ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SE/ TC/ TE/ TR/ TX**
Semester	**: Third**
Course Title	**: ESSENCE OF INDIAN CONSTITUTION**
Course Code	**: 313002**

I. RATIONALE

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - List salient features and characteristics of the constitution of India.
- CO2 - Follow fundamental rights and duties as responsible citizen of the country.
- CO3 - Analyze major constitutional amendments in the constitution.
- CO4 - Follow procedure to cast vote using voter-id.

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313002	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50

Total IKS Hrs for Sem. : 0 Hrs

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

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

Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	**Unit - I Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspectives of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble of the Constitution of India.	Presentations Blogs Hand-outs Modules Flipped classrooms Case studies
2	TLO 2.1 Enlist the fundamental rights. TLO 2.2 . Identify fundamental duties in general and in particular with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	**Unit - II Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance under part-IV-A. 2.3 Relevance of Directive Principles of State Policy under part-IV A.	Presentations Blogs Hand-outs Modules Case Study Flipped Classroom

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship TLO 3.3 Analyze the purposes of various amendments.	**Unit - III Governance and Amendments** 3.1 3.1 Amendment procedure of the Constitution and their types - simple and special procedures. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning
4	TLO 4.1 Explain the importance of electoral rights. TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO TLO 4.10 Follow procedure to cast vote using voter-id.	**Unit - IV Electoral Literacy and Voter's Education** 4.1 Electoral rights , Electoral process of registration 4.2 Ethical electoral participation 4.3 Motivation and facilitation for electoral participation 4.4 Voter's guide 4.5 Prospective empowered voter 4.6 Voting procedure 4.7 Voter awareness 4.8 Voter online registration https://www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Hand-outs Modules Blogs Problem based Learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Assignment

- Outline the procedure to submit application for Voter-id
- Assignments are to be provided by the course teacher in line with the targeted COs.

A1. Prepare an essay on Constitution of India .
A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA

- Assignments are to be provided by the course teacher in line with the targeted COs. A1. Prepare an essay on Constitution of India . A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA A3. Self-learning topics: Parts of the constitution and a brief discussion of each part Right to education and girl enrollment in schools. GER of Girls and Boys. Right to equality. Social Democracy. Women Representation in Parliament and State Assemblies. LGBTQIA+

Micro project

- 1. Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country

2. Prepare elaborations where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
3. Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.

Seminar

- 1 Differences in the ideals of Social democracy and Political democracy.

2 Democracy and Women's Political Participation in India.
3 Khap Panchayat - an unconstitutional institution infringing upon Constitutional ethos.
4 Situations where directive principles prevail over fundamental rights.

Group discussions on current print articles.

-

- Art 356 and its working in Post-Independent India.
- Women's Resrvation in Panchayat leading to Pati Panchayats - Problems and Solutions.
- Adoption of Article 365 in India.
- Need of Amendments in the constitution.
- Is India moving towards a Unitary State Model ?

Activity

- Arrange Mock Parliament debates.

Prepare collage/posters on current constitutional issues.
i. National (Art 352) & State Emergencies (Art 356) declared in India.
ii. Seven fundamental rights.
iii. Land Reforms and its effectiveness - Case study of West-Bengal and Kerala.

Cases: Suggestive cases for usage in teaching:

- A.K. Gopalan Case (1950) :SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.

Shankari Prasad Case (1951) : This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980) :This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978) :A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."
Other cases:
1. Kesavananda Bharati Case (1973) : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not enable it to alter the 'basic structure' of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the 'basic structure' of the Constitution.
2. Mathura Rape Case(1979) : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was was a tribal woman who succumbs to multiple pattiarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim's identity was banned and it was also held that rape trials should be conducted under the cameras.
3. Puttswamy vs Union of India (2017) : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The

court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees fundamental rights. The conflict in this area mainly arises between an individual's right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.
4. Navtej Singh Johar & Ors. v. Union of India (2018) : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.
5. Anuradha Bhasin Judgement (2020) : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Constitution and Preamble	CO1	4	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	4	0	0	0	0
3	III	Governance and Amendments	CO3	4	0	0	0	0
4	IV	Electoral Literacy and Voter's Education	CO4	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of Learning)

XI. SUGGESTED COS - POS MATRIX FORM

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan,Agra, 2017, ISBN:8193413768

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.legislative.gov.in/constitution-of-india	Constitution overview
2	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution

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ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Sr.No	Link / Portal	Description
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: BUILDING PLANNING & DRAWING WITH CAD**
Course Code	**: 313009**

I. RATIONALE

Building planning and drawing are critical components of the construction process, enabling stakeholders to visualize, communicate, problem-solve, comply with regulations, estimate costs, guide construction, and ensure quality throughout the project lifecycle. In today's era of globalization and technology revolutions, it is necessary to prepare the civil engineering drawings in such a way that it can be prepared with utmost precision and accuracy with ability to modify it as and when required. This is only possible if the said drawing is prepared using the CAD software. This course is therefore planned with the goal of developing such competency among the learners.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Prepare Drawings of the given building structure with required specifications using CAD Software.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Draw the line plans of given type of buildings considering the Principles of Planning.
- CO2 - Use CAD software for drafting and editing of the given type of drawing.
- CO3 - Draw the relevant type of plan/drawings for the given type of building.
- CO4 - Draw perspective drawing for the given type of objects.
- CO5 - Draw the Isometric and 3- Dimensional drawings of the given component of the structure.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313009	BUILDING PLANNING & DRAWING WITH CAD	BDC	SEC	2	-	4	2	8	4	-	-	-	-	-	50	20	50#	20	25	10	125

BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the given basic principles of Planning of building (residential and public). TLO 1.2 Propose the relevant dimensions for the given component of building structures. TLO 1.3 Plan the dwelling unit as per the given requirement and specifications TLO 1.4 Plan the dwelling units/building in accordance with the provisions of governing authority in a given area TLO 1.5 Compute the required area of construction using the norms of the local authority. TLO 1.6 Draw line plans for the given residential buildings. TLO 1.7 Draw line plans for the given public buildings.	**Unit - I Principles of Planning** 1.1 Principles of planning of Residential and Public building: Aspect, Prospect, Orientation, Grouping, Privacy, Elegance, Flexibility, Roominess, Circulation, Furniture requirements, Sanitation, Economy. (IKS-Orientation of Indian Heritage Structures such as Mahalaxmi Temple, Kolhapur) 1.2 Space requirement and norms for minimum dimension of different components of building structure. 1.3 Planning of residential buildings as per the given requirement using IS 962-1989. 1.4 Rules and bye-laws of sanctioning authorities (local authority and town planning department) for construction work. 1.5 Plot area, built up area, super built up area, plinth area, carpet area, floor area and FAR (Floor Area Ratio) / FSI. 1.6 Line plans for residential building of minimum three rooms including w/c, bath and staircase as per principles of planning 1.7 Line plans for public building-primary health center, restaurant, bank, post office, hostel and Library.	Video Demonstrations Presentations Site/Industry Visit Case Study Lecture Using Chalk-Board

BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain the various software available with its importance for drawing through CAD to be used in the given situation. TLO 2.2 Undertake the required initial settings of the relevant software to draw the new drawing. TLO 2.3 Use the relevant command to draw the specific feature of the figure or plan in given situation. TLO 2.4 Modify the given drawing/figure using relevant command in given situation. TLO 2.5 Calculate the parameters like distance, area, perimeter of a given figure. TLO 2.6 Trace the anchor point on the given boundaries of the figure to get the relevant dimension of the figure. TLO 2.7 Use the concept of layer to visualize the specific component of the building/drawing. TLO 2.8 Apply the required dimension command to mark the dimensions in the given drawing. TLO 2.9 Use the output of the in the required format using specific command.	**Unit - II Computer aided drawing** 2.1 Fundamentals : various drafting software for civil engineering applications. System requirement for drawing software. Advantages of computer aided drawing over traditional method of drawing. 2.2 Initial setting required to start new drawing. 2.3 Draw commands: Line, poly line, construction line, rectangle, polygon, circle, ellipse, hatch, boundary, text, arc, point, make block. 2.4 Modify commands: Erase, copy, mirror, offset, trim, move, extend, rotate, array, lengthen, scale, chamfer, fillet, explode, stretch. 2.5 Compute area of the given drawing 2.6 Changing properties of entity: line type, color, scale, font- size, color, style. 2.7 Layer command: Create layers for given components of given drawing. 2.8 Dimension toolbar: Quick dimension, linear dimension, and continuous dimension; align dimension, angular dimensions, dimension style. 2.9 Use of plot/print command for the output of given drawing.	Video Demonstrations Presentations Hands-on Model Demonstration Lecture Using Chalk-Board
3	TLO 3.1 To prepare Submission Drawing of load bearing and Framed structure in accordance with the provisions of governing authority in a given area. TLO 3.2 Prepare working drawing of the given Load bearing and Framed structure TLO 3.3 Prepare foundation plan of the given Load bearing and Framed structure. TLO 3.4 Prepare structural drawings of given RCC Components of the building structure.	**Unit - III Planning of Buildings** 3.1 Data drawing (for Load bearing and framed structure): Developed plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement. Planning of staircase- Rise and Tread for residential building. 3.2 Working drawing: Developed plan, elevation, section passing through staircase or Sanitary Block. 3.3 Foundation plan of Load bearing and Framed structure. 3.4 Details of RCC Components: Footing, column, Beam, Chajjas, Lintel, Staircase and slab.	Video Demonstrations Demonstration Model Demonstration Site/Industry Visit Lecture Using Chalk-Board
4	TLO 4.1 Explain the principles of perspective drawings in the given situation TLO 4.2 Prepare perspective drawing of the given object using Two-point perspective method	**Unit - IV Perspective Drawing** 4.1 Definition, Types of perspective, terms and principles used in perspective drawing 4.2 Two Point Perspective of objects- steps, monuments, pedestals.	Video Demonstrations Hands-on Lecture Using Chalk-Board Model Demonstration

BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Justify the need of isometric drawing in civil engineering TLO 5.2 Prepare 3: dimensional drawing using the relevant 3 Dimensional Modify Commands.	**Unit - V Introduction to 3-Dimensional drawings** 5.1 Isometric drawing: meaning and necessity, use of isometric snap, isometric axes, isocircle, isotext 5.2 3-Dimensional drawing: Use of, Extrude, Press pull, Union, Subtraction command for preparing drawing of components-Beam, Columns etc.	Video Demonstrations Hands-on Lecture Using Chalk-Board Demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Represent the given door/window section using their standard signs and symbols.	1	* Draw various types of graphical symbols for materials, doors and windows as per IS 962:1989 **(Sketch book)**	2	CO1
LLO 2.1 Use the symbols to different water supply and Sanitary units of the building in the drawing	2	Draw various types of graphical symbols for sanitary, water supply as per IS 962:1989 **(Sketch book)**.	2	CO1
LLO 3.1 Use the symbols to different Electrical units of the building in the drawing.	3	Draw various types of graphical symbols for electrical installations and write abbreviations as per IS 962:1989 **(Sketch book)**	2	CO1
LLO 4.1 Illustrate different specifications of the given drawings.	4	Write summary of observations of all technical details from the given drawing (One/Two BHK) obtained from the professional architect or civil engineer **(Sketch book)**	2	CO1
LLO 5.1 Identify the different units of the building and prepare the plan as per the actual measurements.	5	*Measure the units of existing building (Load Bearing / Frame structure) & Draw line plan of measured existing building-(Part - I) **(Sketch book)**.	2	CO1
LLO 6.1 Identify the different units of the building and prepare the plan as per the actual measurements.	6	* Measure the units of existing building (Load Bearing / Frame structure) & Draw line plan of measured existing building-(Part -II) **(Sketch book) .**	2	CO1
LLO 7.1 Prepare Line Plans of the Residential building as per the requirement.	7	* Draw line plan to suitable scale (Minimum 1BHK, staircase, WC and Bathroom) for Residential Bungalows. (Minimum three) **(Sketch book)**	2	CO1
LLO 8.1 Prepare Line Plans of the Public building as per the requirement.	8	Draw line plans to suitable scale for Public Buildings - Primary Health Centre **(Sketch book)**	2	CO1
LLO 9.1 Prepare Line Plans of the Public building as per the requirement.	9	Draw line plans to suitable scale for Public Buildings – Hostel, Library. **(Sketch book)**	2	CO1
LLO 10.1 Prepare Line Plans of the Public building as per the requirement.	10	*Draw line plans on sketch book to suitable scale for Public Buildings- Bank, Post Office - **(Sketch book)**	2	CO1

BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Prepare Developed Plan of the residential building as per the requirement.	11	Draw the Developed plan and Elevation for a Framed Structure (One/Two BHK)-Part I **(Sketch book)**	2	CO3
LLO 12.1 Prepare Section of the residential building as per the requirement.	12	Draw the Section through WC, Bath or Staircase for Plan in Practical No.11 for a Framed Structure (One/Two BHK) - Part II **(Sketch book)**	2	CO3
LLO 13.1 Prepare Site Plan and area statement of the residential building as per the requirement.	13	Draw the Site plan including area statement, schedule of opening and construction notes for a Framed Structure (One/Two BHK) - for Plan in Practical No.11 Part III **(Sketch book)**	2	CO3
LLO 14.1 Prepare Perspective view of the given object.	14	*Draw two-point perspective drawing of small objects - steps, monuments, pedestals (anyone) with suitable scale **(Sketch book)**	2	CO4
LLO 15.1 Prepare Line Plans of the Residential building as per the requirement.	15	Prepare Line plan of Residential Building with staircase (minimum two) using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 16.1 Prepare Line Plans of the Public building as per the requirement.	16	Prepare Line plan of Public Building with staircase (minimum Two) with using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 17.1 Prepare Plan and sectional elevation of the Staircase as per the requirement.	17	*Draw plan and Sectional Elevation of dog-legged staircase using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 18.1 Prepare Developed Plan of the load bearing structure as per the requirement.	18	*Draw submission drawing to suitable scale of a single storey load bearing residential building (2BHK) with flat Roof and staircase showing Developed plan and elevation using CAD Software.-Part I **(A-2 Size Half Imperial Sheet)**	2	CO3
LLO 19.1 Prepare Sectional elevation of the load bearing structure as per the requirement.	19	*Draw submission drawing to Suitable scale of a single Storey load bearing residential building (2BHK) with flat Roof and staircase showing - Section passing through Stair or W.C. and Bath using CAD Software - for Plan in Practical No.18 -Part II **(A-2 Size Half Imperial Sheet)**	2	CO3
LLO 20.1 Prepare Foundation Plan of the load bearing structure as per the requirement.	20	*Draw submission drawing to the suitable scale of a single Storey load bearing residential building (2BHK) with flat Roof and staircase showing - a) Foundation plan and schedule of openings. b) Site plan with suitable scale, area statement, construction notes for Plan in Practical No.18- using CAD Software -Part III- using CAD Software**.** **(A-2 Size Half Imperial Sheet)**	2	CO3
LLO 21.1 Prepare Developed Plan of the Framed structure as per the requirement.	21	*Draw submission drawing, to the suitable scale of (G+1) Framed Structure Residential Building (2BHK) with Flat Roof and staircase showing: a) Developed plan b) Elevation - **Part I Using** CAD Software **(A-2 Size Half Imperial Sheet)**	2	CO3
LLO 22.1 Prepare Sectional elevation of the framed structure as per the requirement.	22	*Draw submission drawing, to the suitable scale of (G+1) Framed Structure Residential Building (2BHK) with Flat Roof and staircase showing. - Section passing through Stair, W.C. and Bath- For plan in Practical No.21 - Part II-using CAD Software **(A-2 Size Half Imperial Sheet)**	2	CO3

BUILDING PLANNING & DRAWING WITH CAD **Course Code : 313009**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 23.1 Prepare site plan and area statement of the framed structure as per the requirement.	23	*Draw submission drawing, to the suitable scale, of (G+1) Framed Structure Residential Building (2BHK) with Flat Roof and staircase showing - a) Site plan and area statement b) Schedule of openings and construction notes - For plan in Practical No.21 - Part III using CAD Software **(A-2 Size Half Imperial Sheet)**	2	CO3
LLO 24.1 Prepare working drawing the framed structure as per the requirement.	24	Draw Foundation with suitable scale for Practical No.21 using CAD Software **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 25.1 Prepare Sectional elevation and plan of footing for framed structure as per the requirement.	25	Draw Detailed enlarge section of RCC column and footing with suitable scale using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 26.1 Prepare Sectional elevation and plan of RCC Beam, Lintel Beam and Chajja of framed structure as per the requirement.	26	*Draw Detailed enlarge section of RCC Beam, Lintel and Chajja with suitable scale using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 27.1 Prepare Sectional elevation and plan of Stair case as per the requirement.	27	Draw Detailed enlarge section of RCC staircase with suitable scale using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO2
LLO 28.1 Prepare Isometric drawings of given object.	28	*Draw isometric drawing of simple objects –Straight Lines and edges (minimum 02 objects) using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO5
LLO 29.1 Prepare Isometric drawings of given object.	29	Draw isometric drawing of simple objects-Curved Edges (minimum 02 objects) using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO5
LLO 30.1 Prepare 3-D view of given object.	30	*Draw 3-D view of simple object. (any one) - using CAD Software. **(A-2 Size Half Imperial Sheet)**	2	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Collect and study building Bye laws, rules and regulation for planning any two competent authority such as Gram-Panchayat/Municipal Corporation/Metro Cities/Town Planning Department.
- Prepare report on Provisions given in National Building Code 2005
- Prepare list of the documents required for obtaining permission for construction of residential building/apartment from competent authority and write report.
- Prepare a report on IS-962:1989 - Code of practice for architectural and building drawings
- Prepare Developed Plan and Elevation for a any one Public Building using CAD Software.

Self Learning

- List any five software's used for building planning and drawing and prepare one developed plan using any one Free opensource software.

- Prepare a model of a simple building using cardboard showing different components with suitable color.
- Prepare line plan as per given requirement Using CAD Software. (Any THREE -- other than mentioned in curriculum)
- Free Online Courses on Auto CAD by NPTEL /Coursera/IGNOU/SWAYAM

Assignment

- State and explain the classification of residential buildings with respect to Planning such as Row house/Apartments/detached /Semi-detached Buildings
- Explain the Role of Architect, Structural Engineer and Supervisor in Planning of Building.
- Prepare a report on BUILDING PLAN MANAGEMENT SYSTEM -By Urban Development Department Government of Maharashtra.
- Prepare a report on Building Plan Approval Process as per NBC -2005

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer with specification as 8GB RAM,Graphics Card 4 GB, HDD/SSD 500GB, LCD Monitor with relevant CAD software. (with latest configuration)	All
2	Printer preferably for the output of A-3 size, paper	All
3	LCD projector.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Principles of Planning	CO1	6	0	0	0	0
2	II	Computer aided drawing	CO2	4	0	0	0	0
3	III	Planning of Buildings	CO3	12	0	0	0	0
4	IV	Perspective Drawing	CO4	4	0	0	0	0
5	V	Introduction to 3-Dimensional drawings	CO5	4	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work, Assignment, Microproject (60% Weightage to process and 40% weightage to product)

Summative Assessment (Assessment of Learning)

- Practical Exam, Oral Exam

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	02	01	02	01	02		02			
CO2	02	02	02	03	02	01	02			
CO3	02	02	02	02	02		02			
CO4	02	01	02	02	02		02			
CO5	02	01	01	03	02		01			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Shah. M.G., Kale C.M., Patki S.Y.	Building Drawing	Mcgraw Hill Publishing company Ltd. New Delhi 2002 ISBN: 9780074638767
2	Dr. Swamy Kumara N; Rao Kameshwara A .	Building Planning and Drawing	Charotar Publication, ANAND ISBN : 978-93-85039-12-6 (Ed.2015)
3	Mantri Sandip	A to Z Building Construction	Satya Prakashan; 2nd edition (2015), New Delhi, ISBN: 978-8176849692
4	Nighat Yasmin Ph.D.	Introduction to AutoCAD 2024 for Civil Engineering Applications	SDC Publications, ISBN: 978-1-63057-607-3
5	Malik R.S., Meo G.S.	Civil Engineering Drawing	Computech Publication Ltd New Asian Publishers, 2009, New Delhi ISBN:978-8173180026

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?app=desktop&v=E6TE9u1XgAg	2D Commands - NITTTR Chandigadh-NCTEL
2	https://www.youtube.com/watch?v=rX6XfCMRYU0	Demonstration video 2-Point Perspective View-Basics.
3	https://www.youtube.com/watch?app=desktop&v=N4FUbpGAWNA	3D Commands in Autocad - NITTTR Chandigadh -- NCTEL

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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CONSTRUCTION MANAGEMENT **Course Code : 313010**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: CONSTRUCTION MANAGEMENT**
Course Code	**: 313010**

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

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

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313010	CONSTRUCTION MANAGEMENT	CMA	DSC	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50

CONSTRUCTION MANAGEMENT **Course Code : 313010**

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the term, “Project Life Cycle” with its importance. TLO 1.2 Identify the characteristics of the given project with relevant constraints. TLO 1.3 Select the project from the available options based on feasibility analysis. TLO 1.4 Justify the importance of project management frameworks and standards. TLO 1.5 Select the relevant type of equipment for the given type of activity of project.	**Unit - I Project Initiation and its feasibility** 1.1 Project: Basic Definitions, management functions, ethics, project life cycle- Project Initiation, Project Planning, Project Executing, Project Monitoring and Controlling, Project Closing. 1.2 Project Characteristics and Constraints- Scope, time, cost, Quality; Stakeholder. 1.3 Project Feasibility Analysis- Market analysis, Financial analysis- Net Present Value(NPV), Payback Period, Examine the business problem/opportunity, Identify the requirements, undertake a feasibility study, Rank the feasibility results- Define the criteria, give ranking scores, Identify the feasibility outcome. 1.4 Project Management Frameworks and Standards, Project Management consultant (PMC)- roles & responsibilities. 1.5 Equipment used in executing the Civil Engineering projects- •Earth moving equipment (Tractor, Bulldozer, Scrapers, Excavators), • Hauling Equipment (Drum trucks, Front end loader, Conveyor belt), • Concreting Equipment (RMC mixer, Concrete pump), • Hoisting Equipment (Lifting & lowering equipments, Cranes).	Lecture Using Chalk-Board Presentations Site/Industry Visit

CONSTRUCTION MANAGEMENT **Course Code : 313010**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify the broad activities involved in given construction project. TLO 2.2 Apply the relevant technique of analysis to get the required information about the given project. TLO 2.3 Explain the process of developing the critical path line in solving the given problem.	**Unit - II Project Management and Scheduling** 2.1 Broad activities in construction work – Earthwork, Foundation, RCC Work, Brick work, Scaffolding, Plastering, Painting etc & duration required for complete the activity 2.2 Methods of Scheduling-Gantt Chart, Bar chart, Development of Bar charts and Gantt chart, Merits & limitations of Bar chart & Gantt chart. 2.3 Concept of CPM & PERT: Introduction to Critical path method (CPM), Program evaluation & review techniques (PERT), Network Diagramming of Projects Activity-on-arrow (AOA) Diagrams- Concept of Activity and Event, Time-Analysis of Networks- Forward Pass, Backward Pass, Probabilistic Durations- Optimistic Time, Pessimistic Time, Most Likely Time, Project Scheduling- ES and LS Schedules as Limits, Resource Scheduling, Time/Cost Trade-off	Lecture Using Chalk-Board Video Demonstrations Hands-on Presentations
3	TLO 3.1 Apply the relevant material management techniques in the given construction project. TLO 3.2 Apply the material management technique for rebar in the given construction project..	**Unit - III Material Management** 3.1 Material Management-Introduction, Inventory and inventory control, EOQ (Economic order of quantity), ABC technique, V-E-D analysis, Just in Time Strategy (JIT), Store management & various records related to store management 3.2 Rebar Management: Wastage of steel on site, Preventive measures to avoid the wastage of steel. Rebar, Importance of rebar, Fabrication and transportation of Rebar. Understanding rebar drawings.	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit
4	TLO 4.1 Explain the remedial measures with preventative strategies for the relevant identified cause of accidents on construction sites. TLO 4.2 Follow the relevant legal provisions related to labor laws in project execution.	**Unit - IV Safety and labour laws in construction** 4.1 Importance of Safety in construction work, causes of accidents on construction site & remedial measures, precautions to avoid accidents at site, safety policies. 4.2 Introduction to Labour laws related to construction-Workman Compensation Act, Minimum Wages Act, The Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act, Janshree Vima Yojna	Lecture Using Chalk-Board Video Demonstrations Presentations Site/Industry Visit

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

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

CONSTRUCTION MANAGEMENT **Course Code : 313010**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Select the relevant resources required for plastering or flooring for given construction project/data	4	Draw resource allocation plan for plastering or painting or flooring activity on site	2	CO1
LLO 5.1 Select different equipments used to carry out the construction of building	5	Write a brief report of site inspection with special reference to construction equipments used in the project with relevant photographs, video etc	2	CO1
LLO 6.1 Apply the concept of bar chart/Gantt chart to get the required information about the given project.	6	Draw the bar chart / Gantt chart for the activities of given construction project by using MS Excel/MS Project	2	CO2
LLO 7.1 Apply the concept of network diagram to get the required information about the given project.	7	Forecast the time duration required for various activities of the given construction project to represent them through a network diagram	2	CO2
LLO 8.1 Determine/Find the duration of the project and the sequence of critical activities.	8	*Solve the numerical on CPM for finding duration of project and Critical path of the any one problem for the given data	2	CO2
LLO 9.1 Apply the concept of PERT technique to get the required information about the given project.	9	*Solve the numerical on PERT to represent the sequence of activities and critical path of the any one problem for the given data.	2	CO2
LLO 10.1 Determine the Economic Order Quantity (EOQ) based on the given data	10	*Determination of EOQ (Economic order quantity) based on the given data. (Solve one Numerical)	2	CO3
LLO 11.1 Identify the most important product in given construction project/data	11	*Carry out the ABC analysis for the given problem/data (Solve one Numerical)	2	CO3
LLO 12.1 Apply the principles of management for rebar procurement on the given site.	12	Develop rebar procurement plan for the given construction site. (Manually or by using any open-source software)	2	CO3
LLO 13.1 Select the causes and remedial measures for given construction project/data	13	*Prepare a report on minimum five expected causes of accidents on construction sites with their remedial measures. (Visit any one Industrial/Residential/Public construction building)	2	CO4
LLO 14.1 Select the action plan measures for given construction project/data	14	*Prepare a brief report of the observation made on site with respect to safety on site (Visit any one Industrial/Residential/Public construction building)	2	CO4
LLO 15.1 Select various safety devices used at given construction site	15	Prepare the charts/report on various safety devices used at given construction site (Visit any one Industrial/Residential/Public construction building)	2	CO4

Note : Out of above suggestive LLOs -

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

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

Micro project

- Prepare a report on different forms of inventory storage along with your interpretation.
- Collect the information about latest safety measures adopted at construction project.

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

Assignment

- • Prepare a brief report on overview of Construction Professional Practice in India
- Solve the numerical on bar chart, CPM and cost optimization for the given data.
- Collect and interpret various store forms from PWD, WRD, MJP.
- Download the labour laws documents from internet and write a brief summary on it.
- Learn material management module from free open ware website.
- Visit to a Site to study the construction technique and use of major construction equipment.
- Student should watch any 3 learning website link given in XIII learning websites & portal and prepare a brief report on it.
- Prepare a brief report on role of construction industry in national development.
- Compile minimum 10 safety slogans displayed at various sites with sources and write a brief summary on it.
- Prepare project cost analysis for small construction project.
- Collect & interpret bar chart/CPM network for existing construction project.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Free Open ware software-1. Just-In-Time (JIT), 2. System Application & Product in data processing (SAP), 3. Microsoft Project (MSP)4. Microsoft Excel (MS Excel)5. Primavera6. Enterprise Resource Planning (ERP)	2,3

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Project Initiation and its feasibility	CO1	6	0	0	0	0
2	II	Project Management and Scheduling	CO2	5	0	0	0	0
3	III	Material Management	CO3	2	0	0	0	0
4	IV	Safety and labour laws in construction	CO4	2	0	0	0	0

CONSTRUCTION MANAGEMENT **Course Code : 313010**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
Grand Total				15	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

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

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/105/103/105103206/	Construction Method and Equipment Management
2	https://www.youtube.com/watch?v=Cx7i2wXB0kA&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=16	Project Scheduling

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CONSTRUCTION MANAGEMENT **Course Code : 313010**

Sr.No	Link / Portal	Description
3	https://www.youtube.com/watch?v=j6VIllXT0Vs&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=22	Accidents in Construction Industry
4	https://www.youtube.com/watch?v=EVsi1QamfU0&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=26	Safety Organization and Safety Officer
5	https://www.youtube.com/watch?v=QoXvRBrFWyI&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=25	Implications of Construction Accidents
6	https://archive.nptel.ac.in/courses/105/104/105104161/	Introduction to planning and scheduling, resource levelling and allocation,crashing of networks
7	http://www.cidc.in/	Construction Industry Development Council (CIDC)
8	https://onlinecourses.nptel.ac.in/noc22_ce39/preview	Safety in Construction Industry
9	https://www.youtube.com/watch?v=Tm2HhqMu5Jg	PERT and CPM
10	https://www.youtube.com/watch?v=GAGoqqZSPh4&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=3	Overview of steps in execution of a project
11	https://www.youtube.com/watch?v=kuCHsNXeNMc&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=5	Resource Management in Construction Projects
12	https://www.youtube.com/watch?v=Bh_LYZh3KH4&list=PLWnoy5z_3BObBvFtBlowxM05D-q0VAWEs&index=21	Introduction to construction safety

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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STRENGTH OF MATERIALS **Course Code : 313308**

Programme Name/s	**: Automobile Engineering./ Agricultural Engineering/ Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Production Engineering/**
Programme Code	**: AE/ AL/ CE/ CR/ CS/ LE/ ME/ PG**
Semester	**: Third**
Course Title	**: STRENGTH OF MATERIALS**
Course Code	**: 313308**

I. RATIONALE

All civil & mechanical engineering components are subjected to different types of loads and behave in a specific way. Students can able to understand & analyze various types of loads, stresses & strains with regards to the structural behavior of components and materials. This course is a prerequisite for understanding elastic behavior of different engineering materials, structural analysis, machine design, principles and the strengths of various structural elements used in civil & mechanical industries.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Analyze the stresses & strains in the given structural elements using relevant methods.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Calculate the M.I. of the given object using relevant formulae & methods.
- CO2 - Analyze the structural behavior of the given structural components under various loading conditions.
- CO3 - Draw SFD and BMD for the given structural element under given loading conditions.
- CO4 - Determine the bending and shear stresses in beams under different loading conditions
- CO5 - Analyze the direct & bending stresses in the structural members under eccentric loading conditions.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
313308	STRENGTH OF MATERIALS	SOM	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125	

STRENGTH OF MATERIALS **Course Code : 313308**

Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Calculate Centroid, Moment of Inertia of Plane lamina and radius of gyration of a given lamina. TLO 1.2 Explain Parallel and Perpendicular axes theorems. TLO 1.3 Calculate Moment of inertia of standard solid shapes and hollow shapes. TLO 1.4 Calculate Moment of inertia of composite plane figures such as I, C, T & L sections. TLO 1.5 Understand Moment of inertia for built-up section.	**Unit - I Moment of Inertia** 1.1 Concept of Moment of Inertia, M.I. of plane lamina and radius of gyration of a given lamina. 1.2 Parallel and perpendicular axes theorems (without derivation). 1.3 M.I. of standard basic figures like square, rectangle, triangle, circle, semi-circle, quarter-circle and Hollow Rectangular & Circular sections. (without derivation). 1.4 M.I. of Composite plane figures such as symmetrical and unsymmetrical I-section, channel section, T-section, angle section. Numerical on composite figure consisting of maximum 03 standard shapes. 1.5 Introduction to M.I. for built-up sections. (No numerical). (IKS* Concept of Centre of Gravity & M.I.used in ancient constructions like temples, forts etc.)	Chalk-Board Hands-on Collaborative learning Video Demonstrations Presentations

STRENGTH OF MATERIALS **Course Code : 313308**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Understand concept of stresses and strains in deformable bodies. TLO 2.2 Understand Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio. TLO 2.3 Determine modulus of elasticity, modulus of rigidity and bulk modulus for given material. TLO 2.4 Articulate practical significance of stress- strain curve for given material under given loading conditions for their relevant use. TLO 2.5 Concept of single shear, double shear & punching shear. TLO 2.6 Compute the total deformation for given homogeneous (compound) sections under axial load. TLO 2.7 Determine the stresses in each material for given composite section. TLO 2.8 Compute strain along x, y and z-direction for a given bi-axial or tri-axial stress system. TLO 2.9 Determine volumetric strain & change in volume for given cube or cuboid.	**Unit - II Simple Stresses, Strains & Elastic Constants** 2.1 Concept of elastic body ,definition of stress, strain, Type of stresses & strains. 2.2 Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio. 2.3 Young's Modulus, Shear Modulus, Bulk Modulus & Relation between these three moduli. 2.4 Standard stress strain curve for mild steel bar and Tor steel bar under tension test, Yield stress, proof stress, ultimate stress, breaking stress, and working stress, strain at various critical points, percentage elongation and Factor of safety. 2.5 Shear stress and shear strain, Single shear, Double shear, Punching shear. 2.6 Deformation of body subjected to axial force for uniformed and stepped sections .Deformation of uniform body subjected to forces at its intermediate sections. 2.7 Concept of composite section, stresses induced and load shared by each material under axial loading only.(No numerical on stepped sections). 2.8 Uni-axial, Bi-axial and Tri-axial stress systems. 2.9 Strain in each direction, volumetric strain, change in volume.	- Chalk-Board - Hands-on Collaborative learning - Video - Demonstrations - Presentations
3	TLO 3.1 Enlist Types of Supports & Types of Beams TLO 3.2 Enlist types of loads acting on a beam. TLO 3.3 Understand the relation between SF, BM and rate of loading. TLO 3.4 Draw SFD and BMD for Simply supported beams ,Cantilever beams & overhanging beams. TLO 3.5 Locate point of maximum BM and point of contra-flexure.	**Unit - III Shear Force & Bending Moment** 3.1 Types of Supports: Simple, Hinge, Roller & Fixed and Beams: Cantilever, Simply supported, Roller, Hinge & overhanging beams. 3.2 Types of loads: Concentrated or Point load, Inclined point load & Uniformly Distributed load. 3.3 Meaning of SF and BM, Relation between them, Sign conventions. 3.4 SFD & BMD for Simply Supported, Cantilever and overhanging beams subjected to Vertical point load & UDL only. 3.5 Drawing SFD and BMD, Location of Point of Contra-Shear, maximum BM, Location of Point of Contra-flexure.	Chalk-Board Hands-on Collaborative learning Video Demonstrations Presentations

STRENGTH OF MATERIALS **Course Code : 313308**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Understand concept of pure bending , Neutral Axis and radius of gyration of a given lamina and section modulus. TLO 4.2 Determine Moment of Resistance (M.R.) & section modulus (Z) using Flexural Formula. TLO 4.3 Determine the Bending stresses at given location in simply supported & cantilever beams subjected to standard loading cases (Point load & UDL only). TLO 4.4 Compute & draw maximum and average shear stress for rectangular and circular section. TLO 4.5 Draw shear stress distribution diagram for given section across its depth. TLO 4.6 Determine shear stresses in hollow rectangular section.	**Unit - IV Bending and Shear Stresses in beams** 4.1 Theory of pure bending, assumptions in pure bending, Concept of Neutral Axis and section modulus. 4.2 Flexural Equation (without derivation) with meaning of each term used in equation, bending stresses and their nature, bending stress distribution diagram. 4.3 Bending stress variation diagram across depth of given cross section for cantilever and simply supported beams for symmetrical sections only. 4.4 Shear stress equation (without derivation), meaning of each term used in equation, relation between maximum and average shear stress for square, rectangular and circular section (numerical), shear stress distribution diagram. 4.5 Shear stress distribution diagram for square, rectangular, circle, hollow square, hollow rectangular, hollow circle, T- section & symmetrical I- section only. (no numericals) 4.6 Use of shear stress equation for determination of shear stresses in hollow rectangular section.	Chalk-Board Hands-on Collaborative Learning Demonstration Video Presentations
5	TLO 5.1 Explain effect of direct and eccentric loads on columns. TLO 5.2 Draw resultant stress distribution diagram for a compression member subjected to eccentric load about one of its principal axis. TLO 5.3 Write No tension condition for columns, Core of the section for rectangular & circular column. TLO 5.4 Identify the terms radius of gyration, slenderness ratio & effective length for given column with different end conditions. TLO 5.5 Understand the concept of buckling load in columns using Euler's Formula & Rankine's Formula.	**Unit - V Direct and Bending Stresses** 5.1 Introduction to direct and eccentric loads, Eccentricity about one principal axis, nature of stresses. 5.2 Maximum and minimum stresses, resultant stress distribution diagram. Condition for 'No tension' condition(Problems on Column subjected to Eccentric load about one axis only.) 5.3 Limit of eccentricity, core of section for circular cross sections, middle third rule for rectangular section. 5.4 Introduction to compression members, effective length, radius of gyration, slenderness ratio, type of end conditions for columns. 5.5 Buckling (or Crippling) load for columns by Euler's Formula & Rankine's Formula with meaning of each term in it.(No numericals.)	Chalk-Board Collaborative learning Presentations Demonstration Videos

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify different components of UTM .	1	*Conduct sample compressive and tensile tests on metal using Universal Testing Machine along with introduction to machine & other tests to be conducted on UTM.	2	CO2
LLO 2.1 Perform Tension test on mild steel as per IS:432(1) .	2	*Tension test on mild steel as per IS:432(1) .	2	CO2
LLO 3.1 Perform tension test on Tor steel as per IS:1608, IS:1139 .	3	Tension test on Tor steel as per IS:1608, IS:1139 .	2	CO2

STRENGTH OF MATERIALS **Course Code : 313308**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Conduct compression test on sample test piece using Compression Testing Machine .	4	*Compression test on any two metals like Mild Steel, Brass, Al etc. using Compression Testing Machine .	2	CO2
LLO 5.1 Conduct Izod Impact test on given metals as per IS:1598 .	5	*Izod Impact test on any two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1598 .	2	CO2
LLO 6.1 Conduct Charpy Impact test on given metals as per IS:1598 .	6	Charpy Impact test on two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1757 .	2	CO2
LLO 7.1 Determine Compressive strength of dry and wet bricks .	7	Compressive strength of dry and wet bricks as per IS:3495 (part I), IS:1077 .	2	CO2
LLO 8.1 Perform Single Shear and double shear test on given metals as per IS:5242 .	8	*Single Shear and double shear test on any two metals like Mild steel/ brass/ Al / copper / cast iron etc. as per IS:5242 .	2	CO2 CO4
LLO 9.1 Conduct Compression test on timber section along the grain and across the grain .	9	Compression test on timber section along the grain and across the grain as per IS:2408 .	2	CO1 CO2
LLO 10.1 Plot Shear force and Bending Moment diagrams of beams subjected to different types of loads.	10	*Shear force and Bending Moment diagrams of cantilever, simply supported and overhanging beams for different types of loading . (02 problems on each type of beam) .	4	CO3
LLO 11.1 Conduct Flexural test on timber beam on rectangular section.	11	*Flexural test on timber beam on rectangular section in both orientations as per IS:1708, IS:2408 .	2	CO1 CO4
LLO 12.1 Prepare PPT on Strain Energy. LLO 12.2 Prepare PPT on Thermal Stresses & Thermal Strains.	12	a) Prepare PPT of minimum 05 slides on the concept of Strain Energy & instantaneous stress induced in a material due to gradual, Sudden & impact load. b) Prepare PPT of minimum 04 slides on Thermal Stresses & Thermal Strains.	2	CO2
LLO 13.1 Conduct Flexure test on floor tiles/roofing tiles.	13	Flexure test on floor tiles IS:1237, IS:13630 or roofing tiles as per IS:654, IS:2690 .	2	CO4
LLO 14.1 Determine hardness no. for given metal using Rockwell Hardness Tester.	14	Rockwell Hardness Test on any two Metals like Mild Steel, Brass Copper, Aluminum etc.	2	CO2
LLO 15.1 Determine hardness no for given metals using Brinell Hardness Tester.	15	Brinell hardens test on any two metals like Mild Steel, Brass Copper, Aluminum etc.	2	CO2

Note : Out of above suggestive LLOs -

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

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

Micro project

- Collect the information of Indian Knowledge System (IKS) given in different units.
- Prepare charts of maximum bending moment and shear force values in standard beams.
- Two Numericals on Chimneys (of rectangular and circular cross section) subjected to wind pressure & also draw stress distribution diagram at base of it.

STRENGTH OF MATERIALS **Course Code : 313308**

- Draw & identify difference between Bending stress distribution & Shear stress distribution diagrams for square, rectangular, circle, hollow square, rectangular, circle, T- section, & symmetrical I- section.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Extensometer with least count 0.01mm, maximum extension 25 mm with dial gauge/ digital display suitable for various gauge length.	1,2,3
2	Accessories: Vernier caliper, meter scale, weighing balance, weights, punch, file, hammer, screw driver, pliers, etc.	1,2,3,4,5,6,7,8,9,11,13
3	Universal Testing Machine of capacity 1000kN, 600 kN / 400 kN, analog type/digital type with all attachments and accessories.	1,2,3,8,11,13
4	Tile flexural testing machine confirming to IS:654, capacity 200 Kg with uniform loading rate of 45 to 55 Kg/minute provided with lead shots .	13
5	Brinell and Rockwell Hardness Test machine .	14,15
6	Compression Testing Machine of capacity 2000 kN / 1000 kN, analog / digital type with all attachments and accessories.	4,7,9
7	Izod/Charpy impact testing machine confirming to IS: 1757.	5,6
8	Hot Air Oven with thermostatic control having temp. range 100 to 105 degree celsius .	7

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Moment of Inertia	CO1	10	2	4	6	12
2	II	Simple Stresses, Strains & Elastic Constants	CO2	16	6	8	4	18
3	III	Shear Force & Bending Moment	CO3	14	2	4	10	16
4	IV	Bending and Shear Stresses in beams	CO4	10	2	4	6	12
5	V	Direct and Bending Stresses	CO5	10	2	4	6	12
Grand Total				**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered. • For formative assessment of laboratory learning 25 marks • Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

STRENGTH OF MATERIALS **Course Code : 313308**

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	2	2	1	--	2			
CO2	3	3	3	3	1	--	3			
CO3	3	3	2	1	1	--	2			
CO4	3	3	2	1	1	---	2			
CO5	3	3	2	1	1	--	2			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Khurmi R.S., Khurmi N.	A Textbook of Strength of Materials	S. Chand and Co. Ltd. New Delhi, 2019, ISBN 9789352833979
2	Ramamrutham S.	Strength of Materials	Dhanpat Rai and sons, New Delhi, 2015, ISBN 9788187433545
3	Punmia B. C., Ashok Kumar Jain , Arun Kumar Jain .	Mechanics of Materials	Laxmi Publications (p) Ltd. New Delhi, 2017, ISBN-13: 978-8131806463
4	Rattan S.S.	Strength of Materials	McGraw Hill Education; New Delhi 2017, ISBN-13: 978-9385965517
5	Rajput R. K .	A Textbook of Strength of Materials	S. Chand Publishing 9789352533695, 9352533690

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/DzyIEz3dKXQ?si=beGDRqJ1olZ70LUe	Concept of Stress and Strain .
2	https://youtu.be/RSlmDKHDMUY?si=FHCxXE1QSaa0FqBn	Standard stress-strain curve for mild steel bar and Tor steel bar .
3	https://www.youtube.com/watch?v=MFZ18Ed4HI8	Field Test on TMT .
4	https://www.youtube.com/watch?v=C-FEVzI8oe8	Concept of SFD and BMD .
5	https://www.youtube.com/watch?v=yvbA4mk36Kk	Practical examples of SFD and BMD.
6	https://www.youtube.com/watch?v=f2eGwNUopws	Concept & Numerical on Point of Contraflexure .
7	https://www.youtube.com/watch?v=f08Y39UiC-o	Bending Stresses & Shear Stresses in Beams .
8	https://skyciv.com/structural-software/beam-analysis-softwar e	Calculation & Drawing of SFD & BMD freeware Software .

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STRENGTH OF MATERIALS **Course Code : 313308**

Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

11-01-2025 09:12:22 AM

ADVANCED SURVEYING **Course Code : 313321**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: ADVANCED SURVEYING**
Course Code	**: 313321**

I. RATIONALE

The technology has brought the significant advancements in field of surveying. This will help civil engineers for accurate measurements of physical features of various construction projects and land with utmost accuracy, speed and easy operation of these surveying equipment's. The data obtained by various advanced surveying equipment's includes information of topography, grading, elevation, distances etc. Such data obtained helps civil engineers for future project planning and effective execution. The advanced surveying also helps in identifying potential risks associated with construction projects. This course will help students to acquire skills associated with surveying of land and buildings.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use the relevant instrument to undertake the survey of the given area.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use the Tacheometer to obtain relevant details of the terrain in given situation.
- CO2 - Set out a Simple Circular curve to finalize the alignment of the given element.
- CO3 - Prepare layout plans using relevant surveying instruments.
- CO4 - Locate the co-ordinates of a given stations using the relevant technology.
- CO5 - Interpret the images of given terrain using Photogrammetry Techniques.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313321	ADVANCED SURVEYING	ASU	SEC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

ADVANCED SURVEYING **Course Code : 313321**

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the principles of Tacheometric surveying. TLO 1.2 Use the tacheometer to determine Reduced level, horizontal and vertical distance in the given situation. TLO 1.3 Select the relevant method of Tacheometric surveying in the given situation. TLO 1.4 Calculate constants of a Tacheometer from the given data. TLO 1.5 Specify the Limitations of tacheometry with examples.	**Unit - I Tacheometric Surveying** 1.1 Principle of tacheometry, Use of Tacheometry 1.2 Tacheometer and its component parts, Analytic lens, Tacheometric formula for horizontal distance with telescope horizontal and staff vertical. 1.3 Methods of Tacheometry: Stadia and fixed hair method 1.4 Field method for determining constants of tacheometer 1.5 Limitations of tacheometry.	Video Demonstrations Presentations Collaborative learning Hands-on Model Demonstration Lecture Using Chalk-Board Demonstration
2	TLO 2.1 Classify the curves used in surveying to fix the alignment. TLO 2.2 Draw the labelled diagram of simple circular curve. TLO 2.3 Derive the relationship between Radius and Degree of curve TLO 2.4 Set a simple circular curve using the relevant method of curve setting in the given situation.	**Unit - II Curves setting** 2.1 Curve: Definition, Necessity of Curves, Types of curves used in roads and railway alignments. 2.2 Elements of simple circular curve, Designation of the curve by Radius and Degree of curve. 2.3 Radius and Degree of curve. 2.4 Setting out a simple circular curve by offsets from long chord and Rankine’s method of deflection angles.	Presentations Lecture Using Chalk-Board Collaborative learning Video Demonstrations Demonstration Model Demonstration Hands-on

ADVANCED SURVEYING **Course Code : 313321**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Use the EDM to measure the distance between two given stations. TLO 3.2 Use Electronic Digital Theodolite to measure the required angle. TLO 3.3 Explain the procedure to measure the angle between the given lines using Total Station instrument. TLO 3.4 Undertake the site layout operation for the given building structure using Total Station instrument.	**Unit - III Advanced Surveying Equipment's** 3.1 Electronic Distance Meter (EDM): Principle of Electronic Distance Meter (EDM), component parts and their Functions, use of EDM. 3.2 Electronic Digital Theodolite: Construction and Features of Electronic Digital Theodolite, procedure of angle measurement. 3.3 Total Station: Introduction, component parts with their functions, and Applications of Total Station, Temporary adjustments, sources of errors in Total Station, Measurements of Horizontal angles, vertical angles, distances and coordinates using Total Station. Traversing, Profile Survey and Contouring with Total Station. 3.4 Building Site layout using Total Station: Procedure.	Model Demonstration Video Demonstrations Hands-on Presentations Lecture Using Chalk-Board Collaborative learning Demonstration Site/Industry Visit
4	TLO 4.1 Propose the relevant system of remote sensing to be used for the given situation. TLO 4.2 Describe the procedure to find out the coordinates of the given station using GPS. TLO 4.3 Use the GIS technology to solve the given civil engineering problem.	**Unit - IV Remote sensing, GPS and GIS** 4.1 Remote Sensing : Definition, Electro-Magnetic Energy, Active and Passive system, Applications of remote sensing in Mining, land use / Land cover, mapping, disaster management and Environment. 4.2 Global Positioning System: Introduction, Construction and use of Global Positioning System (G.P.S.) 4.3 Geographic Information System (GIS): Overview, Component, Sources of errors, applications, Software's in GIS.	Presentations Video Demonstrations Collaborative learning Lecture Using Chalk-Board Demonstration Site/Industry Visit Case Study Hands-on
5	TLO 5.1 Suggest the relevant method of aerial surveying for the given situation. TLO 5.2 Classify the type of drones as per DGCA TLO 5.3 Explain the principles of photogrammetry TLO 5.4 Explain the type of Photogrammetry. TLO 5.5 Specify the Merits and Demerits of Photogrammetry surveying. TLO 5.6 Use the photogrammetry techniques to solve civil engineering problems.	**Unit - V Aerial Surveying and Photogrammetry** 5.1 Aerial surveying: Definition, principle, uses, methods 5.2 DGCA Classification of Drones, Silent features of Drone Rules, 2021 as per DGCA. 5.3 Definition of photogrammetry, Basic Principles of Photogrammetry. Types of Photogrammetry: Terrestrial and Aerial Photogrammetry 5.4 Types of Photographs, Terminology in aerial surveying. 5.5 Merits and Demerits of Photogrammetry surveying 5.6 Applications of Photogrammetry in civil engineering.	Case Study Video Demonstrations Demonstration Hands-on Collaborative learning Lecture Using Chalk-Board Presentations Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use theodolite as a Tacheometer to determine the Tacheometric Constant	1	*Determine the Tacheometric Constant	2	CO1

ADVANCED SURVEYING **Course Code : 313321**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Use theodolite as a Tacheometer to compute reduced levels and horizontal distances	2	*Determine reduced levels of given stations and horizontal distances by Tacheometric Method (Part I)	2	CO1
LLO 3.1 Use theodolite as a Tacheometer to compute reduced levels and horizontal distances	3	*Determine reduced levels of given stations and horizontal distances by Tacheometric Method (Part II)	2	CO1
LLO 4.1 Use the offsets from Long Chord Method to Set out a circular curve	4	*Setting out of a circular curve by offsets from Long Chord Method.	2	CO2
LLO 5.1 Apply the technique of Rankine's Method of Deflection Angles to Set out a circular curve	5	*Setting out a circular curve by Rankine's Method of Deflection Angles. **(Project)** (Part I). Plot the curve details on A1 size imperial drawing sheet.	2	CO2
LLO 6.1 Apply the technique of Rankine's Method of Deflection Angles to Set out a circular curve	6	*Setting out a circular curve by Rankine's Method of Deflection Angles. **(Project)** (Part II). Plot the curve details on A1 size imperial drawing sheet.	2	CO2
LLO 7.1 Use EDM to measure horizontal and vertical distance	7	*Determine horizontal and vertical distance by using EDM.	2	CO3
LLO 8.1 Use Electronic Digital Theodolite to determine Horizontal and vertical angles	8	*Determine Horizontal and vertical angles using Electronic Digital Theodolite	2	CO3
LLO 9.1 Set up the Total Station instrument.	9	Setting up the Total Station instrument on site for surveying.	2	CO3
LLO 10.1 Use Total station instrument to measure horizontal, vertical and slope distances	10	*Determine horizontal, vertical and slope distances using Total station equipment (Part I)	2	CO3
LLO 11.1 Use Total station instrument to measure horizontal, vertical and slope distances	11	*Determine horizontal, vertical and slope distances using Total station equipment. (Part II)	2	CO3
LLO 12.1 Use Total station instrument to measure the given horizontal and vertical angles	12	*Determine horizontal and vertical angles using Total Station. (Part I)	2	CO3
LLO 13.1 Use Total station instrument to measure the given horizontal and vertical angles	13	*Determine horizontal and vertical angles using Total Station. (Part II)	2	CO3
LLO 14.1 Use Total station to determine Reduce Levels	14	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part I)	2	CO3
LLO 15.1 Use Total station to determine Reduce Levels	15	*Determine the Reduced Levels of given stations (Minimum 10 station) (Part II)	2	CO3

ADVANCED SURVEYING **Course Code : 313321**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Use Total Station to stack out station points on ground.	16	Stack out (transferring the data on ground) using Total Station (Part I)	2	CO3
LLO 17.1 Use Total Station to stack out station points on ground.	17	Stack out (transferring the data on ground) using Total Station (Part II)	2	CO3
LLO 18.1 Use Total station instrument to measure Reduced Level for given road profile project	18	Road profile of 100m length using Total Station instrument (Part I)	2	CO3
LLO 19.1 Use Total station instrument to measure Reduced Level for given road profile project	19	Road profile of 100m length using Total Station instrument (Part II)	2	CO3
LLO 20.1 Use Total station instrument to prepare contour plans	20	Contouring using Total Station instruments for the area of size 50 X 50 m	2	CO3
LLO 21.1 Use Total Station to prepare Building site layout	21	*Prepare Building site layout by using Total Station **(Project)** (Part I). Plot the project details on A1 size imperial drawing sheet.	2	CO3
LLO 22.1 Use Total Station to prepare Building site layout	22	*Prepare Building site layout by using Total Station **(Project)** (Part II). Plot the project details on A1 size imperial drawing sheet.	2	CO3
LLO 23.1 Use Total station to carry out five-sided closed traverse Surveying Project	23	*Carry out 5-Sided closed traverse Surveying project by using Total Station.**(Project)** Part I). Plot the traverse details on A1 size imperial drawing sheet.	2	CO3
LLO 24.1 Use Total station to carry out five-sided closed traverse Surveying Project	24	*Carry out 5-Sided closed traverse Surveying project by using Total Station. **(Project)** Part II). Plot the traverse details on A1 size imperial drawing sheet.	2	CO3
LLO 25.1 Use GPS technology to locate the coordinates of a station.	25	*Locate the coordinates of a station with the help of GPS.	2	CO4
LLO 26.1 Develop the contour maps using photogrammetry images	26	Create the images of contouring map with given data (Photogrammetry images, etc) using the freeware/open source software (Part I)	2	CO5
LLO 27.1 Develop the contour maps using photogrammetry images	27	Create the images of contouring map with given data (Photogrammetry images, etc) using the freeware/open source software (Part II)	2	CO5
LLO 28.1 Develop the Road Profile plan using photogrammetry images	28	Create the images of Road Profile plan with given data (Photogrammetry images, etc) using the freeware/open source software (Part I)	2	CO5
LLO 29.1 Develop the Road Profile plan using photogrammetry images	29	Create the images of Road Profile plan with given data (Photogrammetry images, etc) using the freeware/open source software (Part II)	2	CO5
LLO 30.1 Use relevant software for preparation of contour maps using given image data	30	*Write a brief report on the visit to nearby surveying software laboratory for visualization of image creation of contouring map of given area using data collected by drone technology / Arrange Expert Lecture / Show study videos of Photogrammetry surveying.	2	CO5

ADVANCED SURVEYING **Course Code : 313321**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Note : Out of above suggestive LLOs -

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

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

Assignment

- Measure the height of the flag post in your institute using Theodolite as tacheometer.
- Measure the height of the slab bottom of second floor of your institute building using Theodolite as tacheometer.
- Set the alignment of proposed road using Theodolite as tacheometer.
- Use freeware or open source software for image processing using photogrammetry principles
- Plot the contours using Total station by direct method.
- Mark building layout using Total station.
- Measure distance between two distant(>500m) points using EDM
- Locate the coordinates of the campus using GPS
- Search and download the freeware/open source software and prepare a report stating the applications.

Micro project

- Carry out comparative study of following survey instruments of different make and brands: Total station/ EDM/GPS/Digital theodolite.
- Collect the relevant technical and commercial information of minimum five advanced survey instruments available in the market with specifications.
- Determine the RLs of the existing structures like lintels, chajja, slab, and beam using Tacheometer and Total station in a multistoried building and compare the results.
- Download specifications for Total Station/ EDM/GPS and make a chart.
- Set the profiles of curves at the changes in alignment of road in the premises of the institute (minimum two).
- Study the specifications of Mobile devices used for distance measurement.
- Collect the information on 360-degree laser
- Collect information of software required for mapping of images for photogrammetry.
- Collect the Information about Drone survey.
- Collect the information on Rover survey for land measurement

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Twenty Second Transit theodolite with accessories.	1,2,3,4,5,6

ADVANCED SURVEYING **Course Code : 313321**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
2	GPS instrument	25
3	Surveying Drone - About 1 to 1.5 Sq. Km. area can be easily captured by one PPK Survey grade Drone flying with an altitude of about 80 to 100m above average ground level)	27,26,28,29,30
4	Electronic Distance meter (+or- 2mm accuracy) with accessories.	7
5	Electronic Digital Theodolite with accessories.	8
6	Total Station (+ or - 2mm accuracy) instrument with accessories	9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Tacheometric Surveying	CO1	10	2	8	6	16
2	II	Curves setting	CO2	8	2	4	6	12
3	III	Advanced Surveying Equipment's	CO3	10	2	8	6	16
4	IV	Remote sensing, GPS and GIS	CO4	9	4	4	6	14
5	V	Aerial Surveying and Photogrammetry	CO5	8	4	4	4	12
Grand Total				**45**	**14**	**28**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Termwork, Assignment, Microproject (60% Weightage to process and 40% weitage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Practical Exam

XI. SUGGESTED COS - POS MATRIX FORM

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

ADVANCED SURVEYING **Course Code : 313321**

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kanetkar T. P.; Kulkarni S. V.	Surveying and Levelling volume I & II	Pune Vidyarthi Gruh Prakashan, Pune; ISBN:978-81-858-2511-3
2	Basak N. N.	Surveying and Levelling	McGraw Hill Education, New Delhi ISBN 93-3290-153-8
3	S. K. Duggal	Surveying I & II	McGraw Hill Education, New Delhi, ISBN: 978-00-701-5137-6
4	Punmia B.C, Ashok Kumar Jain, Arun Kumar	Surveying I & II	Laxmi Publications., New Delhi. ISBN: 8- 17-008853-4
5	Shivam Pandey	Basic Concept of Remote Sensing, GPS, and GIS	Sankalp Publication, Gaurav Path, Bilaspur Chhathisgarh-4955001 ISBN: 978-81-94-77801-1

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/content/storage2/courses/105107122/modules/module7/html/100.htm	Tacheometry Surveying
2	https://www.youtube.com/watch?v=7UhaCqea7IY	Curve Setting
3	https://archive.nptel.ac.in/content/storage2/courses/105107122/modules/module11/index.htm	Curve Setting
4	https://nptel.ac.in/courses/105104100	Lecture on Total Station
5	https://www.youtube.com/watch?v=bbs5AEPstl4	Total Station
6	https://www.youtube.com/watch?v=1KCqxx8r5Y4	Electronic Digital Theodolite
7	https://www.youtube.com/watch?v=QLgwwVdMaWU	Remote sensing GIS and GPS
8	https://archive.nptel.ac.in/courses/105/103/105103193/	Remote Sensing and GIS
9	https://onlinecourses.nptel.ac.in/noc22_ce84/preview	Remote Sensing and GIS
10	https://archive.nptel.ac.in/courses/105/104/105104101/	Aerial Surveying and Photogrammetry
11	https://nptel.ac.in/courses/105104100	Aerial Surveying and Photogrammetry

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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CONCRETE TECHNOLOGY **Course Code : 313322**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: CONCRETE TECHNOLOGY**
Course Code	**: 313322**

I. RATIONALE

Concrete is the most common construction material on earth and it directly determines the construction quality of the concrete structure and plays a very important role in the stability of the building structure. A diploma civil engineering students are required to develop the basic competency in dealing with concrete as a construction material ,so that they should have the basic knowledge of cement chemistry, concrete batching, placement, compaction and curing and testing of concrete. This course will be helpful for students to build their theoretical and practical knowledge in civil and structural engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Design the concrete mix as per the given specifications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Suggest relevant types of cement to be used in the given site conditions.
- CO2 - Classify the given aggregates based on its shape and size with the importance of their properties.
- CO3 - Prepare concrete of required specifications in the given situation.
- CO4 - Undertake the necessary procedures to maintain the quality of given type of concrete.
- CO5 - Suggest relevant type of admixtures to be used in the given situation.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313322	CONCRETE TECHNOLOGY	CTE	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 1 Hrs

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

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

Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the chemical constituents of the given type of cement TLO 1.2 Describe the relevant physical properties of the given type of cement in the given situation. TLO 1.3 Carry out the relevant test on the given sample of cement for the given purpose. TLO 1.4 Propose the relevant type of cement to be used in the given situation.	**Unit - I Cement** 1.1 Chemical Constituents of OPC (Ordinary Portland Cement) and their effects on properties of OPC, Bogue's compounds and their properties, hydration of cement. Physical properties of OPC: fineness, specific gravity, standard consistency, setting time, soundness, compressive strength 1.2 Different grades of OPC 33, 43, and 53 with its uses and specifications of physical properties as per relevant IS codes for OPC. 1.3 Testing of OPC: Field tests and laboratory tests-fineness test, standard consistency test, setting time test, soundness test, and compressive strength test, Storage of cement and effect of storage on properties of cement. 1.4 Field applications of different types of cements: Rapid hardening cement, Low heat cement, Portland pozzolana cement, sulphate resisting cement, blast furnace slag cement, High alumina cement, White cement.	Lecture Using Chalk-Board Hands-on Site/Industry Visit Collaborative learning Video Demonstrations Case Study
2	TLO 2.1 Identify the type of given aggregate samples based on source, shape and size. TLO 2.2 Explain the methodology to suggest suitability of given fine aggregate. TLO 2.3 Explain the methodology to suggest suitability of given coarse aggregate.	**Unit - II Aggregates** 2.1 Aggregates: Requirement of good aggregates, Classification according to source, size and shape. 2.2 Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking, fineness modulus and grading zone of sand by sieve analysis, silt content in sand and their specification as per IS 383, bulking of sand. Concept of crushed Sand. 2.3 Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness, specific gravity, bulk density, fineness modulus of coarse aggregate by sieve analysis, grading of coarse aggregates, crushing value, impact value and abrasion value of coarse aggregates with specification.	Lecture Using Chalk-Board Hands-on Video Demonstrations Site/Industry Visit Collaborative learning Demonstration

CONCRETE TECHNOLOGY **Course Code : 313322**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Justify use of different grades of concrete and their properties for given applications, TLO 3.2 Select w/c ratio for a given grade of concrete, with justification TLO 3.3 Interpret the given data obtained from test on given type of concrete sample. TLO 3.4 Describe the factors affecting overall durability of given type of concrete. TLO 3.5 Explain the given method of concrete mix design for the given situation. TLO 3.6 Describe the need of NDT for the given field situation	**Unit - III Concrete and its testing.** 3.1 Concrete: Necessity of supervision for concreting operation, different grades of concrete (ordinary Concrete, standard concrete and high strength concrete) as per provisions of IS 456. 3.2 Water cement ratio, Duff Abraham w/c law, significance of w/c ratio, selection of w/c ratio for different grades of concrete and different exposure conditions. 3.3 Properties of fresh concrete: Workability, Factors affecting workability of Concrete. Determination of workability of concrete by slump cone test and compaction factor test. Range values of workability requirement for different types of concrete works. Segregation, bleeding and preventive measures. 3.4 Properties of Hardened concrete: compressive strength, durability, impermeability and dimensional changes of concrete, creep and shrinkage. 3.5 Concrete Mix Design objectives, methods of mix design, study of mix design procedure by I.S. method as per I.S. 10262-(Only procedural steps) 3.6 Testing of concrete: Significance of testing, determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results. Non- destructive testing of concrete: Importance of NDT, methods of NDT(only List of methods)	Lecture Using Chalk-Board Video Demonstrations Hands-on Site/Industry Visit Collaborative learning Case Study
4	TLO 4.1 Explain the sequential operations of concreting in given situation. TLO 4.2 Explain the given type of form works and stripping time. TLO 4.3 Identify the type of construction joint to be used in given situations of concreting works, with justification.	**Unit - IV Quality Control of Concrete** 4.1 Concrete operations: Batching – Definition and types of Batching, Mixing – Types of Mixing and Mixers, Transportation- Modes of Transportation of concrete, precautions to be taken during transportation, Placing- placing of concrete in form work, precautions to be taken while placing of concrete, Compaction of concrete-methods of compaction, care to be taken during compaction, Finishing of concrete-purpose of finishing, types of Finishing, Curing of concrete-definition of curing, necessity of curing, different methods of curing and their application 4.2 Formwork for concreting: Different types of formworks for beams, slabs, columns. Materials used for form work. Requirement of good form work. Stripping time for removal of formworks per IS 456-2000 provision for different structural members. 4.3 Joints in concrete construction: Types of joints, joining old and new concrete, methods of joining, materials used for filling joints.	Lecture Using Chalk-Board Video Demonstrations Hands-on Site/Industry Visit Collaborative learning Cooperative Learning

CONCRETE TECHNOLOGY **Course Code : 313322**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Justify the need of given admixtures in concrete mix. TLO 5.2 Describe the characteristics and uses of given type of Mineral admixtures in concrete. . TLO 5.3 Select the type of Special Concrete in the given situation with justification.	**Unit - V Admixture in concrete and Special Concrete** 5.1 Admixture in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixture, air entraining admixture, plasticizers and super plasticizers, (IKS*: Paste of Vegetable Extract and Jaggery used as a admixture in the construction of Vadakumnathan temple, Tirussur, Kerala, India .) 5.2 Cementitious (Mineral) Admixtures: Fly ash, Silica Flume, Blast furnace slag, its use, properties and effects 5.3 Special Concrete: Properties, advantages and limitation of the following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete and self-compacting concrete, light weight concrete.	Lecture Using Chalk-Board Video Demonstrations Case Study Site/Industry Visit Collaborative learning Presentations

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Check suitability of cement based on its fineness.	1	Determine fineness of cement by Blaine's air permeability apparatus or by sieving.	2	CO1
LLO 2.1 Propose the water cement ratio for the given type of cement.	2	*Determine standard consistency, initial and final setting times of OPC.	2	CO1
LLO 3.1 Undertake the testing on the given type of cement to determine its compressive strength.	3	*Determine compressive strength of ordinary Portland cement.	2	CO1
LLO 4.1 Measure the volumetric changes in the given sample of cement.	4	Determine the soundness of ordinary Portland cement (OPC)	2	CO1
LLO 5.1 verify the suitability of given sample of sand to prepare concrete	5	Determine silt content of given sample of sand by volume.	2	CO2
LLO 6.1 Undertake the required test to estimate the quantity of sand for preparing concrete	6	Determine bulking of the given sample of sand.	2	CO2
LLO 7.1 Use relevant aggregate for concrete mix design.	7	Determine bulk density of fine and coarse aggregates.	2	CO2
LLO 8.1 Decide percentage of absorbed water in aggregate and able to decide Water cement ratio.	8	Determine water absorption of fine and coarse aggregates.	2	CO2
LLO 9.1 Decide Grading of fine aggregates for quality of concrete Mix.	9	*Determine Fineness modulus of fine aggregate by sieve analysis.	2	CO2
LLO 10.1 Decide Grading of coarse aggregates for quality of concrete Mix.	10	*Determine Fineness modulus of coarse aggregate by sieve analysis.	2	CO2
LLO 11.1 Decide the suitability of coarse aggregate for wearing or non-wearing surfaces.	11	*Determine aggregate impact value or Crushing Value or Abrasion value	2	CO2
LLO 12.1 Decide the suitability of coarse aggregate for concrete work based on its size and shape.	12	*Determine aggregate elongation index and flakiness index.	2	CO2
LLO 13.1 Decide suitability of concrete according its workability in different situations.	13	*Determine workability of concrete by slump cone test or Compaction factor test.	2	CO3

CONCRETE TECHNOLOGY **Course Code : 313322**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Measure the ability of concrete to resist the compressive loads.	14	*Determine compressive strength of concrete for 7 days	2	CO3
LLO 15.1 know the components parts of RMC and its functioning.	15	*Field Visit/video demonstration on RMC plant to understand the components and its functioning.	2	CO5

Note : Out of above suggestive LLOs -

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

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

specific learning / Skills Development (Self Learning)

- Prepare a list of IS codes with their Specifications required for Cement, Aggregate and concrete (Any three codes for each).
- Study of Sieve Analysis for WMM (Wet Mix Macadam) and GSB(Granular sub base) courses.
- Study of water quality parameters used in concrete as per IS 456.
- Study of various methods of NDT such as Rebound Hammer method and Ultrasonic pulse velocity test.
- Prepare a study report on hot & cold weather concrete.

Micro project

- Market survey to select type of cement for various types of construction works.
- Visit to site under construction to observe concreting operations.
- Visit to site under construction to observe the quality of fresh concrete.
- Visit to site under construction to observe form work, scaffolding used and joints in concrete.
- Search the software/freeware for the course content and prepare report stating their applications.
- Visit to site under construction to collect detail information about the ingredients of concrete mix.
- Market survey to select types of admixture for relevant construction work.
- Prepare mix design for the grade given by course teacher.
- Visit to stone crusher to observe its manufacturing.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Blaine’s air permeability apparatus as per IS: 4031 (part 1)-1999, and sieve no. IS 90 micron - IS Brass Sieve (200 mm dia), 90 Micron size.	1

CONCRETE TECHNOLOGY **Course Code : 313322**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
2	I S sieve set (sizes- 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µ, 300 µ. 150 µ,90 µ and pan) , sieve shaker with adaptors	1,9,10,11
3	Aggregate impact testing apparatus with mould,	11
4	Aggregate crushing mould	11
5	Los Angeles abrasion testing machine	11
6	Elongation gauge and thickness gauge.	12
7	Slump cone(top dia.100mm, bottom dia.200mm, Height 300mm)	13
8	Compaction factor test apparatus	13
9	Table vibrator, moulds(150mm x150mmx 150mm)	14
10	Vicats apparatus- VICAT mould of dia. 80 mm & 40 mm high glass base plate, initial needle, final needle. Consistency plunger M.S. base plate (non porous) of weight 300 gm. Vicat mould split type with camping ring.	2
11	Measuring Cylinder 1000 ml capacity	2,3,5,6
12	Measuring Cylinder of 100 ml capacity	2,3,5,6
13	Compression testing machine-2000 kN capacity, Cement mortar cube vibrator-, moulds size 50 cm2 (7.07 cm x 7.07 cm)	3,14
14	Curing Tank	3,14
15	Le chatelier apparatus	4
16	Hot Air Oven	5,6,7,8,9,10,11,12
17	Density basket as per IS specification	7
18	Weighing Balance	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Cement	CO1	6	2	4	4	10
2	II	Aggregates	CO2	8	2	4	6	12
3	III	Concrete and its testing.	CO3	16	4	8	12	24
4	IV	Quality Control of Concrete	CO4	8	2	4	6	12
5	V	Admixture in concrete and Special Concrete	CO5	7	4	8	0	12
Grand Total				**45**	**14**	**28**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work, Assignment, Micro project, SLH (60% Weightage to process and 40% weightage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Practical Exam,

XI. SUGGESTED COS - POS MATRIX FORM

CONCRETE TECHNOLOGY **Course Code : 313322**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Gambhir, M.L.	Concrete Technology	Tata McGraw Hill Publishing Co. Ltd., New Delhi, ISBN-13: 978-1-259-06255-1
2	Shetty, M.S	Concrete Technology	S. Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi-110055 ISBN, : 978-8-121-90003-4
3	Santhakumar ,A. R	Concrete Technology	Oxford University Press, New Delhi ISBN-13: 978-0-195-67153-7
4	Neville, A. M. and Brooks, J.J.	Concrete Technology	Pearson Education Pvt. Ltd., New Delhi ISBN 978-0-273-73219–8
5	Job Thomas	Concrete Technology	CENAGE Publication ISBN-13:978-81-315-2668-2

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/105/102/105102012/	NPTEL Concrete Technology course by Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi
2	https://youtu.be/sl0smPfvVAo?list=PLkyVnO47pDX9YJglk1o2iYzWgABo5I_xA	Testing of Cement by NITTTR Chandigarh
3	https://www.nitttrchd.ac.in/sitenew1/nctel/civil.php	Practical's on Cement/Concrete/Aggregate by NITTTR Chandigarh
4	https://www.youtube.com/watch?v=yzpWGrh9j6Y	Workability of Concrete – Slump Cone Test. By Ultra tech cement.
5	https://www.youtube.com/watch?v=M9hkvS_OLmk	Ultrasonic Pulse Velocity Test on Concrete.
6	https://youtu.be/6iThtydES5c?si=OAOv5EW3lukFiFBD	Fineness of Cement as per IS 4031-Part1 by Sieving method
7	https://cs-iitd.vlabs.ac.in/List%20of%20experiments.html	Virtual laboratory practical on concrete technology

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CONCRETE TECHNOLOGY **Course Code : 313322**

Sr.No	Link / Portal	Description
8	https://www.researchgate.net/publication/283109018	Research Article on Knowing from the past – Ingredients and technology of ancient mortar used in Vadakumnathan temple, Tirussur, Kerala, India (for IKS) in Journal of Building Engineering, ELSEVIER Publication
9	https://youtu.be/83AcFYK-Eno?si=5HUfRSWIQOLftjvc	Rebound Hammer Test
10	https://youtu.be/KHDdhYVP_GI?si=p3ADC6IkclMTKnai	Visit to Ready mix concrete (RMC) batching plant | How RMC plant works?
11	https://youtu.be/SR_Eq9Z7tbM?si=FQlrkUkEBx5zidt8	Visit to RMC Concrete Batching Plant Animation video
12	https://youtu.be/rdtDV-bE0wo	The Overview of the Stages involved in Manufacture of Concrete

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**

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HIGHWAY ENGINEERING **Course Code : 313323**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: HIGHWAY ENGINEERING**
Course Code	**: 313323**

I. RATIONALE

Efficient network of road is the life line of any nation. Highway engineering is one of the most favored-effective and economical modes of land transportation. It is instrumental in determining the economic development of the country. Highway and Transport facilities are an important part of urban infrastructure. Highway engineering is one of the branches of Civil engineering which deals with the process of design, construction, and maintenance of different types of roads. The basic requirements of efficient transportation are speed, safety, and comfort. It provides door to door service and connects to inaccessible parts of the country. Hence it is essential for Civil engineering student to acquire the knowledge of this course.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Undertake the construction of the given type of pavements including its maintenance (Roads).

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the roads based on recommendations of IRC.
- CO2 - Implement geometrical features of different Highways.
- CO3 - Observe the various road construction activities.
- CO4 - Suggest the traffic control devices and intersections based on traffic flow survey data.
- CO5 - Suggest the relevant precautionary measures to control the drainage based on inspection to maintain the given section of roads.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313323	HIGHWAY ENGINEERING	HEN	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150

HIGHWAY ENGINEERING **Course Code : 313323**

Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the relevant modes of transportation with its importance. TLO 1.2 Explain Role of IRC, NHAI in the development of roads in India. TLO 1.3 Classify the Roads TLO 1.4 Decide the relevant factors influencing the ideal alignment of road pavement.	**Unit - I Introduction to Highway Engineering** 1.1 Different modes of transportation and importance of road transportation. 1.2 History of the Road development in India and the agencies involved in this work. (*IKS- Ancient Roads) 1.3 General classification of Roads. 1.4 Alignment: Definition, Requirements, importance etc. of an ideal road alignment and the factors affecting road alignment.	Video Demonstrations Lecture Using Chalk-Board Site/Industry Visit Presentations Cooperative Learning
2	TLO 2.1 Illustrate various functional terms related to geometrics of the given type of highway with sketches. TLO 2.2 Sketch /Draw the cross sections of roads in embankment and cutting for the given site condition.	**Unit - II Geometric Elements of Highway** 2.1 Definition, purpose, types, and its IRC recommendation of Various geometric elements /Technical terms of road pavement :Permanent way/right of way, road formation, Carriageway width, Road margin, side slopes, side gutter, Camber, Gradient, Super elevation, Curves, Road Widening, Sight distance, Design speed and factors affecting design speed 2.2 Standards cross-sections of EXPRESSWAY, NH, SH, MDR, ODR and VR in embankment and cutting.	Video Demonstrations Presentations Lecture Using Chalk-Board Site/Industry Visit Collaborative learning Case Study

HIGHWAY ENGINEERING **Course Code : 313323**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Undertake the specific test on given sample of bitumen to check its suitability in road construction. TLO 3.2 Differentiate between the flexible and rigid pavement. TLO 3.3 Explain the importance of each layer in given type of road. TLO 3.4 Explain the construction of the given pavement including joints and sealers. TLO 3.5 Describe the components of the hill road in given situation. TLO 3.6 Suggest relevant measures to control the landslide in the given situation.	**Unit - III Construction of Road Pavements** 3.1 Overview of highway construction materials: Aggregate, Cement, Sand, Water, Soil, Bitumen: Ductility, Flash and Fire Point Test, Softening Point Test, Extraction Test, Grade of Bitumen, Emulsion, Cutback, Tar. 3.2 Definition, Types, Structural Components of pavement and their functions. 3.3 Construction of WBM road, Flexible pavement / Bituminous Road. 3.4 Construction of Rigid Pavement (Cement Concrete): methods of construction, Alternate and Continuous Bay Method, Construction joints, filler and sealers. 3.5 Components, functions of Hill roads. 3.6 Landslides: define, Causes, Types, Prevention of landslides.	Video Demonstrations Presentations Lecture Using Chalk-Board Hands-on Site/Industry Visit Case Study
4	TLO 4.1 Conduct traffic volume survey at the given road intersection. TLO 4.2 Justify the importance of PCU in traffic volume study to suggest the solution to the given problem. TLO 4.3 Justify the importance of traffic control devices. TLO 4.4 Justify the Intersections in the given situation.	**Unit - IV Traffic Engineering** 4.1 Traffic Volume Study (TVS): Definition, Purpose of TVS, method of TVS. 4.2 Passenger Car Unit (PCU) and factors affecting it. 4.3 Traffic control devices and its types: road signs, marking, Signals, Traffic Island. 4.4 Road Intersections: Cloverleaf, Diamond and Trumpet Interchange	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Hands-on Cooperative Learning Case Study
5	TLO 5.1 Describe with sketches the relevant method of providing drainage in the given type of Road. TLO 5.2 Identify the causes of failure based on inspection of given type of pavement. TLO 5.3 Suggest the maintenance and repair works required for given type of defective road.	**Unit - V Road Drainage and maintenance** 5.1 Drainage-Definition, necessity, types and sketch of drainage system. 5.2 Failure of flexible and Rigid pavement and Its Causes and preventive measures. 5.3 Necessity of Maintenance of Road & its Classification.	Video Demonstrations Presentations Lecture Using Chalk-Board Site/Industry Visit Cooperative Learning Case Study

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

HIGHWAY ENGINEERING **Course Code : 313323**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, VR.	1	*Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, VR in embankment and cutting on A3 size sketch book.	2	CO1 CO2
LLO 2.1 Identify components of Road.	2	*Visit the existing road to identify the component parts of road and prepare photographic report.	2	CO1 CO2
LLO 3.1 Interpret the result of Softening point test on bitumen.	3	*Conduct Softening point test on bitumen.	2	CO3
LLO 4.1 Interpret the result of Penetration test on bitumen.	4	*Conduct Penetration test on bitumen.	2	CO3
LLO 5.1 Interpret the result of Flash and Fire Point on bitumen.	5	Conduct Flash and Fire Point test on bitumen.	2	CO3
LLO 6.1 Interpret the result of Ductility test on bitumen.	6	Conduct Ductility test on Bitumen.	2	CO3
LLO 7.1 Interpret the result of Bitumen Extraction Test on bitumen.	7	*Conduct Bitumen Extraction Test.	2	CO3
LLO 8.1 Write the function of each layer of Pavement. LLO 8.2 Observe the working of Highway Construction machineries. LLO 8.3 Onsite testing of Material and sequential method of Construction.	8	*Visit the road under construction to identify layers in the flexible pavement/Rigid Pavement. prepare photographic report consisting of Materials, Machineries used, Method of Construction and on-site testing of Materials.	2	CO1 CO2 CO3
LLO 9.1 Identify the components of Hill Roads.	9	Visit the hill road to study its components, geometrics and prepare the photographic report containing details.	2	CO1 CO2 CO3
LLO 10.1 Perform traffic volume survey for a road intersection.	10	*Carry out Traffic Volume Study (minimum two hours of peak period) for an important road intersection or roadway in your city/ town/ village.	2	CO4
LLO 11.1 Analysis traffic volume data and Interpret data.	11	Analysis traffic volume data obtained from above experiment.	2	CO4
LLO 12.1 Examine and relate the meaning of the traffic signs, road markings, islands in your city.	12	*Draw and identify the traffic signs, road markings, islands, intersections in your city/ town/ village and prepare the photographic report.	2	CO4
LLO 13.1 Inspect the existing road drainage system in your area and identify its type.	13	Visit the road of any one type flexible or rigid to know the road drainage system.	2	CO1 CO2 CO5
LLO 14.1 Identify the defects in road.	14	*Visit the road to identify the defects in road and suggest the possible remedial measures for it and prepare photographic report.	2	CO1 CO2 CO5
LLO 15.1 Suggest possible repairs and maintenance of the road.	15	*Suggest possible repairs and maintenance of the road visited in your city/ town/ village.	2	CO2 CO5

HIGHWAY ENGINEERING **Course Code : 313323**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Note : Out of above suggestive LLOs -

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

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

Micro project

- Develop Highway Intersection Model for smooth traffic flow.
- Differentiate geometric terms of different roads (NH, SH, MDR, ODR, VR) passing through your area.
- Advance Techniques of repairs like CBTR, White topping, Preventive maintenance, etc.
- Identify mode of transportation other than land transportation.
- List the National Highways/State Highways passing through Maharashtra.
- Collect the information relevant to transportation engineering about ongoing and completed road projects (Samrudhi-Mahamarg, Golden Quadrilateral, etc.).
- Role of MSRDC, NHAI and IRC in development and construction of roads.
- Asian Highways (AH) analysis.

Assignment

- IS Codes used for Planning, designing, construction and maintenance of roads.
- Illustrate the terms 1) Granular Sub Base-GSB 2) Wet Mix Macadam- WMM.
- New techniques and machineries used for rapid Highway Maintenance around the world.
- Evaluate the camber and gradient of any one road of each type of pavement in your area of college.
- Develop the photographic model of typical pavement structure for actual visited site.
- Make a list of Mega Highway Projects around the world and advanced techniques/machineries used in it.
- Participate in RTO Safety week and Study its activities.
- Observe construction techniques of WBM/Flexible/ Rigid Road.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Ring and Ball test apparatus (Hot plate 160mm dia. with magnetic stirrer, brass ring, steel ball and glass vessel 600ml and glass thermometer +800c.	3
2	Digital Analytical Weighing Scale, Accuracy: 1 Mg capacity : 30 g to 300 g	3,4,5,6,7
3	1) Lab Safety products (Heat Resistant Gloves, PPE Kit for Laboratory work, etc.) 2) Laboratory items-Lab Utensils and Hand Tools and Sample Containers and Bags	3,4,5,6,7

HIGHWAY ENGINEERING **Course Code : 313323**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	Standard Penetrometer with penetration needle 100gm weight, container 55mm dia. and 53mm ht. as per IS:1203.	4
5	Pensky Marten's Flash and Fire Point test apparatus 100x200x240mm with measurement range 0-95 as per IS:1209-1953	5
6	Ductility Testing Machine with ductility mould and base plate	6
7	Bitumen Extraction Test Apparatus: - Centrifuge Extractor, Electrical Operation, Capacity 1500g, with a Dimmer stat for speed control from 2,400 to 3,600 rpm. Suitable for operation on 230 V, 50 Hz, Single Phase, A.C. supply.	7

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Highway Engineering	CO1	3	2	4	0	6
2	II	Geometric Elements of Highway	CO2	15	6	8	8	22
3	III	Construction of Road Pavements	CO3	15	6	8	8	22
4	IV	Traffic Engineering	CO4	6	2	4	4	10
5	V	Road Drainage and maintenance	CO5	6	2	4	4	10
Grand Total				**45**	**18**	**28**	**24**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Termwork, Assignment, Microproject (60% Weightage to process and 40% weightage to product), Question and Answer.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Khanna S.K., Justo, C E G and Veeraragavan, A.	Highway Engineering	New Chand and Brothers, Rookie, 2010, ISBN 978-8185240800
2	Kadiyali, L.R.	Traffic Engineering and Transport Planning	Khanna Publishers, New Delhi, 2008, ISBN: 978-8174092205
3	Duggal, Ajay K. and Puri, V. P.	Laboratory Manual in Highway Engineering	New Age International (P) Limited, Publishers, New Delhi, 2010, ISBN: 9788122403107
4	Raji A. K. and K. K. Babu	Transportation engineering theory and practice)	AICTE New Delhi ISBN 978-81-960576-1-9
5	N L Arora	Transportation engineering	New India Publishing House, New Delhi ...

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://iksindia.org/index.php	Indian Knowledge Systems (IKS)
2	https://www.youtube.com/watch?v=acfJIG9o8iw	Flakiness and Elongation Index of Aggregate
3	https://www.youtube.com/watch?v=TE8zYxUJHt0 https://ts-nitk.vlabs.ac.in/exp/ductility-test/	Ductility test on Bitumen.
4	https://www.youtube.com/watch?v=-yBXl4z70mI https://ts-nitk.vlabs.ac.in/exp/softening-point-test/	Softening point test on bitumen.
5	https://www.youtube.com/watch?v=9HZE6DNfF5U https://ts-nitk.vlabs.ac.in/exp/penetration-test/	Penetration test on bitumen.
6	https://www.youtube.com/watch?v=PR7q4-ilENA	Flash and Fire Point test on bitumen.
7	https://www.youtube.com/watch?v=JEySduXuxCc&t=563s https://www.youtube.com/watch?v=d48qDaiDyVI	Bitumen Extraction Test
8	https://www.youtube.com/watch?v=2VehMMP70HE&list=PLLy_2iUCG87C7nApYQjgkDA0p67fMaXnE	Geometric Design of Highways By Prof. Rajat Rastogi IIT Roorkee
9	https://www.youtube.com/watch?v=5zKC_aq4ypM&list=PLE88643285BC70E0F	Transportation Engineering and Road development Process by IIT Kharagpur
10	https://crridom.gov.in/	CSIR-Central Road Research Institute
11	https://www.irc.nic.in/	Indian Roads Congress (IRC)
12	https://nhai.gov.in/#/	National Highway Authority of India (NHAI)
13	https://msrdc.in/1307/Home	Maharashtra State Road Development Corporation Ltd.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX**
Semester	**: Fourth**
Course Title	**: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY**
Course Code	**: 314301**

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.
- CO5 - Implement the environmental policies under the relevant legal framework.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 2 Hrs

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

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

Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	Lecture Using Chalk-Board Presentations

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS- Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	Lecture Using Chalk-Board Presentations

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem TLO 5.4 Explain the role of information technology in environment protection	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	Lecture Using Chalk-Board Presentations Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Assignment

•

Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
Draft an article on India's Strategies to progress across the Sustainable Development Goals
Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source
Conduct the SWOT analysis of biodiversity hotspot in India
Prepare a mind-mapping for the zero carbon footprint process of your field
Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions
Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -

Unit 1: Living with climate change
Unit 2 : Water Management and Climate Action
Unit 3: Energy Management and Climate Action
Unit 4 : Waste Management and Climate Action
Unit 5 : Bio-cultural Diversity and Climate Action
If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

•

Technical analysis of nearby commercial RO plant.
Comparative study of different filters used in Household water filtration unit
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion

Visit a local polluted water source and make a report mentioning causes of pollution
Any other activity / relevant topic related to the course suggested by the facilitator

Activities

•

Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.
Prepare and analyse a case study on any polluted city of India
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority
Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool
Watch a video related to air pollution in India and present the summary
Any other assignment on relevant topic related to the course suggested by the facilitator

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

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

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
Grand Total				**45**	**20**	**24**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- Online MCQ type Exam

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	-	1	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			
CO5	1	-	2	-	3	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation’s website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	https://www.youtube.com/@ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange – IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Link / Portal	Description
6	https://eepmoefcc.nic.in/index1.aspx?lsid=297&lev=2&lid=1180&langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators
10	https://sustainabledevelopment.un.org/memberstates/india	India’s Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

11-01-2025 10:14:16 AM

HYDRAULICS **Course Code : 314303**

Programme Name/s	**: Agricultural Engineering/ Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering**
Programme Code	**: AL/ CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: HYDRAULICS**
Course Code	**: 314303**

I. RATIONALE

Hydraulics is a course of civil engineering which consists of study of fluid behavior and design of hydraulic structures. The study of hydraulics plays a important role in various civil engineering applications such as water supply, wastewater management, drainage systems and hydraulic structures. Understanding hydraulics for civil engineers will help them to make decisions during design of hydraulic structures and ensuring the efficient management of water supply and wastewater sources. In this course, student will learn behavior of fluid at rest, fluid in motion, flow through open channel and flow through pipe.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

• Apply the principles of hydraulics in given situation to solve the civil engineering problem.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Interpret the pressure parameters obtained from pressure measuring devices in liquids.
- CO2 - Determine total hydrostatic pressure and center of pressure for different conditions.
- CO3 - Calculate relevant parameters for given fluid flow.
- CO4 - Determine loss of head for flow through pipe in given situation.
- CO5 - Find the relevant fluid flow parameters in open channels.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme										
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical					
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314303	HYDRAULICS	HYD	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs

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

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

Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the role of hydraulics in the given civil engineering application. TLO 1.2 Compute different properties of liquid from given data. TLO 1.3 Convert gauge pressure into absolute pressure for the given data and vice-versa. TLO 1.4 Compute pressure at a point and pressure difference between two points for the given data using appropriate device.	**Unit - I Pressure Measurement** 1.1 Technical terms used: Fluid, Fluid Mechanics, Hydraulics, Hydrostatics, and hydrodynamics-Ideal and Real Fluid, Application of hydraulics in Civil Engineering field. 1.2 Physical properties of fluid : Mass Density, Weight Density, Specific Volume, Specific Gravity, Surface Tension of Water, Capillarity of Water, Viscosity, Units of Viscosity, Kinematic Viscosity, Newton's law of Viscosity. 1.3 Various types of pressure: Fluid Pressure, Pressure Head, Pasacl's Law and its applications, Absolute Pressure, Gauge Pressure, Atmospheric Pressure, Vacuum Pressure. 1.4 Pressure Measuring Devices: Piezometer, Simple U tube Manometer, U Tube Differential Manometer and Inverted U Tube Differential Manometer, Bourdon Tube Pressure Gauge.	Model Demonstration Video Demonstrations Demonstration Presentations Lecture Using Chalk-Board Hands-on Site/Industry Visit Case Study
2	TLO 2.1 Determine the variation of pressure with depth for the given fluid. TLO 2.2 Find Total Pressure and Centre of Pressure for given immersed surface. TLO 2.3 Calculate the resultant pressure and its position using pressure diagram.	**Unit - II Hydrostatics** 2.1 Definition of Hydrostatics, Total Pressure and Centre of Pressure :Concept and Applications. 2.2 Total Hydrostatic Pressure and Center of Pressure :on:Horizontally, Vertically Immersed Surfaces: for rectangular, Triangular and Circular lamina. 2.3 Total Pressure and Center of Pressure using Pressure diagram on sides , bottom and partition wall of a tank .	Model Demonstration Video Demonstrations Demonstration Presentations Lecture Using Chalk-Board Hands-on
3	TLO 3.1 Identify the type of flow using the concept of Reynold Number. TLO 3.2 Calculate discharge and velocity in the given situation using Continuity Equation. TLO 3.3 Calculate Total Energy of the given fluid flow. TLO 3.4 Apply Bernoulli's Theorem in the given situation to calculate losses and direction of flow.	**Unit - III Hydro kinematics and Hydro dynamics** 3.1 Types of Fluid Flow: Steady, unsteady, uniform, non uniform, laminar, turbulent, compressible and incompressible flow, Reynold's number. 3.2 Discharge: Definition, Unit, Continuity Equation. 3.3 Energies associated with fluid flow: Potential, Kinetic, Pressure Energy and total energy. 3.4 Bernoulli's Equation: Statement, Assumptions, Equation, Practical applications , Modified Bernoulli's Theorem.	Model Demonstration Video Demonstrations Demonstration Presentations Lecture Using Chalk-Board Hands-on

HYDRAULICS **Course Code : 314303**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Apply the Darcy Weisbach equation to calculate the relevant losses in a pipe flow. TLO 4.2 Calculate minor losses from the given data. TLO 4.3 Calculate Discharge of pipe system(in Parallel and in series) and Design equivalent pipe. TLO 4.4 Draw HGL and TEL from the given data. TLO 4.5 Calculate discharge in a pipe for the given data using venturimeter. TLO 4.6 Calculate coefficients of Orifice Cd, Cc, Cv for given data . TLO 4.7 Suggest the type of pump for given situation. TLO 4.8 Describe the working of the centrifugal pump with sketch. TLO 4.9 Describe the different types of heads associated with Centrifugal pump. TLO 4.10 Compute the power required for Centrifugal pump from the given data.	**Unit - IV Flow through Pipes And Pumps** 4.1 Major head loss in pipe: Frictional loss and its computation by Darcy Weisbach equation. (Simple Numericals on Darcy Weisbach equation) 4.2 Minor Energy (Head) losses in pipe: Sudden Enlargement, Sudden Contraction, loss of head at entrance of pipe, loss of head at exit of pipe, loss of head due to bend in pipes and fittings. 4.3 Flow through pipes in series, pipes in parallel and Dupit's equation for equivalent pipe. 4.4 Hydraulic Gradient Line and Total Energy Line(No Numerical, only representative Diagram). 4.5 Discharge measuring device for pipe flow: Venturimeter, Construction and working. 4.6 Discharge measuring for a tank: using Orifice, Hydraulic Coefficients of Orifice. 4.7 Pump: Types of pump :Centrifugal, Reciprocating pumps and Submersible pumps. 4.8 Centrifugal pump: Component parts and working. 4.9 Types of heads :Suction head, delivery head, static head and Manometric head. 4.10 Compute power requirement of Centrifugal Pump.	Model Demonstration Video Demonstrations Demonstration Presentations Lecture Using Chalk-Board Hands-on Site/Industry Visit
5	TLO 5.1 Describe the geometrical properties of the given Channel. TLO 5.2 Determine discharge in the given channel using relevant formulae for the given data. TLO 5.3 Design the most economical channel section for the given conditions. TLO 5.4 Describe the procedure of finding velocity and discharge using the given flow measuring device. TLO 5.5 Measure the velocity of flow through open channel for the given condition.	**Unit - V Flow through Open Channel** 5.1 Geometrical properties of Channel section: Wetted area, Wetted perimeter, Hydraulic Radius for Rectangular and Trapezoidal Channel section. 5.2 Determination of discharge by Chezy's equation and Manning's equation. 5.3 Conditions for most economical rectangular and trapezoidal channel section. 5.4 Discharge Measuring Devices: 'V' Notches and Rectangular Notches. 5.5 Velocity measurement devices: Floats, Pitot tube.	Model Demonstration Video Demonstrations Demonstration Presentations Lecture Using Chalk-Board Hands-on Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Determine physical parameters of given sample of tap water and muddy water.	1	*Computation of physical properties of given fluid (tap water and muddy water).	2	CO1
LLO 2.1 Determine the physical properties of given sample of oil and Mercury.	2	Computation of physical properties of given liquid (oil and Mercury).	2	CO1

HYDRAULICS **Course Code : 314303**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Measure the pressure at a given point using Bourdon Gauge.	3	Use of Bourdon Gauge to measure the pressure at a given point.	2	CO1
LLO 4.1 Measure the pressure difference between two given points using U tube differential manometer.	4	*Use of U tube differential manometer to measure the pressure difference between two given points.	2	CO1
LLO 5.1 Calculate the resultant pressure and its position for given situation of liquid in a tank.	5	*Find the resultant pressure and its position for given situation of liquid in a tank.	2	CO2
LLO 6.1 Interpret type of flow based on computed value of Reynold's number.	6	Use of Reynold's apparatus to determine type of flow.	2	CO3
LLO 7.1 Apply Bernoulli's theorem the given situation to obtain Total Energy Line.	7	*Use of Bernoulli's apparatus to obtain Total Energy Line for flow in closed conduit of varying cross sections.	2	CO3
LLO 8.1 Determine friction factor for the given pipe using Friction factor Apparatus.	8	*Use of Friction factor Apparatus to determine the friction factor for the given pipe.	2	CO4
LLO 9.1 Determine minor losses in pipe fittings (sudden contraction and Sudden enlargement).	9	*Determination of minor losses in pipe for sudden contraction and sudden enlargement.	2	CO4
LLO 10.1 Calculate minor losses in pipe fitting (Bend and Elbow).	10	Determination of minor losses in pipe fitting such as Bend and Elbow.	2	CO4
LLO 11.1 Determine the Coefficient of discharge for the given venturimeter fitted in pipe section.	11	*Calibration of Venturimeter to find out the discharge in a pipe.	2	CO4
LLO 12.1 Calculate Cd, Cc and Cv for given type of Orifice.	12	Calibration of Orifice to find out the discharge through a tank.	2	CO4
LLO 13.1 Calculate the efficiency of given Centrifugal Pump.	13	*Determination of efficiency of given Centrifugal Pump.	2	CO4
LLO 14.1 Determine the Coefficient of discharge for given 'V' notch fitted to open channel.	14	*Use of 'V' notch to measure the discharge through open channel.	2	CO5
LLO 15.1 Determine the Coefficient of discharge for flow through open channel using rectangular notch.	15	Use of rectangular notch to measure the discharge through open channel.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Collect the technical brochure of available brands of pump in the market and prepare report with your comments.

Determination of type and capacity of pump for residential bungalow (06 Occupants) of G+1 Storey having 200 Sq m built up area.
Prepare a model of rectangular and trapezoidal channel.

Assignment

- State and explain causes and remedial measures of water hammer.

Explain the necessity of hydraulic jump.

HYDRAULICS **Course Code : 314303**

Explain with neat sketch working of single acting and double acting reciprocating pump.
Explain critical, sub critical and supercritical flow with reference to Froude's number.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Measuring cylinder, Weighing balance	1,2
2	Pipe setup, bend, elbow fittings, stop watch	10
3	Pipe set up fitted with Venturimeter, U tube differential manometer, Stop watch	11
4	Centrifugal pump set up	13
5	Channel set up with different notches, Stop watch	14,15
6	U tube differential manometer, Mercury	2,4
7	Bourdon tube pressure gauge	3
8	Reynold’s apparatus, colour dye, Stop watch	6
9	Bernoulli’s apparatus, Stop watch	7
10	Friction factor Apparatus, Stop watch	8
11	Apparatus for finding minor losses in the pipe, Stop watch	9

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Pressure Measurement	CO1	12	2	8	4	14
2	II	Hydrostatics	CO2	12	2	8	4	14
3	III	Hydro kinematics and Hydro dynamics	CO3	10	2	4	6	12
4	IV	Flow through Pipes And Pumps	CO4	16	4	10	6	20
5	V	Flow through Open Channel	CO5	10	4	0	6	10
Grand Total				**60**	**14**	**30**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work ,Assignment, Microproject (60% Weightage to process and 40% weightage to product),Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and PaperTest (WrittenTest),Practical Exam ,Oral Exam

HYDRAULICS **Course Code : 314303**

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Modi, P. N. and Seth, S.M.	Hydraulics and Fluid Mechanics	Standard book house, Delhi ISBN:13: 978-8189401269;
2	Ramamrutham S, and Narayan, R.	Hydraulics, Fluid Mechanics and Fluid Machines	Dhanpat Rai Publishing Company, New Delhi, ISBN:8187433841
3	Khurmi, R S	Hydraulics, Fluid Mechanics, Hydraulic machines	S Chand Publishers, New Delhi ISBN: 9788121901628
4	Rajput, R K	Fluid Mechanics	S Chand, New Delhi ISBN: 9788121916677
5	Dr. R.K. Bansal	Fluid mechanics and hydraulic machines	Laxmi Publication; New Delhi, ISBN: 978-8131808153

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://eerc03-iiith.vlabs.ac.in/	An MoE, Govt of India virtual laboratory of Hydraulics and Fluid Mechanics.
2	https://nptel.ac.in/courses/105105203	Basics of Fluid Mechanics
3	https://archive.nptel.ac.in/courses/105/106/105106114/	Classification of flow
4	https://nptel.ac.in/courses/105103021	Open Channel flow
5	http://www.nitttrc.edu.in/nptel/courses/video/105101082/L01.html	Fluid Properties
6	https://onlinecourses.nptel.ac.in/noc24_ce20/preview	Hydraulic Jump
7	http://www.nitttrc.edu.in/nptel/courses/video/105103021/L01.html	Advanced Hydraulics
8	https://www.youtube.com/watch?v=mIF7nQBbaj0&list=UU__JX7j7HYXROO6jCAUmHIw&index=231	Fluid Pressure
9	https://www.youtube.com/watch?v=-jb5A9GIuNQ	Energy Gradient of pipe flow
10	https://www.youtube.com/watch?v=qie6UCJqM_Q	Bernoulli's Equation
11	https://www.youtube.com/watch?v=PH75Y1wIubQ	Hydraulic Pumps

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HYDRAULICS **Course Code : 314303**

Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

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RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: RAILWAY, BRIDGE AND TUNNEL ENGINEERING**
Course Code	**: 314312**

I. RATIONALE

Railway, Bridge and Tunnel Engineering is an important aspect of Civil Engineering as they are very crucial in shortening the distance of travel. Efficient and Effective network of different modes of transportation plays an important role in the Nation's economic progress and its integration. The basic requirements of efficient transportation are speed, safety and comfort. This course is intended to develop the basic skills related to investigation, surveys, alignment, construction and maintenance of Railway, Bridge, and Tunnels.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Execute the construction and maintenance of railways, bridges and tunnels.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant components of Railway Tracks.
- CO2 - Maintain the given Railway Track.
- CO3 - Maintain the given type of bridge through due inspection.
- CO4 - Suggest the relevant method of constructing a tunnel in the given strata.
- CO5 - Supervise the construction of tunnels including maintenance activities.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314312	RAILWAY, BRIDGE AND TUNNEL ENGINEERING	RBT	DSC	4	-	-	2	6	3	3	30	70	100	40	-	-	-	-	25	10	125

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RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Total IKS Hrs for Sem. : 3 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the development of Indian railways till date. TLO 1.2 Show the components of railway track in the given cross section of track. TLO 1.3 Suggest the types of sleepers provided for the specified railway track with justification. TLO 1.4 Propose the relevant type of ballast to be provided in specified railway track with justification. TLO 1.5 Identify the fixtures with fastening provided in the given rail section.	**Unit - I Introduction to Railway Engineering** 1.1 History of development of railways in India (IKS) ,Railway: Zones of Indian railways, Merits and demerits of roadway and railway, Introduction to Metro and Mono rail, Bullet Train. 1.2 Components of railway track: Rails , ideal requirements of railway track , types of Rails ,Rail Gauge- types, factors affecting selection of a gauge. tilting of rails and coning of wheels. Rail Joints : Necessity, types, requirements of welded joints. Creep of rail: Definition, causes and prevention of creep. 1.3 Sleepers : Requirement, functions and types, sleeper density 1.4 Ballast : requirement, function, types, suitability. 1.5 Rail fixtures and fastenings: fish plate, spikes, bolts, keys, bearing plates, chairs , types of anchors and anti-creepers.	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Site/Industry Visit Case Study

RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Fix the alignment of given railway track laid on typical terrain. TLO 2.2 Draw the cross section of the track showing its geometric elements with neat labels. TLO 2.3 Explain the track geometric components with its importance in its design. TLO 2.4 Explain with sketches the concept of turn outs, points, and crossings w.r.t railway track. TLO 2.5 Propose the relevant type of station with its salient parameters considered in its site selection. TLO 2.6 Justify the necessity of station yard in railway engineering. TLO 2.7 Maintain the track in the capacity of the permanent way inspector.	**Unit - II Track Geometrics** 2.1 Alignment: Factors governing rail alignment. 2.2 Cross sections of Track : Important technical terms-permanent land width/right of way, formation width, side slopes, side drains. Standard cross section of single and double line in cutting and in embankment. 2.3 Railway Track Geometrics: types and factors affecting Gradient , curves , grade compensation , super elevation-limits of Super elevation on curves , cant deficiency (No numerical in question-paper). 2.4 Branching of Tracks: Points and crossings: Turn out-left and right-hand turnout, components, and their functions ,important technical terms ,track junctions-crossovers, scissor cross over, diamond crossing, track triangle. 2.5 Railway Station : Purpose , requirement of railway station , factors affecting site selection for railway station, important technical terms , types of railway station. 2.6 Station yard: Function , Classification- Passenger, goods, locomotive and marshalling yards, drawbacks of marshalling yards. 2.7 Track Maintenance: Necessity , Classification , Tools required for track maintenance with their function , Organization of track maintenance , Duties of permanent way inspector, gang mate and key man.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit
3	TLO 3.1 Elaborate the typical features of major important bridges in India. TLO 3.2 Suggest the relevant type of bridge based on available data. TLO 3.3 Explain Factors affecting Site selection of given type of bridge. TLO 3.4 Explain with sketch Important technical terms related to a bridge. TLO 3.5 Explain with neat sketches the given component of bridge. TLO 3.6 Suggest the relevant type of bridge to be used in the given situation. TLO 3.7 Undertake the inspection of bridge during Pre and post monsoon period. TLO 3.8 Maintain the given type of bridge.	**Unit - III Bridge Engineering** 3.1 History of development of bridges in India (IKS) 3.2 Classification of bridges: according to span, purpose, material, life, alignment, H.F.L, Loading, level of bridge floor. 3.3 Site selection and investigation Factors affecting and controlling: Site For Bridge, Bridge Alignment. 3.4 Important technical terms: Waterway, Economic Span , Afflux ,Scouring , Erosion, Freeboard , Cut Water ,Ease Water,Apron 3.5 Component parts of bridge: Function, requirement, and types- Pier , Abutment , Wing Wall , Foundation ,Bearing 3.6 Types of Bridges: Causeway: Flush, low level, and high-level causeway. RCC Bridges , Pre-stressed bridge: Advantage & dis-advantages, Culvert: Types- Arch, Open or slab, Pipe and box 3.7 Inspection of bridges: General points to be observed, Pre and post monsoon inspection. 3.8 Maintenance of bridges: types - routine and special Maintenance.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit

RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Summarize the typical features of major important tunnels in India. TLO 4.2 Identify the type of the tunnel from the given sketch. TLO 4.3 Explain the criteria for selection of the tunnel for given situation with justification. TLO 4.4 Describe the process of shifting the alignment inside the tunnel through shaft. TLO 4.5 Suggest the relevant method of constructing the tunnel in the given terrain.	**Unit - IV Tunnel Engineering** 4.1 History of development of tunnels in India (IKS). 4.2 Classification of tunnels: according to purpose, conveyance, strata through which tunnel passing, alignment, shape, and size of tunnels. 4.3 Tunnels: Tunnel investigations and surveying, Cross sections for highways and railways. 4.4 Tunnel Shaft : its purpose and construction. 4.5 Methods of tunnelling in soft rock: Needle Beam method, Fore-Poling method, Line Plate method, Shield method.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit
5	TLO 5.1 Suggest the relevant method of constructing the tunnel in the available ground strata. TLO 5.2 Select the relevant type of drilling machine for the given strata. TLO 5.3 Describe the process of lining in the given tunnel in the given situation with justification. TLO 5.4 Justify the need to provide the provision for ventilation and drainage in the tunnel. TLO 5.5 Describe the procedure of maintenance of the given tunnel.	**Unit - V Construction and Maintenance of Tunnels** 5.1 Methods of Tunnelling in Hard Rock: Full-face method, Heading and bench method, drift method, New Austrian Tunnelling Method (NATM). 5.2 Drilling Equipment: TBM Tunnel Boring Machine, drills and drills carrying equipment’s, Types of explosives used in tunnelling. 5.3 Tunnel Lining: Purpose, factors affecting type of lining, and methods. 5.4 Tunnel Ventilation and Drainage: Purpose and methods. 5.5 Tunnel Maintenance: Purpose and Methods.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Micro project

- Prepare report on Railway Zones in India .
- Prepare model of a bridge/Tunnel to demonstrate the relevant concepts.
- Prepare models of different gauges used in railways.
- Collect the details of new technologies of tunnel excavation and prepare the report.
- Collect the information relevant to transportation engineering about ongoing and completed Railway/Bridge/Tunnel projects. (Minimum 3)
- Role of Indian Railway (IR), MSRDC, NHAI and IRC in development and construction of Railways, Tunnels and Bridges.
- Prepare a report on Bullet Train, Mono rail, Metro Rail project.

- Summarize the salient features of relevant IS codes used in this course in the form of a report.

Assignment

- Inspect nearby Railway Track /Bridge/Tunnel (any one) to enumerate the defects if any and prepare the report suggesting remedial measures for ensuring its stability.
- Draw the standard cross section of single line and double line railway on embankment and in cutting.
- List the advanced equipment's/machineries and materials required for preparation of subgrade of railway.
- Compile the relevant information on project Atal tunnel/Patalpani Rail tunnel with your own comments.
- Compile the relevant information on project Bandra Worli sea link bridge/Pamban Bridge with your own comments.
- Visit a nearby Bridge site/Tunnel and prepare a detailed photographic report.
- Compile the relevant information on project Mumbai to Ahmadabad Bullet Train with your own comments.
- Prepare a site visit report to the nearby railway station mentioning the details of the type of station, requirements fulfilling the station and any other important findings with required figures and facts.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer with internet facility	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Railway Engineering	CO1	10	4	4	4	12
2	II	Track Geometrics	CO2	18	4	12	6	22
3	III	Bridge Engineering	CO3	14	2	6	6	14
4	IV	Tunnel Engineering	CO4	10	4	4	4	12
5	V	Construction and Maintenance of Tunnels	CO5	8	0	4	6	10
Grand Total				**60**	**14**	**30**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Under SLA : Assignment, Microproject (60% Weightage to process and 40% weightage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	S. C. Saxena , S. P. Arora	A Text Book of Railway Engineering	Dhanpat Rai Publications (p) Ltd.-New Delhi ISBN-13:978-8189928834
2	Bindra S. P.	Elements of Bridge ,Tunnel & Railway Engineering	Dhanpat Rai Publications (p) Ltd.-New Delhi ISBN: 9789383182220, 9383182229
3	Ahuja & Birdi	Roads, Railways, Bridges and Tunnels Engineering	Standard Book House ISBN: 978-81-89401-33-7
4	Raji A K, K K Babu	Transportation Engineering (Theory and Practice)	AICTE New Delhi ISBN 978-81-960576-1-9
5	N L Arora	Transportation Engineering	New India Publishing House, New Delhi
6	R. Srinivasan	Harbour, Dock and Tunnel Engineering	Charotar Publishing House Pvt. Ltd.ISBN-13 978-9385039195

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://indianrailways.gov.in/	Indian Railway Zones (IKS)
2	https://iricen.gov.in/iricen/BooksList.jsp	IRICEN Books on Railway and Bridge Engineering
3	https://nhsrcl.in/en/home	National High Speed Rail Corporation Limited (Bullet Train)
4	https://msrdc.in/Site/Common/ProjectListDetails.aspx?ID=56&MainId=18	Versova-Bandra Sea Link Project by MSRDC
5	https://marvels.bro.gov.in/AtalTunnel	Atal Tunnel, Rohtang
6	https://archive.nptel.ac.in/courses/105/105/105105216/	Bridge Engineering video lectures by NPTEL
7	https://nptel.ac.in/courses/105107123	Railway Engineering video lectures by NPTEL
8	https://mmrda.maharashtra.gov.in/projects/transport/metro-line-1/overview	Mumbai Metropolitan Region Development Authority

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RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

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ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: ESTIMATING, COSTING AND VALUATION**
Course Code	**: 314313**

I. RATIONALE

In the construction of any civil engineering structure, estimating, costing, and valuation are the fundamental processes that provide valuable insights and support to project planning, budgeting, resource allocation, decision-making, contract negotiation, compliance, performance evaluation, and investment analysis. Today being the era of technology, a provision is also required to be made to implement the above mentioned processes through the use of the various software for achieving the speedy determination of quantities with inbuilt accuracy and precision. This course is specifically designed to develop the basic competencies among the learners to discharge their duties in the field with high efficiency and effectiveness to mitigate risks in projects and thereby to achieve the strategic objective.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Estimate for the given construction materials, labor, and resources required for construction projects accurately.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use the relevant modes of measurements for the given item of work.
- CO2 - Prepare approximate estimate of a civil engineering works.
- CO3 - Prepare detailed estimate of a civil engineering works.
- CO4 - Fix the rate for the given item of work using relevant rate analysis technique.
- CO5 - Conduct the process of the valuation for the specified purpose.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314313	ESTIMATING, COSTING AND VALUATION	ECV	DSC	4	-	4	-	8	4	4	30	70	100	40	50	20	25#	10	-	-	175

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the importance of an Administrative Approval and Technical Sanction in civil engineering projects. TLO 1.2 Perform the role of an estimator in civil engineering projects TLO 1.3 Write the detailed specifications for the given construction project. TLO 1.4 Undertake the relevant modes of measurement as per IS 1200 TLO 1.5 Apply the rule of deduction for the given construction work as per IS: 1200 TLO 1.6 Use the various formats of measurements and bill of quantities for the given work.	**Unit - I Basics of Estimating and costing** 1.1 Introduction: Estimating, Types and purpose, costing, Administrative Approval, Technical Sanction and Budget provision. 1.2 Roles and responsibility of Estimator. 1.3 SSR: Meaning, Purpose, Checklist and Detailed Specification of items of work in load bearing and framed structure as per the Execution. 1.4 Modes of measurement and desired accuracy in measurements of different items of work as per IS: 1200. 1.5 Rules for deduction in Masonry work, Plastering and Pointing and Painting work as per IS: 1200. 1.6 Standard formats of Measurement sheet, Abstract sheet, Face sheet.	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Specify the purpose of an approximate estimate in the given civil engineering project. TLO 2.2 Use relevant type of method to prepare an approximate estimate TLO 2.3 Prepare an approximate estimate for the given civil engineering structure.	**Unit - II Approximate Estimate** 2.1 Approximate estimate: Definition, Purpose, types. 2.2 Methods of approximate estimate: Service unit method, Plinth area rate method, Cubical content method, Typical bay method, Approximate quantity method. (Numerical on any one method out of Service unit method, Plinth area rate method, Typical bay method). 2.3 Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects.	Lecture Using Chalk-Board Presentations Flipped Classroom

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the procedure of the detailed estimate for the given project. TLO 3.2 Classify the detailed estimate based on the purpose of civil work. TLO 3.3 Propose the relevant method of detailed estimate for the given project. TLO 3.4 Determine the quantities for given Load bearing structure. TLO 3.5 Calculate the quantities of given component of RCC framed structure. TLO 3.6 Prepare the bar bending schedule for the given component of RCC project. TLO 3.7 Estimate the steel requirement of given building component. TLO 3.8 Prepare the bill of quantity for the given civil work. TLO 3.9 Calculate the earthwork quantity for the given civil Engineering work.	**Unit - III Preparation of Detailed Estimate** 3.1 Detailed Estimate: Definition and Purpose, Data required for detailed estimate, Procedure of preparation of detailed estimate, taking out quantities and Abstracting in prescribed format. 3.2 Types and Uses of detailed Estimates: Revised estimate, supplementary estimate, revised and supplementary estimate, repair and maintenance estimate. 3.3 Methods of Detailed Estimate- a) Unit quantity method and total quantity method. b) Long wall and Short wall method (out to out and in to in method or PWD method), Centre line method. 3.4 Calculate the quantities of the given items for the given load bearing structure. 3.5 Calculate the quantities of the given items for the given RCC framed structure. 3.6 Bar bending schedule, Rebar: Meaning, Purposes. 3.7 Steel requirement for footing, column, beam, Lintel, chajja and slab, Determination of rebar quantities as per IS 2502:1963. 3.8 Provisions in detailed estimate: contingencies, work charged establishment, centage charges, water supply and sanitary Charges and electrification charges. 3.9 Earthwork : Quantities for roads, Bunds and canal by Mid sectional area method, Mean sectional area method, Prismoidal formula method and trapezoidal formula method.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Case Study
4	TLO 4.1 Explain the importance of rate analysis in civil engineering. TLO 4.2 Justify the importance of sundry charges in the estimate of the civil work TLO 4.3 Fix the market rate of a given item of work using relevant rate analysis method TLO 4.4 Assign different skilled labor for different items TLO 4.5 Deploy the relevant type of manpower for the specified work. TLO 4.6 Prepare rate analysis for the given items of work.	**Unit - IV Rate Analysis** 4.1 Rate Analysis: Definition, purpose, importance and factors affecting. 4.2 Sundry Expenses: Lead (Standard and Extra), lift, overhead charges, water charges and contractors profit. 4.3 Procedure of rate analysis market rate determination etc. 4.4 Task work- Definition, factors Affecting, types, Task work of different skilled labor for different items. 4.5 Categories of labors, their daily wages, types and number of labors for different items of work. 4.6 Preparing rate analysis of different items of work: PCC, RCC work in (column, beam, lintel, slab), brick masonry, stone masonry, Vitrified tile flooring, plastering.	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain the purpose of valuation of the given civil structure. TLO 5.2 Differentiate between the terms, “cost, value and price” with their significance in civil engineering. TLO 5.3 Classify the value of the given structure. TLO 5.4 Calculate the depreciation of the cost of the given structure using relevant method of depreciation. TLO 5.5 Compute the capitalized value of the structure based on given data. TLO 5.6 Calculate monthly rent of the given building as per PWD norms. TLO 5.7 Signify the importance of the terms, “Lease and Mortgage”.	**Unit - V Valuation** 5.1 Definition and purpose of Valuation, role of valuer. 5.2 Define: Cost, Price and Value, Characteristics of Value, Factors Affecting Value. 5.3 Types of Value: Book Value, Scrap Value, Salvage Value, Speculative Value, Distress Value, Market Value, monopoly Value, Sentimental Value. 5.4 Depreciation, Obsolescence, Sinking Fund. Methods of Calculation of Depreciation : Straight Line Method, Sinking Fund Method, Constant Percentage Method. 5.5 Computation of capitalized value, Gross income, Outgoings, Net Income, Year Purchase, Types of outgoings. 5.6 Fixation of rent as per PWD Norms and Practice. 5.7 Lease : types of lease, lease hold property and free hold property, Mortgage : Mortgage deed, precautions to be taken while making mortgage.	Presentations Case Study Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare the check list of items to be executed with market rates and units for detailed estimate of the given structure from the given drawing.	1	Prepare the checklist of items from given drawing.	2	CO1
LLO 2.1 Analyze the SSR of into relevant categories and subcategories of construction activities.	2	*Analysis of SSR for any five item of construction.	2	CO1
LLO 3.1 Prepare the approximate estimate for the given civil engineering works. (service unit method)	3	*Prepare approximate estimate by using service unit method.	2	CO2
LLO 4.1 Prepare the approximate estimate for the given civil engineering works. (Typical bay method)	4	*Prepare approximate estimate by using Typical bay method.	2	CO2
LLO 5.1 Use long wall short wall method to determine the quantity of items of work (Excavetion,PCC ,UCR,DPC) using standard measurement sheet for 1BHK load bearing residential Building (Part-I).	5	*Determine the quantities for Excavation, PCC ,UCR, DPC of 1BHK load bearing residential building using long wall short wall method. (Part I)	2	CO3
LLO 6.1 Use long wall short wall method to determine the quantity of items of work (Brick Work,Plastering, flooring, slab)using standard measurement sheet for 1BHK load bearing residential Building (Part-II	6	*Determine the quantities for Brick Work, Plastering, flooring, slab of 1BHK load bearing residential building using long wall short wall method. (Part II)	2	CO3

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Use Center line method to determine the quantity of items of work (Excavetion,PCC ,UCR,DPC) using standard measurement sheet for 1BHK load bearing residential Building. (Part-I)	7	Determine the quantities for Excavation, PCC ,UCR,DPC of 1BHK load bearing residential building using Center line method (Part I).	2	CO3
LLO 8.1 Use Center line method to determine the quantity of items of work (Brick Work,Plastering, flooring, slab)using standard measurement sheet for 1BHK load bearing residential Building (Part-II)	8	Determine the quantities for Brick Work, Plastering, flooring, slab of 1BHK load bearing residential building using Center line method (Part II).	2	CO3
LLO 9.1 Prepare detailed estimate for RCC (G+1) residential framed structure from the given drawing. (Part-I)	9	*Prepare detailed estimate with abstract for RCC (G+1) residential framed structure. (Part I) (Manual)	2	CO3
LLO 10.1 Prepare detailed estimate for RCC (G+1) residential framed structure from the given drawing. (Part-II)	10	*Prepare detailed estimate with abstract for RCC (G+1) residential framed structure. (Part II) (Manual)	2	CO3
LLO 11.1 Use the relevant open source software to prepare detailed estimate for RCC (G+1) residential framed structure from the given drawing. (Part-I)	11	*Prepare detailed estimate with abstract for RCC (G+1) residential framed structure using relevant available open source Software.(Part-I)	2	CO3
LLO 12.1 Use the relevant open source software to prepare detailed estimate for RCC (G+1) residential framed structure from the given drawing. (Part-II)	12	Prepare detailed estimate with abstract for RCC (G+1) residential framed structure using relevant available open source software.(Part-II)	2	CO3
LLO 13.1 Calculate the reinforcement quantities for footing of a room size for 4 m X 5 m from the given set of drawings.	13	Prepare the bar bending schedule with reinforcement estimate for the footing of given structure.	2	CO3
LLO 14.1 Calculate the reinforcement quantities for column of a room size for 4 m X 5 m from the given set of drawing.	14	*Prepare the bar bending schedule with reinforcement estimate for the column of given structure.	2	CO3
LLO 15.1 Calculate the reinforcement quantities for beam of a room size for 4 m X 5 m from the given set of drawing.	15	Prepare the bar bending schedule with reinforcement estimate for the beam of given structure.	2	CO3
LLO 16.1 Calculate the reinforcement quantities for slab of a room size for 4 m X 5 m from the given set of drawing.	16	*Prepare the bar bending schedule with reinforcement estimate for the slab of given structure.	2	CO3
LLO 17.1 Estimate the steel quantity from the given drawing using IS code 2502-1963 for rebaring of beam structural members.	17	Prepare the bar bending schedule with reinforcement estimate for rebaring of beam to be extended.	2	CO3
LLO 18.1 Estimate the steel quantity from the given drawing using IS code 2502-1963 for rebaring of column structural members.	18	Prepare the bar bending schedule with reinforcement estimate for rebaring of column to be extended.	2	CO3
LLO 19.1 Use the Trapezoidal method to determine the earth work quantity in embankment and cutting.	19	*Determine the earth work quantity in embankment and cutting using Trapezoidal method.	2	CO3
LLO 20.1 Use the Prismoidal method to determine the earth work quantity in embankment and cutting.	20	Determine the earth quantity in embankment and in cutting using Prismoidal method.	2	CO3
LLO 21.1 Use the mid sectional area method to determine the earth work quantity in embankment and cutting	21	*Determine the earth work quantity in embankment and in cutting using mid sectional area method.	2	CO3

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Use the mean area method to determine the earth work quantity in embankment and cutting.	22	Determine the earth work quantity in embankment and cutting using mean area method.	2	CO3
LLO 23.1 Use the relevant open source software to prepare detailed estimate of the WBM Road. (Part I)	23	Prepare the detailed estimate of W.B.M. Road using relevant open source software (Part I)	2	CO3
LLO 24.1 Use the relevant open source software to prepare detailed estimate of the WBM Road. (Part II)	24	Prepare the detailed estimate of W.B.M. Road using relevant open source software (Part II)	2	CO3
LLO 25.1 Prepare the detailed estimate for small septic tank from given set of drawing.	25	Prepare the detailed estimate for small septic tank	2	CO3
LLO 26.1 Prepare the rate analysis for the given five item of work.	26	*Prepare the rate analysis for the given five item of work.	2	CO3
LLO 27.1 Carry out survey of different categories of labor it's types, and no of labor for different item of work on site and prepare its report..	27	*Carry out survey and prepare a report on different Categories and types of labor required for completion of various items of work on site. (visit and compare any three sites).	2	CO4
LLO 28.1 Prepare the chart reflecting all values pertaining to valuation of residential building with their significance.	28	Create a chart reflecting all values pertaining to valuation of residential building with their significance.	2	CO5
LLO 29.1 Determine the valuation of a given structure and submits the valuation report in prescribed formats.	29	*Prepare the valuation report for the given building.	2	CO5
LLO 30.1 Determine the monthly rent of the given area of the building from the given data.	30	*Determine the monthly rent of the given area of building from the given data.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Enlist the minimum ten salient provisions made in IS:1200 with special reference to load bearing structure.
- Enlist the minimum ten salient provisions made in IS:1200 with special reference to Framed structure.
- Prepare detailed estimate of minimum one load bearing structure using available open source software.
- Rate analysis by analyzing no of labor required for different items of civil works such as 10 cu. m excavation, cement concrete in foundation, Bricks work, rubble stone masonry works. Etc. and 100 m2 12mm thick plastering, 20 mm thick Damp proof course, cement pointing, white washing etc.
- Collect the rebar reinforcement drawings of minimum one building and interpret the drawings with report.
- Prepare rate analysis of Painting work for OBD, Plastic emulsion, Oil paint, luster paint having minimum 150 m2 area.
- Prepare approximate estimate of minimum one residential building.
- Prepare valuation report of minimum one residential building.
- Workout quantities of cement, sand and bricks for 30 m3,40m3.50m3,60m3 in cement mortar 1:6

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer systems with internet connection	3
2	Available Software of estimating and Costing.	3

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Estimating and costing	CO1	6	2	4	0	6
2	II	Approximate Estimate	CO2	8	0	4	4	8
3	III	Preparation of Detailed Estimate	CO3	24	6	14	10	30
4	IV	Rate Analysis	CO4	12	4	4	6	14
5	V	Valuation	CO5	10	2	4	6	12
Grand Total				**60**	**14**	**30**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks will be conducted and average of two-unit test considered.for formative assessment of exercises writing 50 marks.each exercises will be assessed considering appropriate % weightage to process and product and other instructions of assessments.

Summative Assessment (Assessment of Learning)

- Term Work, Practical Exam, Oral and Written End semester Exam

XI. SUGGESTED COS - POS MATRIX FORM

ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Datta, B.N.	Estimating and Costing in Civil engineering	UBS Publishers Distributors Pvt. Ltd. New Delhi. ISBN:9788174767295
2	Chakraborti,M.	Estimating and costing, specification and valuation in civil engineering	Monojit Chakraborti, Kolkata (2006) ISBN-10: 818530436X ISBN-13: 978-8185304366
3	Patil, B.S.	Civil Engineering Contracts and Estimates	Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 8173715599
4	Rangwala,S.C.	Valuation of Real Properties	Charotar Publishing House Pvt. Limited (2008) ISBN:9788185594774, 8185594775
5	Birdie,G.S.	Estimating and Costing	Dhanpat Rai Publishing Company(P) Ltd.NewDelhi110002 ISBN : 978-93-84378-13-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://mjp.maharashtra.gov.in/schedule-rate-dsr/	Schedule Rate (DSR) Maharashtra Jeevan Pradhikaran
2	https://mjp.maharashtra.gov.in/schedule-rate-dsr/	CPWD in house codes, manuals, schedules, technical specifications, design manuals and technical publications.
3	https://www.microsoft.com/en-in/microsoft-365/excel	Microsoft Excel 365 open source software
4	https://www.youtube.com/watch?v=IoBd5UhGifs	Full Building Estimation in Excel sheet
5	https://youtube.com/playlist?list=PLMCExauCXvoOGL3nP49ee_-Uatf1PAJ8q&si=N4gNlyNL3PzLvRTx	Estimating, Costing and Valuation
6	https://www.youtube.com/watch?v=iry2zEoPvsU	Sinking Fund / Book Value / Scrap Value / Market Value / Salvage Value / Valuation
7	https://www.youtube.com/watch?v=C6O09yOa45c	Rate Analysis Of Civil Work | How to Prepare Rate Analysis | Rate Analysis for 1000 sqft house plan
8	https://www.youtube.com/watch?v=H5qIwRCOFn4&list=PLv20kpHlalH1zD-oueYjooR-KdO6q_NLa&index=4	Administrative approval, Technical sanction and Budget provision

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ESTIMATING, COSTING AND VALUATION **Course Code : 314313**

Sr.No	Link / Portal	Description
9	https://www.youtube.com/watch?v=ZAnIaZIMGtw&list=PLv20kpHlalH1zD-oueYjooR-KdO6q_NLa&index=5	Types of estimates - Approximate estimate and Detailed estimate
10	https://www.youtube.com/watch?v=-BRwUs27ByY	Valuation of a Property / What is the purpose of Valuation / What factors affecting Valuation
11	http://acl.digimat.in/nptel/courses/video/124105015/lec40.pdf	Rebar Detailing

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024 **Semester - 4, K Scheme**

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WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: WATER AND WASTEWATER ENGINEERING**
Course Code	**: 314314**

I. RATIONALE

Urbanization is rapidly increasing, straining resources and infrastructure, and jeopardizing environmental quality. Therefore, it is necessary to ensure safe drinking water, effective waste disposal methods, and a pollution-free environment for maintaining good sustainable public health. A civil engineer is required to develop a basic understanding of the sources, characteristics, purification methods and conveyance system of water supply including the knowledge of domestic sewage disposal and its treatment. This course is intended to develop the basic competencies among the learners about water and wastewater treatments.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain the processes related to water treatment and wastewater treatment.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Interpret the water demand and quality of water.
- CO2 - Apply the water purification processes.
- CO3 - Select the distribution system and pipe network for water supply.
- CO4 - Interpret the plumbing system and sewer appurtenances.
- CO5 - Apply the wastewater treatment processes.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314314	WATER AND WASTEWATER ENGINEERING	WWE	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Total IKS Hrs for Sem. : 2 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify the sources with intake structures of water on the basis of given criteria. TLO 1.2 Determine future population by using relevant forecasting method. TLO 1.3 Undertake the testing of given water sample using relevant method as per IS code.	**Unit - I Sources, Characteristics and Demand of Water** 1.1 Sources of water: Surface and Subsurface sources of water. Intake Structures: Definition, types and factors governing the location. 1.2 Demand of water: Need to protect water supplies, Demand of water: Definition, Types, Factors affecting, rate and variations in water demands. Forecasting of population: Introduction and Methods, (Numerical based on Arithmetical Increase, geometrical decrease & Incremental increase only). Design period, estimating of demand of water supply required for city or town. 1.3 Characteristics and testing of water: Need for analysis of water, Physical, Chemical and Biological properties of water. Testing of water for Total solids, hardness, chlorides, Dissolved Oxygen, pH, Fluoride, Nitrogen and its compounds, Bacteriological tests, E. coli, B. coli index, MPN. Sampling of Water: Single & Grab. Water quality standards as per (I.S. 10500:2012).	Demonstration Video Demonstrations Lecture Using Chalk-Board

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Draw the labeled flow diagram of water treatment plant with enough description. TLO 2.2 Justify the process of filtration of water. TLO 2.3 Justify the process of disinfection of water. TLO 2.4 Apply the relevant technique of water softening and de-fluoridation for the given sample of water. TLO 2.5 Apply electrolysis and reverse osmosis technique on the given sample of water for the intended purpose.	**Unit - II Purification of Water** 2.1 Purification of Water: Flow diagram of water supply scheme, function of units of water supply scheme. Screening - Types, functions and suitability. Aeration - objects and methods of aeration. Plain sedimentation, Sedimentation with coagulation, principles of coagulation, types of coagulants, (IKS*: Alum is placed in clay water pot) Jar Test, process of coagulation, types of sedimentation tanks. Clariflocculator - Principle and working with diagram. 2.2 Filtration: Theory of filtration, classification of filters - slow sand filter, rapid sand filter, pressure filter, construction and working of slow sand filter and rapid sand filter. 2.3 Disinfection: Objects, methods of disinfection, Chlorination- Application of chlorine, forms of chlorination, types of chlorination practices, residual chlorine and its importance, orthotolidine test. 2.4 Water Softening Methods: Need and necessity of Water softening, lime soda process and zeolite process. De-fluoridation techniques. 2.5 Advanced Water Treatments: Electrolysis, Reverse Osmosis.	Demonstration Lecture Using Chalk-Board Collaborative learning Video Demonstrations Site/Industry Visit Case Study
3	TLO 3.1 Select the relevant mode of conveyance system in the given situation. TLO 3.2 Suggest the water distribution method for the given situation. TLO 3.3 Use the relevant pipe network system for water distribution in the given situation.	**Unit - III Water Distribution System** 3.1 Conveyance: Pipes - Types, Choice of materials, Joints and valves - Types, location and functions. 3.2 Distribution methods: Methods - Gravity, pumping, and combined system, suitability, advantages and disadvantages. (IKS* Harappa and Mohenjo-daro, Katraj lake-Shaniwar wada, Nahr-e-Ambari water course) Service reservoirs - types and functions. 3.3 Pipe Network System: Dead end system, grid iron system, circular system, radial system - their suitability, advantages and disadvantages.	Demonstration Video Demonstrations Lecture Using Chalk-Board Collaborative learning Case Study

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Propose the relevant sanitary fittings to be used at the given location of sanitation system. TLO 4.2 Illustrate relevant type of plumbing system for the given situation. TLO 4.3 Justify the relevant type of sewerage system for the given situation. TLO 4.4 Illustrate sewer appurtenances in the given situation.	**Unit - IV Building Sanitation System** 4.1 Building Sanitation: Necessity of sanitation, Necessity to treat domestic sewage, Definitions: Sewage, sullage, types of sewage, Water pipe, Rain water pipe, Soil pipe, Sullage pipe, Vent pipe, Building sanitary fittings - Water closet (Indian and European type), flushing cistern, wash basin, sinks, Urinals. Traps: Types, quality and function. 4.2 Systems of plumbing: One pipe, two pipe, single stack, choice of system, Principles regarding design of building drainage, layout plan for building sanitary fittings (drainage plan), Inspection and junction chambers- necessity, location, size and shape, Maintenance of sanitary units such as wash basin, sink, traps and chambers. 4.3 Systems of Sewerage: Introduction, Systems of sewerage: Separate, Partially Separated and Combined. 4.4 Sewer Appurtenances: Definition, Types of Sewers, Design of sewers, Self cleansing velocity and non scouring velocity, Laying, Testing and maintenance of sewers, Cleaning of municipal sewers before and after monsoon, Manholes and Drop Manhole - component parts, location, spacing, construction details. Sewer Inlets, Street Inlets.	Lecture Using Chalk-Board Lecture Using Chalk-Board Demonstration Video Demonstrations Site/Industry Visit
5	TLO 5.1 Evaluate the given characteristics of the sewage sample in relation with MPCB norms. TLO 5.2 Describe the function of various units of sewage treatment plant. TLO 5.3 Describe the construction of septic tank with its working principle. TLO 5.4 Describe the construction of septic tank with its working principle.	**Unit - V Sewage Treatment System** 5.1 Analysis of sewage: Characteristics of sewage, D.O., B.O.D., C.O.D. and its significance,Aerobic and anaerobic process, Maharashtra Pollution Control Board Norms for the discharge of treated sewage, Purposes of sewage treatment. 5.2 Treatment of Sewage: Flow diagram, Screening, Grit removal, Skimming, Sedimentation of sewage, Sludge digestion, Trickling filters, Activated sludge process. Disposal of sewage, Oxidation pond, Oxidation ditch. 5.3 Septic tank & soak pit: Principle, Construction, Working and Maintenance. 5.4 Recycling and Reuse of domestic wastewater: Necessity, Advantages, Disadvantages, methods and uses.	Lecture Using Chalk-Board Video Demonstrations Demonstration Site/Industry Visit Collaborative learning Case Study

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Determine the pH value of the given sample of water.	1	*Determination of pH value of water sample.	2	CO1
LLO 2.1 Determine the turbidity of the given sample of water.	2	*Determination of the turbidity of the sample of water.	2	CO1
LLO 3.1 Use the Whatman filter paper to determine the suspended solids, dissolved solids and total solids of given sample of water.	3	*Determination of suspended solids, dissolved solids and total solids of a water sample.	2	CO1
LLO 4.1 Use digital TDS meter to determine the TDS (Total Dissolved Solids).	4	Determination of the TDS by using a portable digital TDS meter.	2	CO1

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Use mechanical/digital DO meter to find the dissolved oxygen content present in a given sample of water.	5	Determination of the dissolved oxygen in a given sample of water.	2	CO1
LLO 6.1 Undertake the test to detect the presence of residual chlorine in a given sample of water using orthotolidine testing kit.	6	*Determination of residual chlorine in the sample of water.	2	CO2
LLO 7.1 Undertake a field visits to water treatment plant.	7	*Preparation of report on field visit to the nearby water treatment plant.	2	CO2
LLO 8.1 Deploy the jar test method to find the optimum dose of coagulant in the given raw water sample.	8	*Determination of the optimum dose of coagulant in the given raw water sample by jar test.	2	CO2
LLO 9.1 Write a report on working of water purifier, (RO purifier).	9	Demonstration of water purifier based on its components and working, (RO purifier).	2	CO2
LLO 10.1 Draw sketches of various joints used in the water supply pipeline.	10	*Illustration of various joints used in water supply pipeline through sketches.	2	CO3
LLO 11.1 Draw a labeled sketch of the one pipe, two pipe system and layout plan for drainage for a residential building.	11	Preparation of a sketch of one pipe, two pipe system and layout plan for drainage for a residential building.	2	CO4
LLO 12.1 Calculate BOD of given sample of wastewater.	12	Determination of BOD of a given sample of wastewater.	2	CO5
LLO 13.1 Calculate the dissolved oxygen content in the given sample of wastewater.	13	*Determination of the dissolved oxygen in the given sample of wastewater.	2	CO5
LLO 14.1 Calculate COD of a given sample of wastewater.	14	Determination of COD of a given sample of wastewater.	2	CO5
LLO 15.1 Write a report on wastewater treatment plant.	15	Preparation of a report on a field visit to the wastewater treatment plant.	2	CO5

Note : Out of above suggestive LLOs -

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

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

Micro project

- Present the test results of minimum three water samples obtained from a locally available area to ascertain its characteristics. (pH, Turbidity, D. O., Residual chlorine, Temperature, etc.)

Conduct an internet surfing survey/visit to local statutory water bodies for the quality of water, prepare a report on it and write your comment.
Present the test results of minimum three wastewater samples obtained from a locally available area to ascertain its characteristics.
Suggest minimum ten remedial measures for the control of pollution of local water sources by conducting relevant studies and tests.
Visit the site where recycling and utilization of treated wastewater is being implemented and prepare a detailed report on it.
Suggest minimum three social and eco-friendly methods to treat sullage water.
Suggest minimum five relevant methods/strategies to save water.
Suggest a treatment given to bore water to make it fit for drinking.

List a minimum of six building sanitary appurtenances used in current practice.
Prepare a presentation with minimum ten slides on the treatment of wastewater.

Assignment

- Collect information regarding minimum ten norms for water and wastewater treatment of statutory water bodies.

Prepare a presentation with minimum ten slides on conventional or advanced wastewater treatment processes.
Draw minimum four sketches of valves used in the water supply pipeline.
Study the related free open software for the design of the water supply distribution network.
Prepare a report of minimum five pages on the plumbing system for an existing building (G+1 or above) in the nearby area.
Prepare a report of minimum five pages on the drainage system for an existing building (G+1 or above) in the nearby area.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital pH meter (4 Digit Display (LED), 0 to 1000 mV, Resolution: 0.01 pH, Manual Temperature, Compensation: 0 to 80 degree C.)	1,12
2	BOD incubator with BOD bottles (Rated Voltage: AC 220V±10% 50Hz, Power: 2800W, Temperature Controlling Mode: Digital Display, Temperature Controlling Point: 24 degree C, 93.5 degree C, Temperature Controlling Precision: ±0.1 degree C)	11
3	Digital COD digester (Glassware: 15 Reaction Vessels & Air Condensers, Temperature: 150 ± 1% degree C, Capacity: 15 Samples at a time, Sample Size: 20 ml, Range: 0 to 500 ppm without dilution, Timer: 2 hours timer with Buzzer, Power Requirement: 230V 1000W	14
4	Digital Turbidity Meter. (Range 0 to 200 NTU, Resolution 1NTU, Accuracy: ± 3% FS, ± 1 Digit, Display 3½ Digit 7-Segment LED Light Source 6V, 0.3 Amp Tungsten Lamp, Detector: Photodiode, Sample System: 30 mm Clear Glass Test Tubes, Power 230 V ± 10% AC, 50 Hz, Accessories Test tube Set of 5, Operation Manual, Dust Cover.	2
5	Electric Oven with digital control (Temperature: 300 degree C, 25 kg capacity)	3
6	Digital DO meter (Range: 0 to 20 ppm, Resolution: 0.1 ppm, Temperature compensation: 0 to 50 degree C)	5,11,13,14
7	Orthotolidine test kit (free and total chlorine testing for EPA reporting over the range of 0-4 mg/L.)	6
8	Jar Test Apparatus (Digital timer: 1 to 99 minutes, material: Stainless steel, Power: Electric supply, Range: 25 to 250 rpm, with 6 glass jars of 1000 mL)	8

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Sources, Characteristics and Demand of Water	CO1	10	4	8	0	12
2	II	Purification of Water	CO2	16	6	6	6	18
3	III	Water Distribution System	CO3	8	2	4	4	10
4	IV	Building Sanitation System	CO4	14	2	4	10	16
5	V	Sewage Treatment System	CO5	12	0	8	6	14
Grand Total				**60**	**14**	**30**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks each will be conducted and average of two-unit tests considered. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- Assignment and Term Work, Written end semester examination.

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	N. N. Basak	Environmental Engineering	McGraw Hill Education India ISBN: 9780070494633, 0070494630.
2	B. C. Punmia Ashok Jain Arun Jain	Environmental Engineering Vol. I & Vol. II Water Supply Engineering & Wastewater Engineering (Including Air Pollution)	Laxmi Publications (P) Ltd., New Delhi ISBN: 81-7008-092-4, ISBN-13: 9788131805961.

WATER AND WASTEWATER ENGINEERING **Course Code : 314314**

Sr.No	Author	Title	Publisher with ISBN Number
3	Birdie, G. S. Birdie, J. S.	Water Supply and Sanitary Engineering	Dhanpat Rai and Sons, 2011 ISBN: 81874337954.
4	Garg, S.K.	Environmental Engineering Vol. I and Vol. II	Khanna Publishers, New Delhi, 2017, ISBN-10: 8174091203; ISBN-13: 978-8174091208.
5	Nelson DI	Environmental Engineering	CBS Publisher and Distributer ISBN: 9788123928715.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://ee1-nitk.vlabs.ac.in/List%20of%20experiments.html	Experiments for drinking Water.
2	https://ee1-nitk.vlabs.ac.in/	Experiments for drinking water and wastewater.
3	https://www.vlab.co.in/participating-institute-nitk-surathkal	Experiments for drinking water and wastewater.
4	https://www.vlab.co.in/ba-nptel-labs-civil-engineering	Experiments for drinking water and wastewater.
5	https://iitb.vlabs.co.in/discipline.html?discipline=Civil_Engineering	Experiments for drinking water and wastewater.
6	https://nitsri.ac.in/Department/Library/List_VLabs	Experiments for drinking water and wastewater.
7	https://www.youtube.com/watch?v=V_bd-Ijo7Ic	Determination of pH.
8	https://www.youtube.com/watch?v=4AWR_xfwfi4	Turbidity Determination
9	https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp	Working of wastewater treatment Plant.
10	https://www.youtube.com/watch?v=4-SRMmqH2s4&list=PLLy_2iUCG87AZvtaiuD3r4HATrBKhb90P	Working of wastewater treatment Plant.
11	https://www.mpcb.gov.in./water-quality/standards-	Standard Norms as per MPCB
12	https://cpcb.nic.in/who-guidelines-for-drinking-water-quality/	Standard Norms as per CPCB
13	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cpcb.nic.in/wqm/BIS_Drinking_Water_Specification.pdf	BIS: Drinking Water specifications (IS 10500:2012)
14	https://archive.nptel.ac.in/content/storage2/courses/105104102/Lecture%2014.htm	Water distribution systems

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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GEOTECHNICAL ENGINEERING **Course Code : 314315**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: GEOTECHNICAL ENGINEERING**
Course Code	**: 314315**

I. RATIONALE

The stability of any structure depends upon behavior of soil and bearing capacity of soil to carry loads under different loading conditions. Thus, the geotechnical engineering enables the decision maker to predict the behavior of soil under different loading conditions and also to determine the probable settlement arising from the construction activities. This course therefore will develop the basic understanding among the students to ensure the safety, stability, and long-term quality in the wide range of civil engineering projects such as buildings, dams, towers, embankments, roads, railways, retaining walls, bridges, underground tank and underwater structures.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Evaluate various soil properties required for design of foundation.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply the basic knowledge of Geology and Geotechnical Engineering in given situation
- CO2 - Measure the physical properties of given soil sample
- CO3 - Determine the shear strength of given soil sample
- CO4 - Use the relevant method of compaction to determine parameters of given soil sample
- CO5 - Undertake the relevant soil investigation techniques to determine the bearing capacity of the given soil strata

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314315	GEOTECHNICAL ENGINEERING	GTE	DSC	3	-	2	3	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

GEOTECHNICAL ENGINEERING **Course Code : 314315**

Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Elaborate the importance of geology in civil engineering field. TLO 1.2 Classify the given type of rocks based on their genesis. TLO 1.3 Signify the importance of soil as a construction material. TLO 1.4 Justify the importance of Geo-technical Engineering in civil Engineering.	**Unit - I Overview of geology and geotechnical engineering** 1.1 Introduction to Geology: Branches, importance of geology, composition of earth. 1.2 Petrology: Definition of a rock, classification based on their genesis (mode of origin), formation, classification and engineering uses of igneous, sedimentary and metamorphic rocks. (IKS*: Sun temple of Konark made up of Chlorite, Laterite, Khondalite stones) 1.3 IS definition of soil, Importance of soil in Civil Engineering as construction material for foundation bed of structures. 1.4 Field applications of geotechnical engineering for foundation design, pavement design, design of earth retaining structures, design of earthen dam.	Lecture Using Chalk-Board Presentations Demonstration Site/Industry Visit Case Study

GEOTECHNICAL ENGINEERING **Course Code : 314315**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Elaborate the physical properties of soil. TLO 2.2 Determine the Index properties of given soil sample using the relevant method. TLO 2.3 Draw the particle size distribution curve for the given sample with its interpretation. TLO 2.4 Interpret the computed values of Atterberg's limits of Consistency for the given soil specimen data.	**Unit - II Physical and Index Properties of Soil** 2.1 Physical Properties: Soil as a three phase system, water content, void ratio, porosity and degree of saturation, density index, unit weight of soil mass; bulk unit weight, dry unit weight, unit weight of solids, saturated unit weight, submerged unit weight, specific gravity 2.2 Determination of Index Properties of Soil: determination of water content by oven drying method as per IS code, determination of bulk unit weight and dry unit weight by core cutter method and sand replacement method as per IS code, determination of specific gravity by pycnometer. 2.3 Particle size distribution, mechanical sieve analysis as per IS code, particle size distribution curve, effective diameter of soil, Uniformity coefficient and coefficient of curvature, well graded and uniformly graded soils, particle size. classification of soils, I.S. classification of soil. 2.4 Consistency of soil: Stages of consistency, Atterberg's limits of consistency viz. Liquid limit, plastic limit and shrinkage limit, plasticity index, determination of liquid limit, plastic limit	Lecture Using Chalk-Board Presentations Demonstration Hands-on Site/Industry Visit
3	TLO 3.1 Apply the Darcy's law of permeability in given situation to determine the coefficient of permeability for a given soil sample. TLO 3.2 Apply the concept of flow net in the given situation. TLO 3.3 Draw the Mohr-coulomb failure envelope for the given type of soil sample. TLO 3.4 Use the relevant method to determine shear strength of given soil sample.	**Unit - III Permeability and Shear Strength of Soil** 3.1 Definition of permeability, Darcy's law of permeability, coefficient of permeability, factors affecting permeability, determination of coefficient of permeability by constant head and falling head permeability tests, simple problems to determine coefficient of permeability. 3.2 Seepage through earthen structures, seepage velocity, seepage pressure, phreatic line, flow lines, application of flow net, (No numerical problems.) 3.3 Shear failure of soil, field situation of shear failure, concept of shear strength of soil, components of shearing resistance of soil – cohesion, internal friction. Mohr-coulomb failure theory, Strength envelope, strength Equation for purely cohesive and cohesion less soils. 3.4 Laboratory methods: Direct shear test, vane shear test (Numerical on direct shear test only)	Lecture Using Chalk-Board Presentations Demonstration Hands-on Site/Industry Visit

GEOTECHNICAL ENGINEERING **Course Code : 314315**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Undertake the compaction of given sample using relevant method of compaction. TLO 4.2 Use the relevant method of soil stabilization for the given situation as per IS code. TLO 4.3 Determine the CBR value of given soil sample as per IS code. TLO 4.4 Explain the lateral earth pressure theory with labelled sketch for given situation.	**Unit - IV Compaction and Stabilization of soil** 4.1 Concept of compaction, purpose of compaction, field situations where compaction is required, Standard proctor test – test procedure as per IS code, Compaction curve, optimum moisture content, maximum dry density, Zero air voids line, Modified proctor test, factors affecting compaction, field methods of compaction : rolling, ramming and vibration, concept of consolidation, difference between compaction and consolidation. 4.2 Concept of soil stabilization, necessity of soil stabilization 4.3 California bearing ratio, C.B.R. test, interpretation of C.B.R. values. 4.4 Definition of earth pressure, lateral earth pressure at rest, active earth pressure and passive earth pressure with no surcharge condition, coefficient of earth pressure, Rankine's theory and its assumptions.	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on Site/Industry Visit
5	TLO 5.1 Undertake relevant Exploration Technique for evaluating soil strata. TLO 5.2 Determine the bearing capacity of soil using the relevant data for the given soil sample. TLO 5.3 Justify the need of field test in determining the bearing capacity of the soil for the given strata	**Unit - V Site Investigation and Bearing Capacity of Soil** 5.1 Site Investigation: Necessity of site investigation and sub-soil exploration, types of exploration, criteria for deciding the location and number of test pits and bores. Field identification of soil: dry strength test, dilatancy test and toughness test, Determination of free swell index. 5.2 Bearing capacity: Definition of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure, Introduction to Terzaghi's analysis and its assumptions (No Numerical). Types of failures in soil: general, local and punching shear failure, effect of water table on bearing capacity. 5.3 Field methods for determination of bearing capacity – Plate load test and standard penetration test. Test procedures as Per IS: 1888 & IS:2131	Lecture Using Chalk-Board Presentations Video Demonstrations Collaborative learning Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the type of given rock specimen.	1	*Identification of rocks from the given specimen	2	CO1
LLO 2.1 Use oven drying method to determine the percentage of moisture content in given soil specimen.	2	*Determination of moisture content of given soil sample by oven drying method as per I.S. 2720 part- II	2	CO2
LLO 3.1 Use pycnometer method for determining specific gravity of given soil sample to classify its type.	3	*Determination of specific gravity of soil by pycnometer method as per I.S. 2720 part- III.	2	CO2
LLO 4.1 Undertake the core cutter method to find bulk and dry unit weight of given soil sample in field.	4	*Determination of Bulk and dry unit weight of soil in field by core cutter method as per I.S. 2720 (Part- XXIX).	2	CO2
LLO 5.1 Undertake the sand replacement method to find bulk and dry unit weight of coarse-grained soils.	5	Determination of bulk and dry unit weight of soil in field by sand replacement method as per I.S. 2720 (Part- XXVIII).	2	CO2

GEOTECHNICAL ENGINEERING **Course Code : 314315**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Classify type of soil based on grain size distribution.	6	*Determination of grain size distribution of given soil sample by mechanical sieve analysis as per I.S. 2720 (Part- IV).	2	CO2
LLO 7.1 Identify given soil based on plasticity chart.	7	*Determination of Plastic Limit & Liquid Limit along with Plasticity Index of given soil sample as per I.S. 2720 (Part- V).	2	CO2
LLO 8.1 Find co efficient of permeability of soil through coarse grained soils and fine grained soil.	8	*Determination of co efficient of permeability by constant head test as per I.S. 2720 (Part- XVII) or Determination of co efficient of permeability by falling head test as per I.S. I.S. 2720 (Part-XVII)	2	CO3
LLO 9.1 Determine the shear strength of soil sample using direct shear test.	9	Determination of shear strength of soil by direct shear test as per I.S. 2720 (Part-XIII)	2	CO3
LLO 10.1 Determine shear strength of soil in undisturbed as well as remoulded cohesive soil sample.	10	Determination of shear strength of soil by vane shear test as per I.S. 2720 (Part-XXX)	2	CO3
LLO 11.1 Perform standard proctor test to determine parameters such as OMC, MDD and amount of compaction	11	*Determination of OMC and MDD by standard proctor test of given soil sample as per I.S. 2720 (Part- VII).	2	CO4
LLO 12.1 Perform modified proctor test to determine parameters such as OMC, MDD and amount of compaction	12	Determination of OMC and MDD by Modified proctor test of given soil sample as per I.S. 2720 (Part- VIII).	2	CO4
LLO 13.1 Perform the CBR test on a given soil sample to evaluate thickness of pavement	13	Determination of CBR value as per IS 2720 (Part-16).	2	CO4
LLO 14.1 Classify given soil sample by conducting field tests Through Visual inspection, Dry strength test, Dilatancy test and Toughness test.	14	Use of field tests to idendify type of given soil sample.	2	CO5
LLO 15.1 Find degree of Expansiveness of given soil based on free swell index.	15	Determination of free Swell index of soil as per IS 2720 (Part 40)	2	CO5

Note : Out of above suggestive LLOs -

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

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

SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)/ASSIGNMENTS

- a. Collect the data of various rock specimen such as igneous, sedimentary, metamorphic and compare their properties with respect to geotechnical Engineering.

b. Collect minimum three pictures rock mass showing Folds, Faults, Joints along with description.
c. Observe open source videos for determination of Shrinkage limit of soil sample as per I.S. 2720 (Part- V) and write a procedure.
d. Determine bearing capacity of soil using assumed value of liquid limit and plastic limit and show calculations (Workout bearing capacity of soil using established co relation.)
e. Enlist minimum five compaction equipments along with their description
f. Enlist various soil stabilization techniques and write information of any three (including sketches).

GEOTECHNICAL ENGINEERING **Course Code : 314315**

g. Comment in the form of report on the effect of unconsolidated undrained, consolidated undrained and consolidated drained in shear test
h. Summarize the importance of Geosynthetic materials including their applications in civil Engineering
i. Summarize in the form report on the importance of piles including sketches and case studies
j. Write a report on role of Geophysical Exploration in civil Engineering.

Micro project

- a. Collect minimum five types of rock specimen in your area and compare their properties with respect to geotechnical Engineering aspect

b. Visit nearby site having excavation pits and write short note about it strata by visual inspection.
c. Collect minimum three samples of soil in your area and compare them for any three properties of soil
d. Visit nearby reclamation land and study the stabilization method.
e. Identity two different locations and suggest the appropriate stabilization methods (soil-cement, soil-lime, soil-flyash etc.) to improve its engineering properties.
f. Study different free open sources software available for Geotechnical Engineering.
g. Collect the photograph and information of anchors (stabilization of slopes) used to avoid over turning of structure.
h. Collect the photographs and information on Causes, Effects and Types of Landslides.
i. Collect information on foundations of ancient structures with Geotechnical Engineering aspect.
j. Visit nearby two sites to classify soil based on field tests.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Vane shear test apparatus- as per 2720 (Part -30)	10
2	Proctor compactometer for light compaction and heavy compaction as per IS specification	11,12
3	CBR apparatus as per IS specification IS 2720 (Part-16).	13
4	425 micron IS Seive and 100ml capacity graduated glass cylinder	15
5	Oven-thermostatically controlled to maintain temperature of 110 degree Celsius to 115 degree Celsius	2,3,4,7,11,12
6	Pycnometer – consisting of 1 kg. honey /fruit jar with plastic cone, locking ring and rubber seal.	3
7	Core cutter apparatus- cylindrical core cutter of steel 100 mm dia x 127.3mm high with 3mm wall thickness beveled at 1mm.	4
8	Sand replacement apparatus- as per IS: 2720(Part-28)	5
9	Mechanical sieve shaker- carries up to 7 sieves of 15 cm to 20 cm dia (as per IS 2720-(Part 4)1985)	6
10	Casagrande liquid limit apparatus- as per IS: 9259-1979	7
11	Constant head permeameter- as per IS:2720(Part-4)1986	8
12	Falling head permeameter -as per IS:2720(Part-4)1986	8
13	Direct shear test apparatus- as per IS: 2720(Part 13) 1986	9

GEOTECHNICAL ENGINEERING **Course Code : 314315**

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of geology and geotechnical engineering	CO1	5	4	4	0	8
2	II	Physical and Index Properties of Soil	CO2	12	4	4	12	20
3	III	Permeability and Shear Strength of Soil	CO3	10	2	8	6	16
4	IV	Compaction and Stabilization of soil	CO4	10	4	4	6	14
5	V	Site Investigation and Bearing Capacity of Soil	CO5	8	0	8	4	12
Grand Total				**45**	**14**	**28**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit test of 30 marks will be conducted and average of two unit test is considered, Assessment of laboratory learning , Assignment, Microproject, Self learning (60% Weightage to process and 40% weightage to product), Question and Answer.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Practical Exam/ Oral Exam

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Punmia, B.C.	Soil Mechanics and Foundation Engineering	Laxmi Publication (P) ltd., New Delhi, ISBN 9788170087915
2	Murthy, V.N.S.	A text book of soil mechanics and foundation Engineering	CBS Publishers & Distributors Pvt. Ltd., New Delhi 2016 ISBN: 9788123913629

GEOTECHNICAL ENGINEERING **Course Code : 314315**

Sr.No	Author	Title	Publisher with ISBN Number
3	Ramamurthy, T.N. & Sitharam,T.G.	Geotechnical Engineering (Soil Mechanics)	S Chand and Company LTD., New Delhi, ISBN: 9788121924573
4	Braja M. Das	Principles of Geotechnical Engineering	Cengage Learning ISBN: 9789355738103
5	Parbin Singh	Engineering And General Geology	S K Kataria and Sons ISBN-13 978-8188458516

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/N2J-tvEeI4c?si=SgQPoICSbFAuOVLd	Determination of Water Content of Soil by Oven Drying Method
2	https://youtu.be/l6vk0EM4yPg?si=-M6WwrpxOlZYHy94	Determination of Specific Gravity of soil
3	https://youtu.be/5rDHjZ_RJq0?si=V714qwz1vE8f5pSP	Determination of Dry Density of Soil by Core Cutter Method
4	https://youtu.be/YejCi5SEOAU?si=n8w1uAauI7ZgaG9P	Determination of Dry Density of Soil by Sand Replacement Method
5	https://youtu.be/pM-w_cvk1nA?si=3evWNLPjtwFxtsP0	Determination of Liquid Limit and Plastic Limit of Soil
6	https://youtu.be/bmpn5oNDvOs?si=LxcoQUSe_lmL3QQ1	Direct Shear Test
7	https://youtu.be/CAezS3mPzOc?si=9-bIMPqTKy1MuPDG	Grain Size Analysis of Soil
8	https://youtu.be/c4i_y6u-tsE?si=BjcItf55LqNn2Ihn	Water Content Dry Density Relation Using Light Compaction OMC and MDD
9	https://youtu.be/fCmMW73rP64?si=mdAiq1WPkpc9n1Dl	California Bearing Ratio (CBR) value test
10	https://youtu.be/Lrml0egYtM4?si=ag1mezmk74UAuyCf	Determination of swelling properties (Free Swell Index of Soil)
11	https://smfe-iiith.vlabs.ac.in/List%20of%20experiments.html	Virtual laboratory practical for Soil Mechanics.
12	https://youtu.be/8Q8CZW9-jXE?si=8Yrf2NvS9b5v9kcF	A Soil Investigation Work (Borehole Drilling: SPT & Rock Coring)
13	https://www.ijsrp.org/research-paper-0121/ijsrp-p10935.pdf	The Architectural Study of Sun Temples in India: Based on Location, Construction Material and Spatial Analysis Study
14	https://youtu.be/QuE4tEK-5iY?si=t61uZOWhS_nd5z8H	Shallow Foundation: Plate Load Test
15	https://youtu.be/DjWDOqQjsyQ?si=k43rXl2I19YK9msV	How to conduct SPT / Standard Penetration Test/ Soil Exploration Technique/ Site Investigation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students