	Scheme of Valuation			
	TED (15)-3012 Surveying -II (REVISION – 2010) check	Score	Sub Total	Total
	PART - A			
I (1)	Transiting is the process of turning the telescope in vertical plane through 180° about the trunnion axis.	1	2	
	Swinging the telescope is the process of turning the telescope in horizontal plane	1		
I(2)	The latitude of a survey line may be defined as its co-ordinate length measured parallel to an assumed meridian direction (i.e., true north or magnetic north or any other reference direction).	1	2	
	The departure of a survey line may be defined as its co-ordinate length measured at right angles to the meridian direction.	1		10
I (3)	Stadia tacheometry is based on the principle that the ratio of the perpendicular to the base is a constant in similar isosceles triangles.	2	2	
I(4)	Transition curve -A curve whose radius varies gradually from infinity to finite value equal to the radius of circular curve to be connected is known as transition curve. It is to be introduced between a straight and a curve path.	2	2	
I (5)	Aerial Photogrammetry is that branch of photogrammetry, where the photographs are taken by a camera mounted on aircraft flying over the area.	1	2	
	Terrestrial Photogrammetry is that branch of photogrammetry where in the photographs are taken from a fixed position on or near the ground.	1		

PART - B

II(1) The following errors are eliminated by method of repetition

1. Errors due to eccentricity of verniers and centres are eliminated by taking both vernier readings. 1½
2. Errors due to inadjustments of line of collimation and the trunnion axis are eliminated by taking both face readings. 1½
3. The error due to inaccurate graduations are eliminated by taking the readings at different parts of the circle. 1½
4. Errors due to inaccurate bisection of the object, eccentric centring, etc., may be to some extent counter-balanced in different observations. 1½

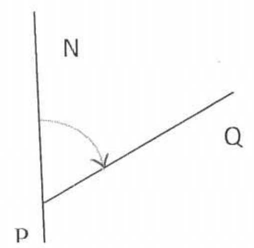
6

II(2) To measure the magnetic bearing of a line with a theodolite, the theodolite should be provided with either a tubular compass or trough compass. 1

The Following are the steps:

1. Set the instrument at P and level it accurately. 1
2. Set accurately the vernier A to zero. 1
3. Loose the lower clamp. Release the needle of the compass. Rotate the instrument about its outer axis till the magnetic needle roughly points to north. Clamp the lower clamp. Using the lower tangent screw, bring the needle exactly against the mark so that it is in magnetic meridian. The line of sight will also be in the magnetic meridian 1
4. Loose the upper clamp and point the telescope towards Q. Bisect Q accurately using the upper tangent screw. Read verniers A and B. 1
5. Change the face and repeat steps 2, 3 and 4. The average of the two will give the correct bearing of the line PQ. 1

6



3

II (3) Bowditch's method

The basis of this method is on the assumption that the errors in linear measurements are proportional to $\sqrt{l}$ and that the errors in angular measurements are inversely proportional to $\sqrt{l}$ where l is the length of a line. Bowditch's rule is mostly used to balance a traverse where linear and angular measurements are of equal precision. The total error in latitude and in the departure is distributed in proportion to the lengths of the sides. 1 3

Bowditch's rule is :

Correction to latitude (or departure) of any side = Total error in latitude (or departure) X (Length of that side / Perimeter of traverse) 2

Thus, if CL = correction to latitude of any side

CD = Correction to departure of any side

ΣL = Total error in latitude

ΣD = Total error in Departure

Σl = Length of the perimeter

l = Length of any side 6

$$C_L = \sum L.\frac{l}{\sum l}$$

$$C_D = \Sigma D.\frac{l}{\Sigma l}$$

Transit Method

Transit rule may be employed where angular measurements are more precise than the linear measurements. According to this rule, the total error in latitudes and in departures is distributed in proportion to the latitudes and departures of the sides 1 3

Transit rule is :

Correction to latitude (or departure) of any side = Total error in latitude (or departure) X (Latitude (or departure) of that line / Arithmetic sum of latitudes (or departures) 2

Thus, if L = Latitude of any line

D = Departure of any line

L_T = arithmetic sum of latitudes

D_T = arithmetic sum of departures

We have $C_L = \sum L.\frac{L}{L_T}$

$$C_L = \Sigma D.\frac{D}{D_T}$$

II (4) In order to have a check on field work and in order to balance a traverse, the lengths and direction of each line is generally measured in the field. There are times, however, when it is not possible to take all measurements due to obstacles or because of some over-sight. Such measurements are known as omitted measurements or missing quantities and can be calculated by latitudes and departures provided the quantities required are not more than two. There are four general cases of omitted measurements 1 /6

2

1. (a) When the bearing of one side is omitted

   (b) When the length of one side is omitted

   (c) When the bearing and length of one side is omitted

2. When the length of one side and the bearing of another side are omitted 1
3. When the lengths of two sides are omitted. 1
4. When the bearings of two sides are omitted. 1

II (5) <u>Fixed hair method</u>

In this method the observation along the staff is made with the help of a stadia diaphragm having stadia wires at fixed or constant distance apart. The readings on the staff corresponding to all the three wires are taken. The staff intercept i.e., the difference of the readings corresponding to top or bottom wires will therefore, depend on the distance of the staff from the instrument. When the staff intercept is more than the length of the staff, only half intercept is read. For inclined sights, readings may be taken by keeping the staff either vertical or normal to the line of sight. 3

This is the most common method of tacheometry and the name stadia method generally bears reference to this method.

Movable Hair Method or Subtense Method

This method is similar to the fixed hair method except that the stadia interval is variable. Suitable arrangement is made to vary the distance between the stadia hair so as to set them against the two targets on the staff kept at the point under observation. Thus, in this case, the staff intercept,i.e.,the distance between the two targets is kept fixed while the stadia interval i.e., the distance between the stadia hairs is variable. As in the case of fixed hair method, inclined sights may also be taken. 3 6

II (6) S = 3.250 -0.950 = 2.300m

h = 0.950m

$$D = \frac{S}{\tan 6^\circ 30' - \tan 4^\circ 30'}$$ 3

= 65.340m 6

$$V = D \tan \theta_1 = 65.340 \times \tan 4^\circ 30'$$ 1

RL of A = RL of instrument axis + V – h 2

= 255.50 + 5.142 – 0.950

= 259.692m

II (7) Functions of total station

1) To give average angles and measurements electronically
2) To adjust the measurements from the pressure of climate and temperature changes.
3) To find the heights in trigonometrical leveling
4) To correct the defects due to curvature and refraction
5) Changing the inclined lengths to horizontal lengths
6) To find the vertical heights directly
7) To measure the area with single station

8) To orient the total station by resection method
9) Making the centre line for typical residential building
10) Longitudinal section and cross sections for proposed road/ canal or pipe line (any 6 points) 6x1 = 6

6x1 | 6

PART –C
UNIT -I

III (a) The fundamental lines and their relations of a theodolite.

The fundamental lines of a transit are:

1. The vertical axis
2. The horizontal axis (or trunnion or transit axis)
3. The line of collimation (or line of sight)
4. Axis of plate level
5. Axis of altitude level
6. Axis of the striding level, if provided

6x½

Following are the relationships between the fundamental lines.

1. The axis of the plate level must lie in a plane perpendicular to the vertical axis.
2. The line of collimation must be perpendicular to the horizontal axis at its intersection with the vertical axis.
3. The horizontal axis must be perpendicular to the vertical axis.
4. The axis of the altitude level must be parallel to the line of collimation.
5. The vertical circle vernier must read zero when the line of collimation is horizontal.
6. The axis of the striding level must be parallel to the horizontal axis.

5 ~~6½~~ | 8

III (b) The method known as direction method or reiteration method or method of series is suitable for the measurement of the angles of a group having a common vertex point.Several angles are measured successively and finally the horizon is closed.

1

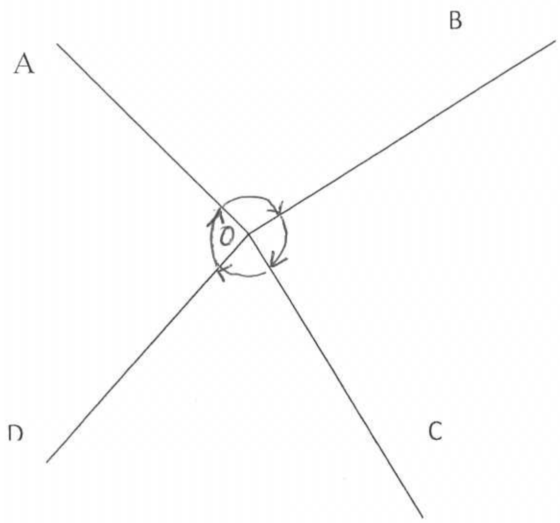
Procedure

Let the angles to A, B, C and D from station point O are to be measured.

6 | 7

1. Set the instrument over O and level it. Set one vernier to zero and bisect point A accurately.
2. Loose the upper clamp and turn the telescope clockwise to point B. Bisect B accurately using the upper tangent screw. Read both verniers. The mean of the vernier readings will give the angle AOB.
3. Similarly, bisect successively, C, D, etc., thus closing the circle. Read both the verniers at each bisection. Since the graduated circle remains in a fixed position through the entire process, each included angle is obtained by taking the difference between two consecutive readings.
4. On final sight to A, the reading of the vernier should be the same as the original setting. If not, note the reading and find the error due to slips, etc. and if the error is small, distribute it equally to all angles. If large, repeat the procedure and take a fresh set of readings.
5. Repeat steps 2 to 4 with the other face.

15

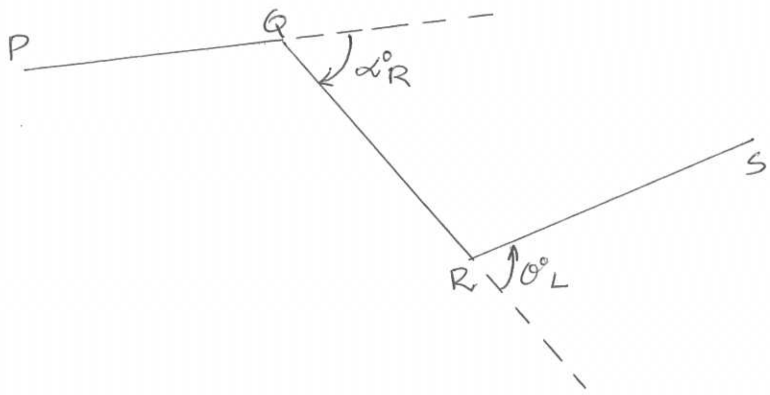


IV (a) Deflection angle is the angle which a survey line makes with prolongation of the preceding line 2

Procedure

To measure deflection angle at Q:

1. Set the instrument at Q and level it
2. With both plates clamped at 0^0, take back sight on P.
3. Plunge the telescope. Thus the line of sight is in the direction PQ produced when the reading on vernier A is 0^0
4. Unclamp the upper clamp and turn the telescope clockwise to take the foresight on R. Read both the verniers. 6 8
5. Unclamp the lower clamp and turn the telescope to sight P again. The verniers still read the same reading as in (4). Plunge the telescope.
6. Unclamp the upper clamp and turn the telescope to sight R. Read both verniers. Since the deflection angle is doubled by taking both face readings, one half of the final reading gives the deflection angle at Q (procedure 6 marks)



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IV (b) List out the temporary and permanent adjustments of a transit theodolite

Temporary adjustments are :

1. Setting over the station 3
2. Levelling up
3. Elimination of parallax

Permanent adjustments are:

1. Adjustment of plate level 7
2. Adjustment of the cross hairs of the diaphragm
3. Adjustment of the line of sight 4
4. Adjustment of the horizontal axis
5. Adjustment of the vertical circle index

UNIT –II

V(a)

Bearing of AB		=	$221^0 18'40''$
Add	<B	=	$\underline{114^0 55'40''}$
			$336^0 14'20''$
Deduct			$\underline{180^0 00'00''}$
Bearing of BC		=	$156^0 14'20''$
Add	<C	=	$\underline{94^0 38'50''}$
			$250^0 53'10''$
Deduct			$\underline{180^0 00'00''}$
Bearing of CD		=	$70^0 53'10''$
Add	<D	=	$\underline{129^0 40'40''}$
			$200^0 33'50''$
Deduct			$\underline{180^0 00'00''}$
Bearing of DE		=	$20^0 33'50''$
Add	<E	=	$\underline{112^0 54'30''}$
			$133^0 28'20''$
Add			$\underline{180^0 00'00''}$
Bearing of EA		=	$313^0 28'20''$
Add	<A	=	$87^0\underline{50'20''}$
			$401^0 18'40''$
Deduct			$\underline{180^0 00'00''}$
Bearing of AB		=	$221^0 18'40''$

Which agrees with the observed bearing of AB and therefore checks the arithmetical work.

V(b) In traversing, when the survey lines form a circuit which ends at the starting point, it is known as a closed traverse and if the circuit ends elsewhere, it is said to be an open traverse.

The errors involved in traversing are two kinds: linear and angular:

For important work the most satisfactory method of checking the linear measurements consists in chaining each survey line a second time, preferably in the reverse direction on different dates and by different parties.

The following are the checks for the angular work:

(1) Traverse by included angles

(a) The sum of measured interior angles will be equal to (2N-4) right angles, where N = number of sides of the traverse. 2

(b) If the exterior angles are measured their sum should be equal to (2N+4) right angles. 7 15

(2) Traverse by deflection angles

The algebraic sum of the deflection angles should be equal to 360^0, taking the right hand deflection angles as positive and left hand angles as negative. 1

(3) Traverse by direct observation of bearings

The fore bearing of the last line should be equal to back bearing $\pm180^0$ measured at the initial station. 1

VI (a) The computations for a closed traverse may be made in the following steps and entered in a tabular form known as Gale's Traverse Table. 2

1. Sum up all the included angles. Their sum should be equal to (2N±4) right angles according as the interior or exterior angles are measured, where N is the number of sides of the traverse.
2. If not apply the necessary corrections to the angles so that the sum of the corrected angles will exactly equal (2N±4) right angles. 8
3. Calculate the whole circle bearings of the other lines from the observed bearing of the first line and the corrected included angles.
4. From the whole circle bearings of the lines, deduce the reduced bearings (R.B.) of the lines, and determine the quadrants in which the line lie 6
5. From the given lengths and the calculated reduced bearings of the lines, compute their latitudes and departures (consecutive coordinates)
6. Add all northings, and add all southings, and find the differences between the two sums. Similarly obtain the the sum of all eastings and the sum

all westings.

7. Apply the necessary corrections to the latitudes and departures so that the sum of the northings equal to that of the southings and the sum of the eastings equals that of the westings.
8. From the corrected consecutive coordinates, obtain the independent coordinates of the lines so that they are all positive, the whole of the traverse thus lying in the first quadrant (N.E.)

VI (b) RB of PQ = 180°0'0'' - 140°15'0'' = S 39°45'0'' E

RB of QR = N 36°25'0''

RB of RS = 360°0'0'' - 338°45'0'' = N 21°15'0'' W

Latitude of PQ = 70.80 X cos39°45'0'' = -54.434

Departure of PQ = 70.80 X sin39°45' = +45.272

Latitude of QR = 195.90 X cos36°25' = +157.6448

Departure of QR = 195.90 X sin36°25' = +116.2966

Latitude of RS = 35.20 X cos21°15' = +32.8066

Departure of RS = 35.20 X sin21°15' = +12.7578

Lat. Of PQ + Lat:of QR + Lat.of RS + Lat. SP = 0

-54.434 + 157.6448 + 32.8066 + Lat. Of SP = 0

Lat. Of SP = -136.0174

3

Dep. Of PQ + Dep.of QR + Dep. RS + Dep. Of SP = 0

+45.272 + 116.2966 -12.7578 + Dep. Of SP = 0

Dep.of SP = -148.8188 7 15

$$Length\ of\ SP = \sqrt{(-136.0174)^2 + (-148.8188)^2}$$

$\cancel{4}$ 2

= 201.6129m

$$tan\theta = \frac{-148.8188}{-136.0174} = \frac{Dep.of SP}{Lat.of\ SP}$$

$\theta = 47°34'$

2

SP lies in III quadrant

$\theta = S47°34'E$

VII(a) Given k = 100 , C = 0.15, S = 2.250 - 0.750 = 1.500m θ= $8^0 12'$

Horizontal Distance CD

$D = ks\ cos^2\theta + C\ cos\theta$ 4

$CD = 100 \times 1.500\ cos^2 8°12' + 0.15\ cos 8°12'$

= 147.097m

Reduced Level of D

RL of instrument axis = RL of BM + V_1 + h_1 1

$V = ks\ \frac{sin2\theta}{2} + C\ sin\theta$ 1

$\theta = 5°12'$ $S = 2.450 - 1.150 = 1.300$ 8

$V_1 = 100 \times 1.300 \times \frac{sin2(5°20')}{2} + 0.15\ sin5°20'$

= 12.045m

$h_1 = 1.800m$

∴RL of instrument axis = 750.500 + 12.045 + 1.800

= 764.345m

RL of D = RL of instrument axis + V_2 – h_2 1

$V_2 = 100 \times 1.500 \times \frac{sin2(8°12')}{2} + 0.15\ sin8°12'$

= 21.1756 + 0.0214

= 21.197m

$h_2 = 1.500m$ 1

RL of D = 764.345 + 21.197 – 1.500

= 784.042m

VII (b) Anallactic lens is an additional convex lens placed between the diaphragm and objective at a fixed distance from the latter. 2

By providing anallactic lens, the vertex is formed at the vertical axis and its position is always fixed irrespective of the staff position. 1

Advantages

(i) Due to anallactic lens the additive constant vanishes and the computations are made quicker.

(ii) As a rule, the anallactic lens is sealed against moisture and dust.

(iii) The loss of light may be compensated by the use of slightly larger object glass.

any 2 points 2 7 15

Disadvantages

(i) The anallactic lens absorbs much of the incident light

(ii) The anallactic lens can not be easily cleaned. 2

(iii) If the anallactic lens is adjustable, it is a potential source of error unless proper field check is made from time to time.

any 2 points

VIII(a) Distance – elevation formulae for horizontal sights

Consider Fig. in which O is the optical centre of the objective of an external focusing telescope.

Let A, C and B = The points cut by the three lines of sight corresponding to the three wires.

b, c and a = top, axial and bottom hairs of the diaphragm

ab = i = interval between the stadia hairs (stadia interval)

AB = s = staff intercept

f = focal length of the objective

f_1 = Horizontal distance of the staff from the optical centre of the objective

f_2 = Horizontal distance of the cross - wires from O

d = Distance of the vertical axis of the instrument from O

D = Horizontal distance of the staff from the vertical axis of the instrument

M = Centre of the instrument, corresponding to the vertical axis

Since the rays Bob and AOa pass through the optical centre,

they are straight so that $\triangle$s AOB and aOb are similar.

Hence $\frac{f_1}{f_2} = \frac{s}{i}$

Again, since f1 and f2 are conjugate focal distances, we have from lens formula,

$$\frac{1}{f} = \frac{1}{f_1} = \frac{1}{f_2}$$

Multiplying throughout by ff_1, we get

$$f_1 = \frac{f_1}{f_2} f + f$$

Substituting the values of $\frac{f_1}{f_2} = \frac{s}{i}$ in the above we get

$$f_1 = \frac{s}{i} f + f$$

The horizontal distance between the axis and the staff is

$$D = f_1 + d$$

$$D = \frac{f}{i} s + (f + d)$$

$$D = ks + c$$

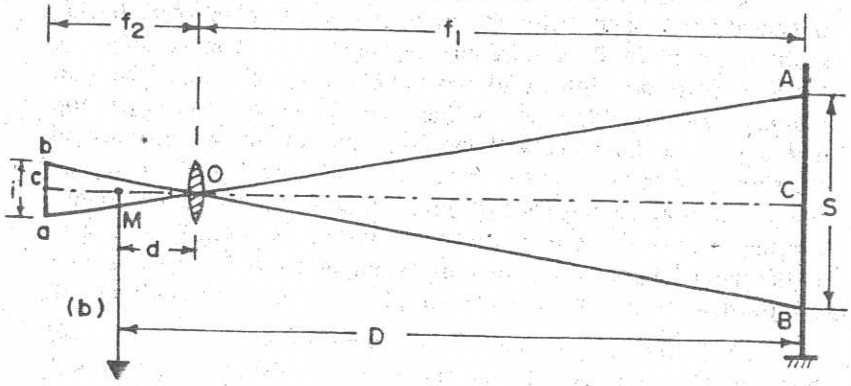
8

The above equation is known as distance equation

The constant $k = \frac{f}{i}$ is known as the multiplying constant or stadia interval factor and the constant $(f + d) = C$ is known as the additive constant. 4

<u>Elevation Formula</u>

Elevation of staff station = Elevation of the instrument axis – central hair reading 2



2

VIII (b) Given

$\theta_1 = 1°54'$
$\theta_2 = 2°36'$
$\theta_3 = 3°6'$

$r_1 = 1.72m$

$r_2 = 1.825m$

$r_3 = 1.61m$

$s_1 = 2.42 - 1.02 = 1.4m$

$s_2 = 2.43 - 1.22 = 1.21m$

$s_3 = 2.435 - 0.785 = 1.65m$

$h_1 = 1.480m$

$h_2 = 1.480m$

$h_3 = 1.500m$

$$V_1 = kS_1 \frac{sin2\theta_1}{2}$$

$$V_1 = 100 \times 1.400 \times \frac{sin2(1°54')}{2}$$

$= 4.639$m

$$V_2 = kS_2 \frac{sin2\theta_2}{2}$$

$$V_2 = 100 \times 1.210 \times \frac{sin2(2°36')}{2}$$

$= 5.483m$

$$V_3 = kS_3 \frac{sin2\theta_3}{2}$$ 1

$$V_3 = 100 \times 1.650 \times \frac{sin2(3°6')}{2}$$ 7 15

$= 8.910m$

RL of A = RL of BM + r_1+v_1-h_1 2

= 100 + 1.72+ 4.639 – 1.480

= 104.879m

RL of P = RL of BM + r_1 + v_1 + v_2 – r_2 2

= 100 + 1.72+ 4.639 + 5.483 – 1.825

= 110.017m

RL of Q = RL of P + r_3 – v_3 – h_2 2

= 110.017 + 1.61 - 8.910 – 1.500

= 101. 217m

IX (a) Deflection angle = 180^0 -120^0 = 60^0 = $\triangle$

(i) Tangent distance = R tan ($\triangle$ / 2)

= 600 tan (60^0/2) 2

= 346.41m

The length of the curve = $\pi R\triangle/180$

= π X 600 X 60/180

= 628. 32m

(ii) Chainage of the point of commencement = Chainage of point of intersection – tangent length

= 2500 – 346.41

= 2153.59m 2

(iii) Chainage of the point of tangency = Chainage of point of commencement + length of curve 8

= 2153.59 + 628.32

= 2781.91m 2

(iv)Length of long chord = 2Rsin(Δ / 2)

= 2 X 600 X sin30^0

= 600m 2

IX(b) Remote sensing is defined as the science and art of acquiring information about a material object by making measurements at a distance without coming into physical contact with the object. 1

1. Help in the assessment of flood and drought
2. Reliable and timely information on areas inunded by flood, duration of flood, river configuration during and after flood, areas with silt deposits, and areas vulnerable to bank erosion
3. Provide useful data on the factors controlling the occurrence and movement of ground water.
4. It is possible to identify the point at which the pollution occurred in a water body and the extent of pollution
5. To study the formation of sedimentary rocks and to identify deposits of various minerals, detect oil fields and identify water resources under the surface of the earth.
6. Identify potential fishing zone, coral reef mapping and find other weather from ocean
7. Terrain analysis for acquiring knowledge
8. To study cloud motion and predict rain

9. Great assistance in environmental impact assessment
10. The changes taking place in the area of forest, agriculture, residential and industrial areas can be assessed regularly and monitored. It is possible even to find out the areas of different crops 6 7 15
11. Used in site investigations for dams, reservoir, bridge, pipe line, crossing of rivers,etc.
12. The natural hazards can be predicted and it can be minimized.

any 6 points

X(a) Advantages of GPS

1. Intervisibility between stations or points surveyed is not necessary. This allows control stations to be placed conveniently
2. GPS can be used in any weather condition day or night
3. Very easy to use
4. Simple operation or use without any complex or technical steps
5. Gives quick results
6. Produces results with very high geodetic accuracy 8×1 8
7. More work can be accomplished in less time with less man power
8. Limited calculation and tabulation works required
9. Large area can be surveyed in short duration
10. Network independent site selection is used, hence sites can be placed where needed
11. Three dimensional co-ordinates are obtained any 8 points

X(b) Applications of GIS

1. Mapping of places of tourist interest or pilgrimage both in hardcopy and soft copy forms
2. Updating and digitization of wards and services map of different cities and towns for their betterment both in terms of economy or finance and environment
3. Consolidation of land holdings and land records
4. Natural disaster management

5. Planning of construction of road, rail, dam, tunnel, etc.
6. Urban and regional planning
7. Development of accurate navigational maps both at ocean, water and land for better traffic flow and least risk of accidents
8. National natural resource management
9. Monitoring environmental changes such as soil erosion, pollution, flood hazards, etc.
10. Conservation and exploitation of natural resources
11. Telecommunication services
12. Development of land use plans
13. Rural land management and agricultural land management
14. Watershed management
15. Waste and reclamation projects
16. For better and foolproof security with up-to-date and accurate maps in the form of digitized or special software both for military and civilian purposes
17. Maps and GIS for government officials and the common people to understand the real positions and facts in their jobs

7x1 7

(any 7 points)