Time : Three hours   FullMarks: 70

Figures in the margin indicate full marks
(One mark is reserved for neatness in each half)

FIRST HALF
Answer any four questions

1.   (2+6.5)
a)   What is 'spherical excess' for a spherical triangle?
b)   What is the geodetic area enclosed within the spherical triangle between Kolkata (88°20' E, 22°32' N), Mumbai (72°50' E, 18°58' N) and Delhi (77°13' E, 28°38' N)? What is the 'convergence' between Kolkata and Delhi and shortest distance between them? What will be the direction of flight from Kolkata to Delhi?

2.   ·   (2+6.5)
a)   'The bearing of a particular line (AB) is unique; while azimuth is not unique' – Justify.
b)   In order to ascertain the directions of the underground flow of water, borings were taken at points A, B, and C; B being true north of A and C lying eastward of A and B. The distance from A to B was 914.6 m, B to C 1219.5 m and A to C 1524.4 m. The observed underground water levels above the datum were at A 39.63, at B 51.83 and at C 3.05 m. What is the direction of the underground flow of water?

3.   (3+5.5)
a)   Show with a sketch the right ascension, hour angle and azimuth of a star.
b)   Draw a neat diagram of the celestial sphere to show the following:

   i)   Zenith, nadir and celestial horizon
   ii)   Celestial poles and equator
   iii) First point of Aries and first point of Libra
   iv)   Ecliptic
   v)   Position of the Sun
   vi)   Position of earth
   vii) Position of a star, RA = 3 h and declination = 55° N
          Given that :
   (i)   Date of observation : July 3, 1979
   (ii) Place of observation : 22.5° N and 88.5° E
   (iii) Time of observation : LAT = 10.30 h
   (iv) RA of Sun = 6 h 49 m

4.   (3+2.5+3)
a)   On a ship, the following measurements are made of the stars Alpha Centauri (Azimuth: 183.0°; Zenith distance: 74.0°) and Vega (Azimuth: 51.0°; Zenith Distance: 54.5°). The declinations of the Alpha Centauri and Vega are -60.5° and 38.5°. Find the latitude.
b)   What are parallax and semidiameter corrections for astronomical observations?
c)   An observation gave the meridian altitude of the lower limb of the Sun as 28°57'52" looking towards the south point of the horizon. Sun's declination is 9°17'30" S. Apply the following corrections and compute the latitude of the station:
   Semidiameter   =   16'05"
   Parallax   =   8"
   Refraction   =   1'47"

5.   (2.5 + 2+4)
a) "Overlap and sidelap are necessary for proper aerial photographic coverage" – Discuss this statement.
b) What is parallax in stereophotogrammetry?
c) An aircraft flying at an altitude of 4600 m above MSL photographs 5 strips of 20 photographs each of a terrain having h_{avg} = 300 m above MSL. If f = 205.53 mm, find the scale of the photograph and the area covered by each photograph of size 23 x 23 cm. Assuming 60% forward and 20% sidelap, find the total area covered by the photography.

6.   (3+3+2.5)
a) Briefly indicate, with aid of sketches, the displacements that make an aerial photograph of the terrain different from map of such terrain.
b) Points A and B are at elevations 273 m and 328 m above datum, respectively. The photographic coordinates of their images on a vertical photograph are:
x_a = -68.27 mm; x_b = -87.44 mm
y_a = -32.37 mm; y_b = 26.81 mm
What is the horizontal length of the line AB if the photo was taken from 3200 m above datum with a 21 cm focal length camera?
c) What is the height of a tower above terrain which appears on a truly vertical photograph with the following data:
Flying height above base of tower = 3200 m
Distance between principal point and the image of the tower base = 75.11 mm
Distance between principal point and the image of the top of the tower = 82.54 m

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SECOND HALF
Answer Question No. 7 and any two from the rest

7. Write short notes on the following (any four):   (4×3 = 12)
a) True value and most probable value of a quantity
b) Geostationary satellite and Sun-synchronous satellite
c) Independent quantity and Conditioned quantity
d) Radiometric Resolution
e) Spatial resolution
f) Passive sensing and active sensing
g) Consecutive coordinates and Independent coordinates

8.   (3+3 +5)
a) Calculate the most probable value and the probable error of the volume of a box whose sides are 10 ± 0.02 m, 12 ± 0.01 m and 10 ± 0.03 m.
b) Find the most probable value of the angle A from the following observation equations:
A = $40^0 20'12"$ – weight 1, 2A = $80^0 40'20"$ – weight 2 and 6A = $242^0 1'6"$ – weight 3
c) State laws of weights with example.

9.   (4+7)
a) Derive the expression for the horizontal distance D of a vertically held staff for a tacheometer if the line of sight of the telescope is inclined upwards.

b) Following observations were made by a tacheometer fitted with a anallatic lens having multiplying constant =100.00

Instrument station	Staff Station	Vertical angle	Staff hair reading (m)			Remarks
			Lower	Middle	Upper	
A	Bench Mark	-2°24'	1.20	1.83	2.46	Reduced level of the
A	B	+4°36'	1.35	1.82	2.29	bench mark
B	C	+6°12'	0.72	1.88	2.04	= 37.725 m

If the height of the instrument at A and B are 1.44m and 1.41m respectively and the staff held vertically, compute the elevations of A, B and C.

10.   (5 + 6)
a) 'Following observations are made for a closed traverse.

Line	Latitude (m)	Departure (m)
AB	-300	+450
BC	+640	+110
CD	+100	-380
DE	-440	-180

Compute the area of the traverse by (a) co-ordinate method (b) the departure and total latitude method.

b) A straight tunnel is to be run between two points A and B, whose independent coordinates are:

Point	Independent coordinates	
	N	E
A	0	0
B	3014	256
C	1764	1398

It is desired to sink a shaft at D, the mid-point of AB, but it is impossible to measure along AB directly. So D is to be fixed from C, another point whose coordinates are known. Calculate the (i) Independent coordinates of D (ii) Length and bearing of CD (iii) angle ACD, given the W.C.B. of AC is $38^0 24'$.

11.   (11)
The length and bearings of a closed traverse ABCD, as observed with a transit theodolite are given below. Prepare a Gale's traverse table.

Line	Length	Included angle	W.C.B.
AB	255 m	$\angle A = 93^0 18' 16''$	$140^0 42'$
BC	656 m	$\angle B = 74^0 16' 25''$	
CD	120 m	$\angle C = 123^0 42' 00''$	
DA	668 m	$\angle D = 68^0 41' 16''$	