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

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

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

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
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

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

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.
- 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
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			

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

Sr.No	Author	Title	Publisher with ISBN Number
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