study with Design of a Small-Scale Dam for Water Supply and Irrigation Purposes
5. Environmental Impact Analysis for Biodiversity Conservation in the Vicinity of a Dam Project
6. Prepare a brief report of cropping pattern, for the given minor irrigation project in your district with reference to growth in yield, increase in command and culturable area and economic status of the concern people.
7. Conduct internet survey for Water shed management project (s) in the Bihar State with a detailed report of it.
8. Prepare a detailed report of visit to a recently executed rain water harvesting project in your vicinity.
9. Prepare a brief report on applications of remote sensing and GIS in water resource engineering with relevant examples.

c. Other Activities:

1. Seminar Topics:

   Any one of the following
   - Rain water harvesting
   - Utility of dam & spillway
   - Micro irrigation system.
   - Rain Gauges and its Applications
   - Applications of remote sensing and GIS in water resource engineering

2. Visits: Visit nearby Dam/Weir/Barrage etc. Prepare report of visit with special comments on discharge of water, material used.
3. Self- learning topics:
   - Forms of precipitation.
   - Evaporation -- process, measurement, and estimation.
   - Water Management
   - Dam Safety and Maintenance

(M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/ performance of each student in each of these designed activities is to be used to calculate **CO attainment.**

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	15%	20%	-	-
CO-2	15%	15%	10%	15%	20%	-	-
CO-3	25%	20%	15%	25%	20%	-	-
CO-4	25%	25%	30%	30%	20%	-	-
CO-5	20%	25%	30%	15%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

(N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Numbers	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Hydrology	06	CO1	10	3	3	4
Unit-2.0 Crop Water Requirement	08	CO2	10	3	3	4
Unit-3.0 Dam and Spillway	10	CO3	14	4	4	6
Unit-4.0 Minor and Micro Irrigation	12	CO4	18	4	4	10
Unit-5.0 Diversion head work and canal	12	CO5	18	6	6	6
Total Marks	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

(O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

(P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

(Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

(R) Suggested Learning Resources:

(a) Books:

S. No	Titles	Author(s)	Publisher and Edition with ISBN
1.	Irrigation and hydraulic structure	S. K. Garg	Khanna publisher, New Delhi ISBN 81-7409-047-9
2.	Irrigation engineering and water power engineering	B.C.Punmia	Laxmi Publication, Delhi ISBN 13: 9788131807637
3.	Engineering Hydrology	K. Subramanya	McGraw Hill Education ISBN 13: 9789383286539
4.	Irrigation Engineering	R.K Sharma T.K Sharma	S Chand Publications ISBN 13: 9788121921282
5.	Irrigation Engineering	N.N Basak	McGraw Hill Education ISBN 13:978-0074635384
6.	Water Resource Engineering	Piyush Goyal	Vayu Education of India ISBN 13: 978-9382174462

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/105/104/105104103/
2. https://nptel.ac.in/courses/105105110
3. https://www.youtube.com/watch?v=tW2w14YIQ98
4. htttp://www.imd.gov.in
5. https://onlinecourses.nptel.ac.in/noc21_ag08/preview
6. https://expertcivil.com/diversion-headworks/

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. IS:4410-Part-V-1982-Canals
2. IS:4410-Part-VI-1983-Reservoirs
3. IS:4410-Part-VII-1983-Dams
4. Lab Manuals

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A) Course Code : 2415306 (P2415306/S2415306)

B) Course Title : Summer Internship -I (Common For all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- **CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- **CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- **CO-4** Identify the probable job function and job position in their relevant programme of study.

F) Suggested Course Articulation Matrix (CAM):

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

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2415306	Summer Internship -I	-	-	02	02	04	02

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2415306	Summer Internship -I	-	-	10	15	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Suggested Instructional/Implementation Strategies: Mentors/ Coordinators/ Teachers need to plan and implement the summer internship in their respective programme as per the outcome expected from the programme. However in general, summer internship would help in exploring and exposing

the student to the below mentioned dimensions of the world of work. These dimensions can further be explored in depth as per the need and advancement in respective programmes in later stages. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the whole to part approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the specific diploma programme and then teaching the related concepts ('Part') of the same in subsequent semesters.

- Industrial Layout
- Organizational Structure
- Corporate Communications
- Strategic, Rolling and Developmental plans
- Maintenance Procedures
- Inventory Control and Management System
- Purchase and Store Procedures
- Major Machinery, Tools, Equipment, Devices, Software, Control System etc.
- Product Development, Manufacturing, Packaging and Delivery
- Project Management
- Operation and Maintenance
- Warehouse Management
- Assembly Line
- Quality Assurance and Testing Cell
- Process/ Software Development/ Fabrication/ Construction Work Management
- Testing and Quality Assurance Practices
- Total quality management
- Calliberation and Certification practices
- Safety Practices
- Industrial Acts
- Industrial Grievances
- Behavioural Aspects
- Conduction of Meetings and Discussions
- Sales and Marketing Strategies
- Forecasting and Target Setting
- Production Planning and Control
- Storage Retrieved and Material handling Practices
- Automation and Control Facilities
- Enterprise Resource Planning (ERP)
- Supply Chain
- Customer Satisfaction Strategies
- Finance and Accounts
- Research and Development
- Promotion and Capacity Building Schemes
- Reduce, Reuse and Recycling Efforts and Policies
- Recognitions and Rewards
- After Sale Services
- Promotional Avenues
- Social Corporate responsibilities

J) Assessment of Summer Internship -I

S. No.	Criteria of Assessment	% of Weightage
1.	Maintaining the log book after having exposure to different types of industry/ world of work	15
2.	Preparing the list of job functions and job positions of relevant programme	20
3.	Identify the probable enterprise/ startup for futuristic planning	15
4.	Report writing of summer internship as per the prescribed format	30
5.	Presentation of Report	20
Total		**100**

Note: S. no. 1 to 3 shall be considered for progressive assessment. While S. No. 4 & 5 shall be considered for end term assessment

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