Faculty of Topo. & GIS	
No. 02 /Topo & GIS /41-D-1/ Special Course	**Date:** 2nd Jan, 2026
Course: "Route Planning & Transmission Line Survey Using Modern Technologies"	**No. of trainees:**20
Course Duration. 05-01-26 to 02-04-26	**Course Officer:** S.D. Sharma, OS

Session Plan

Session No.	Time	Session Topic/Contents	Mode	Faculty
Day 1: 05th Jan, 2026				
I	**9:30 to 11:00 hrs**	Inaugural / Registration Course Overview		
II	**11:30 to 13:00 hrs**	**Fundamentals of Surveying** • Definition, Objectives and importance of surveying & Mapping • Historical development of surveying • Classification of surveys (based on purpose, instruments and methods) • Types of Maps – Topographical, Cadastral, Thematic Maps, Political Maps, Physical Maps, Relief Maps. • Field planning & Reconnaissance for mapping terrain and elevation	**Lecture**	**S.D.Sharma, OS**

III	**14:00 to 15:30 hrs**	**Principles of Surveying**
		• Fundamental concepts
		• Working from whole to part
		• Location of a point by measurement from known points
		• Supporting principles
		  • Consistency of Measurement
		  • Independent Check
		  • Accuracy and precision proportionate to Purpose
		  • Economy
		  • Redundancy of measurements
		• Accuracy and precision in measurements
			Lecture	**P.S.Kalam, SS**

IV	**16:00 to 17:30 hrs**	**National Geospatial Policy 2022:** • Objectives, • Fundamental Geospatial Data Themes • Importance of Elevation and depth in mapping • Important milestones for realization of Vision & Goals of the Policy. • Geospatial Standards • ISO & BIS Geospatial Standards • United Nations Integrated Geospatial Information Framework (UN-IGIF) • Various Online Platforms for geospatial data. • Accessibility of SOI Data and Toposheets for use in field survey planning. • SOI Index sheets	**Lecture**	**Mahesh R, DSG**

Day 2: 06th Jan, 2026				
I	**9:30 to 11:00 hrs**	Electronic Total Station (ETS) • What is ETS? • Working principles of ETS • Parts of ETS	**Lecture**	**B Anand, OS**

II	**9:30 to 11:00 hrs**	**Coordinate Systems-I**
		• Concept and importance of coordinate systems in Surveying & route planning
		• Types of coordinate systems:
		  • Geographic (geodetic) coordinates: latitude, longitude, height
		  • Rectangular (Cartesian) coordinates: X, Y, Z, etc
		• Conversion between geodetic and rectangular coordinates
		• Mathematical relationships and examples
			Lecture	**D.K.Singh, DSG**

III	**14:00 to 15:30 hrs**	Instrument Setup and Orientation Practice and Observation of Angles and Distances	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	Provision of Control by Traverse Survey using ETS	**Field**	**-do-**
		Day 3: 07th Jan, 2026, 2026		
I	**9:30 to 11:00 hrs**	**Errors in Electronic Total Station** • Collimation Error • Horizontal axis error • Vertical circle index error • Some other Errors in Total Station Observational / Personal Errors, Natural Errors, Target / Prism Errors Adjustments in ETS	**Lecture**	**B Anand, OS**
II	**11:30 to 13:00 hrs**	**Coordinate Systems-II** • Geocentric and topocentric systems • Curves on the ellipsoid of revolution • Meridian, prime vertical, and parallels • Radius of curvature • Principal radii of curvature in meridian and prime vertical	**Lecture**	**S.D.Sharma, OS**
III	**14:00 to 15:30 hrs**	Provision of Control by Traverse Survey using ETS	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	-Contd.-	**Field**	**-do-**
Day 4: 08th Jan, 2026				
I	**9:30 to 11:00 hrs**	ETS Instrument Specifications, Data Structure, Configuration and User Interface	**Lecture**	**S.D.Sharma, OS**

II	**11:30 to 13:00 hrs**	**Datums**
		• Definition and purpose of geodetic datums
		• Horizontal Datum and Reference Ellipsoid
		  • Geometry of ellipsoid: semi-major axis, flattening, eccentricity
		  • Global(WGS 84) vs. Local datums
		  • National Geodetic Reference Frame (Indian datum)
		• Transformation between datums
		  • Determination of transformation parameters between ellipsoids
		  • Bursa–Wolf transformation model (7-
			Lecture	**D.K.Singh, DSG**

		parameter) • Importance of having consistent Datum.		
III	**14:00 to 15:30 hrs**	Provision of Control by Traverse Survey using ETS	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	-Contd.-	**Field**	**-do-**
Day 5: 09th Jan, 2026				

I	**9:30 to 11:00 hrs**	**Map Projections-I**
		• Concept of map projection — need for representing Earth's curved surface on a plane
		• Classification of projections based on:
		  • Developable surface: cylindrical, conical, azimuthal
		  • Projection property: conformal, equal-area, equidistant
		• Conformal map projection — preservation of angles and shapes
		• Isometric latitude and scale factor
		• Conditions for conformality
			Lecture	**Yogachandar PA, SS**

II	**11:30 to 13:00 hrs**	**Introduction to Error** What is measurement (Direct and Indirect) and error in surveying? Definition: Mistake; Systematic errors; Random errors Precision Vs Accuracy Definition: True Value; Error; Most probable value; residual; Degree of freedom; variance; standard deviation Root mean square error	**Lecture**	**P.S.Kalam, SS**

III	**14:00 to 15:30 hrs**	**Map Projections-II**
		• Mercator and Transverse Mercator Projections
		  • Mathematical formulae and characteristics
		  • Universal Transverse Mercator (UTM) projection: properties, formula, and grid system
		  • Web Mercator
		• Lambert Conformal Conic (LCC) Projection
		  • Single and two standard parallels
		  • Formula and construction steps
		• Conversion between different projections
			Lecture	**S.D.Sharma, OS**

IV	**16:00 to 17:30 hrs**	**Demo on Robotic Total Station**	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
Day 6: 12th Jan, 2026				

I	**9:30 to 11:00 hrs**	**Control Survey**
		• National Spatial Reference Framework(NSRF)
		• Classification of control surveys – Horizontal and Vertical
		• Horizontal control: definition,orders, accuracy standards and planning
		• Methods of establishing horizontal control
		  • Triangulation
		  • Trilateration
		  • Traversing
		  • GNSS/GPS-based control
		• Instruments used — theodolite, total station / ETS, Popular GNSS receivers.
		• LiDAR, UAV survey
			Lecture	**S.D.Sharma, OS**

II	**11:30 to 13:00 hrs**	**Error Analysis** Random Error Statistical tool for quantifying the quality of observation and final result: t distribution, chi distribution, f- distribution Confidence Interval Introduction to error propagation and Least square adjustment	**Lecture**	**P.S.Kalam, SS**
III	**14:00 to 15:30 hrs**	Detailed Survey using ETS	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	**-Contd.-**	**Field**	**-do-**
Day 7: 13th Jan, 2026				

I	**9:30 to 11:00 hrs**	**Vertical Control Survey**
		• Definition
		• Basic principles of leveling
		• Indian Vertical Datum, MSL, Geoid
		• Methods of establishing vertical control
		  • Spirit levelling
		  • Trigonometrical levelling
		  • GNSS-based height determination
		• Profile Data Collection
		• Digital Terrain Model, Digital Elevation Model,Digital Surface Model
			Lecture	**S.D.Sharma, OS**

II	**11:30 to 13:00 hrs**	**Errors in Vertical Control Survey, Types, Bench Marks, and Instruments** • Sources of errors in leveling • Classification of levelling – ST/DT, HP and accuracy standards • Types of Bench Marks in Survey of India • Instruments used in levelling	**Lecture**	**S.D.Sharma, OS**
III	**14:00 to 15:30 hrs**	Detailed Survey using ETS	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	**-Contd.-**	**Field**	**-do-**
		Day 8: 15th Jan, 2026		
I	**9:30 to 11:00 hrs**	**Standards for Transmission Line Survey** • BIS standards for transmission Survey • Preparation of Route Alignment Map • Detailed Survey • Preparation of Survey Chart • Check Survey	**Lecture**	**S.D.Sharma, OS**

II	**11:30 to 13:00 hrs**	**Map reading**
		• **Introduction to Map Reading**
		  • Importance and purpose of map reading in surveying.
		  • SOI toposheets and Index
		  • Sheet Numbering system of SoI
		• **Basic Elements of a Map**
		  • Title, legend, north direction, scale and marginal information
		  • Map symbols and their meanings (natural and
			Lecture	**B Anand, OS**

		man-made features) • Grid lines, coordinates and index information • Magnetic declination		
III	**14:00 to 15:30 hrs**	Detailed Survey using ETS	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	**-Contd.-**	**Field**	**-do-**
Day 9: 16th Jan, 2026				

I	**9:30 to 11:00 hrs**	• **Map Scales and Measurements**
		  • Types of scales — numerical, graphical
		  • Measuring distances and areas on maps
		• **Contours and Relief Representation**
		  • Definition of contour and contour interval
		  • Interpretation of contour patterns (hill, valley, ridge, depression, spur, etc.)
		  • Hill shading
		  • Determining slope and gradient from contours
		  • Sheet Numbering system of SoI
		  • Planning Route with the help of SoI Maps
			Lecture	**B Anand, OS**

II	**11:30 to 13:00 hrs**	**Collection of Profile Data for Transmission line construction** • Reconnaissance Survey • Selection and Marking of Angle Points (APs) • Establishment of Survey Control Points • Longitudinal (Centerline) Profile Survey	**Lecture**	**S.D.Sharma, OS**
III	**14:00 to 15:30 hrs**	Hands on session with ETS Instrument	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
IV	**16:00 to 17:30 hrs**	**-Contd.-**	**Field**	**-do-**
Day 10: 19th Jan, 2026				
I	**9:30 to 11:00 hrs**	**Collection of Profile Data for Transmission line construction** • Cross-Section Survey • Obstacle Mapping (Rivers, Roads, Lines, Structures) • Corridor survey/Strip maps • Preparation of Plan and Profile Sheets • Field Documentation and AP Sketches	**Lecture**	**S.D.Sharma, OS**
II	**11:30 to 13:00 hrs**	Hands on session with ETS Instrument	**Field**	**Anurag Mishra, Syr K. Omkar Swamy, Syr O. Praveen Kumar, Syr V Thang Thuam, Syr**
III	**14:00 to 15:30 hrs**	Hands on session with ETS Instrument	**Field**	**-do-**
IV	**16:00 to 17:30 hrs**	Hands on session with ETS Instrument	**Field**	**-do-**
Day11: 20th Jan, 2026				
I	**9:30 to 11:00 hrs**	Introduction to GNSS and its Signal Structure • GNSS Fundamentals: What is GNSS and Why we use it?. • GNSS Signals: Frequencies, Codes, Carriers & Navigation Message	**Lecture**	**D.K. Singh, DSG**
II	**11:30 to 13:00 hrs**	Working principle of GNSS and Precaution to be taken • How GNSS Determines Position — Ranging & Trilateration.	**Lecture**	**Bhaskar Sharma, OS**

		• Precautions To Be Taken During Gnss Surveying		
III	**14:00 to 15:30 hrs**	Types of Error & mitigation • Types Of GNSS Errors & mitigation • Satellite-Related Errors & mitigation • Atmospheric Errors & mitigation • Receiver-Related Errors & mitigation	**Lecture**	**Vivek Dwivedi, OS**
IV	**16:00 to 17:30 hrs**	GNSS Instrument Specifications • Positioning Performance Specifications • Signal Tracking Capability • Antenna Specifications • Data Handling & Recording • Communication & Connectivity • Power & Battery	**Lecture**	**Sumit Bhadra, OS**
Day 12: 21st Jan, 2026				
I&II	**9:30 to 13:00 hrs**	GNSS Surveying Methods • No. of receivers used • Whether corrections are applied in real-time or post-processed • Whether the receiver is static or moving • Accuracy requirement	**Lecture**	**Bhaskar Sharma, OS**
II	**11:30 to 13:00 hrs**	-Contd.-	**Lecture**	**-do-**
III&IV	**14:00 to 17:30 hrs**	GNSS Static and Rapid Static observation at Base and Rover Station simultaneously	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
IV	**16:00 to 17:30 hrs**	-Contd.-	**Field**	**-do-**
Day 13: 22nd Jan, 2026				
I	**9:30 to 11:00 hrs**	Introduction to CORS • What is a CORS station • Why is **CORS** needed • How does a CORS system work • What is a CORS network	**Lecture**	**Sumit Bhadra, OS**
II	**11:30 to 13:00 hrs**	Registration For Use Of CORS On Survey of India CORS Site	**Lecture**	**Vivek Dwivedi, OS**
III & IV	**14:00 to 17:30 hrs**	Baseline Processing and Adjustment of GNSS Static and Rapid Static Data (TBC) Observed in the Field, along with Processing of the Same Station Using Downloaded CORS Data	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 14: 23rd Jan, 2026				
I,II,III& IV	**9:30 to 17:30 hrs**	Baseline Processing and Adjustment of GNSS Static Rapid Static Data (TBC) Observed in the Field, along with Processing of the Same Station Using Downloaded CORS Data	**Lab**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 15: 27th Jan, 2026				
I&II	**9:30 to 13:00 hrs**	RTK Method of Observation in Field (F)	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
III&IV	**14:00 to 17:30 hrs**	NRTK Observation using CORS in Field	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 16: 28th Jan, 2026				
I,II,III& IV	**9:30 to 17:30 hrs**	**Hands on Session with GNSS Instruments** • Provide control point using Static Observation. • Provide control point using NRTK Observation	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 17: 29th Jan, 2026				
I	**9:30 to 11:00 hrs**	Fundamental Principles and Procedures of Levelling • Fundamental Principles Of Levelling	**Lecture**	**Vivek Dwivedi, OS**

		• Standard Field Procedures • Method of Computing Reduced Level		
II	**11:30 to 13:00 hrs**	Geoid as the Reference Surface for Height Determination • What is the geoid • Why geoid is used for heights	**Lecture**	**Bhaskar Sharma, OS**
III	**14:00 to 15:30 hrs**	Heights and Their Interrelationships: • Orthometric • Ellipsoidal • Geoidal Heights	**Lecture**	**Vivek Dwivedi, OS**
IV	**16:00 to 17:30 hrs**	Levelling Instrumentation and Specifications • Types Of Levelling Instruments • Components Of Levelling Instruments • Levelling Staff Specifications • Accuracy Specifications Of Levelling Instruments	**Lecture**	**Manuj K Kumar, Syr**
Day 18: 30th Jan, 2026				
I,II,III& IV	**9:30 to 17:30 hrs**	Levelling Practical	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 19: 02th Feb, 2026				
I,II,III& IV	**9:30 to 17:00 hrs**	-Contd.-	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**
Day 20: 03th Feb, 2026				
I,II,III& IV	**9:30 to 17:00 hrs**	Hands on Session with Levelling Instrument	**Field**	**Goutam K Anand, Syr Shashi Kiran N, Syr Manuj K Kumar, Syr**

Tea break I 11:00 to 11:30 hrs
Lunch break 13:00 to 14:00 hrs
Tea break II 15:30 to 16:00 hrs

(Pankaj Singh Kalam)
Superintending Surveyor
Faculty of Topo. & GIS

Copy to:

1. The Addl. S.G.(NIGST) / DSG (Tech.), NIGST for information please.
2. Head, Faculty of Geodesy/P&RS/R&D/Geo-ICT for information please.
3. The officers mentioned above for information and n/a.