INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**SURVEYING & GEOMATICS**				
Course Code	ACEB01				
Programme	B.Tech				
Semester	III	CE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	3	1.5
Chief Coordinator	Mr. B Suresh, Assistant Professor				
Course Faculty	Dr. Shruthi Kaviti, Assistant Professor, Mr. B Suresh, Assistant Professor				

I. COURSE OVERVIEW:

Surveying is the technique, profession, science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the Earth, and to depict them in a their objectives. Surveyors use elements of mathematics (geometry and trigonometry), physics, engineering and law. Surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, usable form, or to establish the position of points or details. These points are usually on the surface of the earth, and they are often used to establish land maps and boundaries for ownership or governmental purposes. To accomplish vertical and slope distances with computerization, electronic distance measurement (EDM), total stations, remotes sensing, Photogrammetry, GPS surveying and laser scanning have supplemented to a large extent.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHSB02	I	Linear Algebra and Calculus	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Surveying & Geomatics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Presentation on real-world problems
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering science	1	Seminars
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	1	Assignments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Presentation on real-world problems
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	3	Seminars
PSO 3	**Self-learning and Service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Describe the function of surveying in civil engineering construction.
II	Work with survey observations, and perform calculations.
III	Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses.
IV	Operate an automatic level to perform differential and profile leveling; properly record notes mathematically reduce and check levelling measurements

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Explore the importance of Linear, angular and graphical methods involved in surveying to make a plan or map.	CLO 1	Analyze the sources of errors in linear measurements.
		CLO 2	Obtain the direction of a surveying line with a prismatic and surveyors compass.
		CLO 3	Explain the importance of theodolite and understand the principle of measuring angles in horizontal and vertical plains
		CLO 4	Draw cross section and prepare a contour maps for road works, rail works, canals etc.,

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO5	Draw and calculate the area enclosed with in the traverse
CO 2	Understand various method of curve setting and Elements of curves at various locations	CLO 6	Use Elements of simple, reverse, transition and compound curves at suitable locations
		CLO 7	Understand the Method of setting out simple curves, compound curves and reverse curves etc.,
		CLO 8	Calculate length of curve using various methods
		CLO 9	Analyze geometric design of vertical curve at suitable location
CO 3	Analyse Co-ordinate transformation and accuracy considerations with GPS	CLO 10	Understand the basic Principle of Electronic Distance Measurement
		CLO 11	Understand different types of EDM instruments such as Distomat, and Total Station
		CLO 12	Summarize the Advantages and Applications Total Station
		CLO 13	Understand Field Procedure for total station survey and Errors in Total Station Survey
		CLO 14	Differentiate the advantages of global positioning system and geographical information system.
		CLO 15	Analyze Co-ordinate transformation and accuracy considerations with GPS
CO 4	Analyze photographic mapping, mapping using paper prints, stereo plotting instruments, mosaics and map substitutes.	CLO 16	Understand the basic concepts involved in Photogrammetric surveying
		CLO 17	Understand perspective geometry of aerial photograph
		CLO 18	Analyze relief and tilt displacements using aerial photogrammetric surveying.
		CLO 19	Explain terrestrial photogrammetry, flight planning, Stereoscopy, ground control extension for photographic mapping by aerial triangulation and radial triangulation methods
		CLO 20	Analyze photographic mapping, mapping using paper prints, stereo plotting instruments, mosaics and map substitutes
CO 5	Summarize the concept of interaction of electromagnetic radiation with the atmosphere and earth surface	CLO 21	Understand the basic concept of Electromagnetic Spectrum
		CLO 22	Summarize the concept of interaction of electromagnetic radiation with the atmosphere and earth surface
		CLO 23	Analyze remote sensing data acquisition on platforms and sensors
		CLO 24	Analyze visual image interpretation and digital image processing techniques

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACEB01.01	CLO 1	Analyze the sources of errors in linear measurements	PO 1	2
ACEB01.02	CLO 2	Obtain the direction of a surveying line with a prismatic and surveyors compass	PO 1	2
ACEB01.03	CLO 3	Explain the importance of theodolite and understand the principle of measuring angles in horizontal and vertical plains.	PO 1	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACEB01.04	CLO 4	Draw cross section and prepare a contour maps for road works, rail works, canals etc.,	PO 2	1
ACEB01.05	CLO 5	Draw and calculate the area enclosed with in the traverse.	PO 2	1
ACEB01.06	CLO 6	Use Elements of simple, reverse, transition and compound curves at suitable locations	PO 2	1
ACEB01.07	CLO 7	Understand the Method of setting out simple curves, compound curves and reverse curves etc.,	PO 2	1
ACEB01.08	CLO 8	Calculate length of curve using various methods	PO 5	1
ACEB01.09	CLO 9	Analyze geometric design of vertical curve at suitable location.	PO 2	1
ACEB01.10	CLO 10	Understand the basic Principle of Electronic Distance Measurement	PO 2	1
ACEB01.11	CLO 11	Understand different types of EDM instruments such as Distomat, and Total Station.	PO 1	2
ACEB01.12	CLO 12	Summarize the Advantages and Applications Total Station	PO 1	2
ACEB01.13	CLO 13	Understand Field Procedure for total station survey and Errors in Total Station Survey.	PO 1	2
ACEB01.14	CLO 14	Differentiate the advantages of global positioning system and geographical information system.	PO 2, PO 5	1
ACEB01.15	CLO 15	Analyze Co-ordinate transformation and accuracy considerations with GPS.	PO 2	1
ACEB01.16	CLO 16	Understand the basic concepts involved in Photogrammetric surveying.	PO 2	1
ACEB01.17	CLO 17	Understand perspective geometry of aerial photograph.	PO 1	2
ACEB01.18	CLO 18	Analyze relief and tilt displacements using aerial photogrammetric surveying.	PO 1	2
ACEB01.19	CLO 19	Explain terrestrial photogrammetry, flight planning, Stereoscopy, ground control extension for photographic mapping by aerial triangulation and radial triangulation methods.	PO 2, PO 5	1
ACEB01.20	CLO 20	Analyze photographic mapping, mapping using paper prints, stereo plotting instruments, mosaics and map substitutes	PO 2	1
ACEB01.21	CLO 21	Understand the basic concept of Electromagnetic Spectrum.	PO 1	2
ACEB01.22	CLO 22	Summarize the concept of interaction of electromagnetic radiation with the atmosphere and earth surface.	PO 5	1
ACEB01.23	CLO 23	Analyze remote sensing data acquisition on platforms and sensors.	PO 5	1
ACEB01.24	CLO 24	Analyze visual image interpretation and digital image processing techniques	PO 5	1

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)				
	PO 1	PO 2	PO 5	PSO1	PSO2
CO 1	2	2		2	
CO 2		2	2		2
CO 3	2	1		2	2
CO 4	2	2	2	2	
CO 5	3		1	2	2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												2		
CLO 2	3														
CLO 3	1														
CLO 4		2											2		
CLO 5		2													
CLO 6		1												2	
CLO 7		2													
CLO 8					2										
CLO 9		1													
CLO 10		2													
CLO 11	3													2	
CLO 12	3														
CLO 13	2														
CLO 14		1											2		
CLO 15		1													
CLO 16		2											2		
CLO 17	3														

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 18	2												2		
CLO 19		2			2										
CLO 20	2														
CLO 21	3												2		
CLO 22					1										
CLO 23					1									2	
CLO 24					1										

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO5,PSO1, PSO2	SEE Exams	PO1, PO2, PO5,PSO1, PSO2	Assignments	PO2	Seminars	-
Laboratory Practices	PO 5	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

Module-I	INTRODUCTION TO SURVEYING
Principles, Linear, angular and graphical methods, Survey stations, Survey lines ranging, bearing of survey lines, levelling: Plane table surveying, Principles of levelling booking and reducing levels; differential, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes. Triangulation and Trilateration Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control methods, triangulation network signals. Baseline choices instruments and accessories extension of base lines corrections Satellite station reduction to centre, Inter visibility of height and distances, Trigonometric levelling, Axis single corrections.	
Module-II	**CURVES**
Elements of simple and compound curves, Method of setting out, Elements of Reverse curve, Transition curve, length of curve, Elements of transition curve, Vertical curves.	

Module-III	MODERN FIELD SURVEY SYSTEMS
Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station, Parts of a Total Station, Accessories, Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey. Global Positioning Systems (GPS), Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.	
Module-IV	**PHOTOGRAMMETRIC SURVEYING**
Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping aerial triangulation, radial triangulation, methods; photographic mapping, mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes	
Module-V	**REMOTE SENSING**
Introduction, Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing	
Text Books:	
1. Madhu, N, Sathikumar, R and Satheesh Gobi, "Advanced Surveying: Total Station, GIS and Remote Sensing", Pearson India, 2nd Edition, 2006. 2. Manoj, K. Arora and Badjatia, "Geomatics Engineering", Nem Chand & Bros, 2011. 3. Bhavikatti, S.S., "Surveying and Levelling", I.K. International, Vol. I and II, 2010.	
Reference Books:	
1. Chandra, A.M., "Higher Surveying", New Age International (P) Limited, 3rd Edition, 2002. 2. Anji Reddy, M., "Remote sensing and Geographical information system", B. S. Publications, 2001 3. Arora, K.R., "Surveying", Standard Book House, Vol-I, II and III, 2015.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Principles, Linear, angular and graphical methods, Survey stations,	CLO 1	T1:3.1
3	Survey lines ranging, bearing of survey lines	CLO 2	T1:3.14
4-5	Plane table surveying, Principles of levelling booking and reducing levels	CLO 2	T1:11.1
6-7	Levelling differential, reciprocal levelling, profile levelling and cross sectioning.	CLO 3	T1:9.1
8-9	Digital and Auto Level, Errors in levelling; contouring Characteristics, methods, uses	CLO 4	T1:9.4
10-11	Areas and volumes. Triangulation and Trilateration Theodolite survey	CLO 4	R3:13.1
12-13	Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control methods.	CLO 5	R3:14.1
14-15	Triangulation network signals. Baseline choices instruments and accessories extension of base lines corrections Satellite station reduction to centre	CLO 5	R3:14.4
16	Inter visibility of height and distances, Trigonometric levelling, Axis single corrections	CLO 5	R3:9.26
17-20	Elements of simple and compound curves.	CLO 6	R1:8.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
21-25	Method of setting out, Elements of Reverse curve,	CLO 7	R1:6.1
26-28	Transition curve, length of curve,	CLO 8	R1:6.4
29-31	Elements of transition curve, Vertical curves	CLO 9	R1:8.5
32	Principle of Electronic Distance Measurement, Modulation	CLO 10	R1:8.6
33	Types of EDM instruments	CLO 11	R1:11.2
34-35	Distomat, Total Station, Parts of a Total Station and Accessories	CLO 12	R1:11.6
36-39	Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey	CLO 13	R1:11.5
40-43	Global Positioning Systems (GPS), Segments, GPS measurements, errors and biases	CLO 14	R1:11.12
44-47	Surveying with GPS, Co-ordinate transformation, accuracy considerations.	CLO 15	R1:11.13
48-49	Introduction, Basic concepts, perspective geometry of aerial photograph.	CLO 16	R2:7.2
50-53	Relief and tilt displacements, terrestrial photogrammetry, flight planning.	CLO 17	R1:9.1
54-56	Stereoscopy, ground control extension for photographic.	CLO 18	R1:9.4
57-58	Mapping aerial triangulation, radial triangulation, methods	CLO 19	R1:9.6
59-60	Photographic mapping, mapping using paper prints	CLO 20	R1:9.8
61-62	Mapping using stereo plotting instruments, mosaics, map substitutes	CLO 20	R1:9.10
63-65	Introduction, Electromagnetic Spectrum.	CLO 21	R1:10.2
66-69	Interaction of electromagnetic radiation with the atmosphere and earth surface,	CLO 22	R1:10.5
70-73	Remote sensing data acquisition	CLO 23	R1:10.7
74-77	Platforms and sensors; visual image interpretation; digital image processing	CLO 24	R1:10.13

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Compute irregular area and volume of a field by the method of chain triangulation, closed traverse to identify the basic errors	Seminars	PO 1	PSO 1
2	Sketch the profile of land using the levelling instruments and justification of result through algebraic checks	Seminars / NPTEL	PO 5	PSO 1
3	To perform smart work with the application of total station in real life experience to reduce the manual errors involved in reading and recording of measured data	NPTEL	PO 2	PSO 1

Prepared by:
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HOD, CE