UNIVERSITY OF LONDON

B.Sc. (ENGINEERING) EXAMINATION 1964

PART III

for Internal and External Students

(23) MECHANICS OF FLUIDS AND SURVEYING II

SURVEYING

Tuesday 16 June: 2.30 to 5.30

Answer FIVE questions.

1. If a great circle line of length D miles joins two points A and B of the same latitude λ, show that the azimuth angle for setting out the line from either end will differ from 90° or 270° by an amount α, given by:

$$\sin \alpha = \frac{D}{2R} \tan \lambda$$

where R is the radius of the earth in miles. Show also that the maximum offset distance Δ, from the line to the line of latitude connecting A and B is given by:

$$\Delta = \frac{D^2}{8R} \tan \lambda .$$

If the distance from A to B is 30 miles and the common latitude is N 54°, find the azimuth of AB to the nearest second and, by slide rule, the maximum offset distance. Take the earth's radius as 3956 miles.

2. Describe, with sketches, how a minor control plot is obtained from a set of overlapping vertical air photographs. How does the use of slotted templates facilitate the work when a large number of photographs is involved?

3. List the corrections usually applied to base-line observations stating the meaning of the symbols used and their units. Describe two methods of setting out a base-line indicating the conditions under which each would be used.

Turn over

RP 64/97/28/350

4. The right ascensions and declinations of two stars to be used to determine the latitude of a place, whose longitude is E 30° 50′ 39″ and whose approximate latitude is S 20° are given below:

Star	R. A.	Declination
1	10h 17m 56·5s	N 20° 01′ 45″
2	10h 30m 43·8s	S 61° 30′ 00″

If the value of R at the previous Greenwich mean noon is 10h 33m 48·2s, determine the G.M.T. of local transit of the stars.
The maximum observed altitudes of stars 1 and 2 at transit are 49° 55′ 23″ and 48° 34′ 32″ respectively. What is the latitude of the place?

5. A circular curve must pass through a point P, which is 210·7 ft from I, the intersection point and on the bisector of the internal angle of the two straights AI, IB. Transition curves 600 ft long are to be applied to each end and one of these must pass through a point whose co-ordinates are 500 ft from the first tangent point along AI and 9·7 ft at right angles from this straight. IB deflects 37° 54′ right from AI produced. Calculate the radius and tabulate the data for setting out the complete curve.

6. The observed angles of a polygon ABCD with central point P are set out in the table together with their log sin differences for 1 sec (e.g. 0.0000017). Adjust the polygon angles to the nearest second by the method of equal shifts. All angles have the same weight. The L.H. log sin sum minus the R.H. log sin sum = 0.0000435.

	Central	L.H. Angles		R.H. Angles		Sum
△	Observed	Observed	Diff 1″	Observed	Diff 1″	Sum
APB	65° 58′ 00″	51° 08′ 05″	17	62° 54′ 15″	11	180° 00′ 20″
BPC	114° 02′ 00″	36° 13′ 20″	29	29° 44′ 25″	37	179° 59′ 45″
CPD	65° 57′ 20″	61° 45′ 15″	11	52° 17′ 15″	16	179° 59′ 50″
DPA	114° 02′ 20″	30° 13′ 25″	36	35° 44′ 10″	29	179° 59′ 55″

7. Two stations A and B are 5710 ft apart. The following observations were recorded: height of instrument at A, 4·64 ft and at B, 4·88 ft; height of signal at A, 7·33 ft and at B, 6·67 ft. Elevation to signal at B, 1° 08′ 08″, depression angle to signal at A, 1° 06′ 15″. If 1 second at the earth's centre subtends 101·31 ft at the earth's surface, calculate the difference of level between A and B and the refraction correction.

8. From a station P, the angles subtended by points Q, R, S and T were measured by two observers A and B. The results are tabulated below:

Angle		Observer
QPR	16° 02′ 51″	A
RPS	40° 34′ 08″	A
SPT	22° 11′ 04″	A
QPS	56° 37′ 01″	B
RPT	62° 45′ 09″	B

In order to apportion weights to their observations, a separate test was carried out, in which both A and B measured a given angle a large number of times. The analysis of the test showed that the standard error of B was twice that of A. Apply appropriate weights to the observations and determine the most probable values of the angles to the nearest 0·1 seconds.

9. In a triangle ABC, AB = 17 350 ft, AC = 17 046 ft and the angles B and C were 55° 01′ 05″ and 62° 04′ 20″ respectively. Station A could not be occupied and observations were taken from P, 37 ft from A and inside the triangle. Instrument readings at P were: on A, 00° 00′ 00″, on C, 148° 28′ 40″, on B, 211° 31′ 10″. Calculate the angular error in the triangle.

D. GADD
F. C. SCOTT