WINTER– 18 EXAMINATION

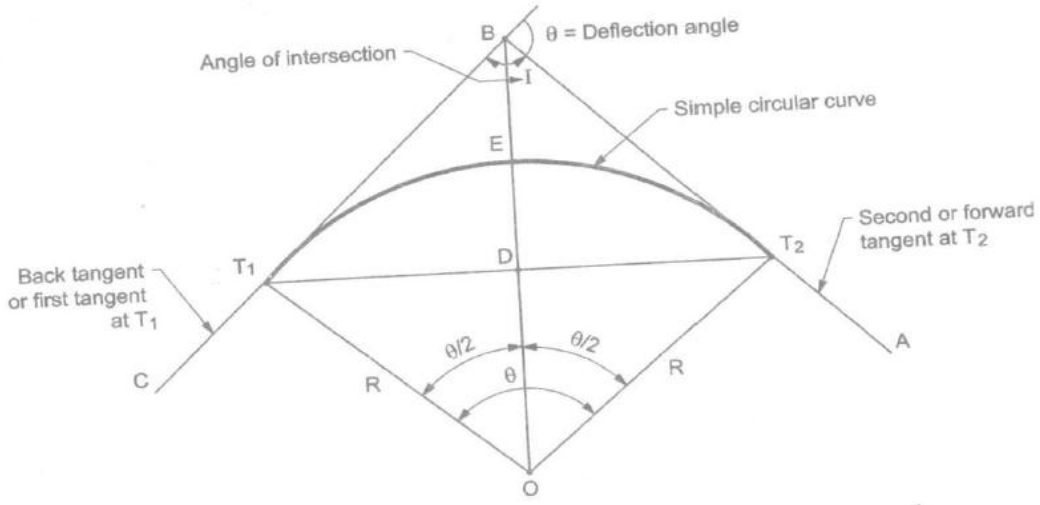
Subject Name: Advanced Surveying **Model Answer** Subject Code: 22301

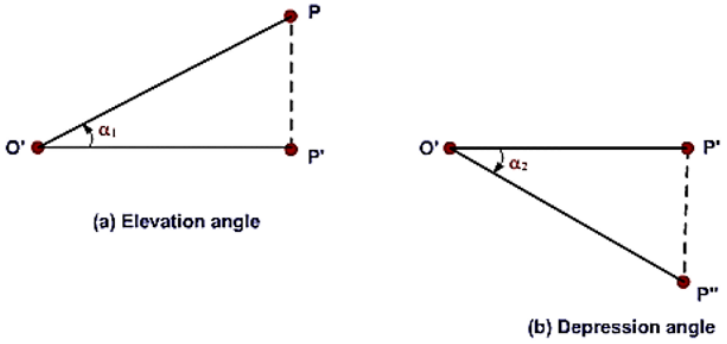
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	A)	**Attempt any FIVE of the following**	**(10)**
Q.1	(a) Ans.	**State the situations where plane table survey is suitable.** Following are the situations where plane table survey is suitable i) It is suitable in localities where the compass survey is unreliable due to local attraction. ii) When map is required to prepare in less time.	02 M
Q.1	(b) Ans.	**Define telescope inverted and telescope normal.** **Telescope inverted** The position of telescope with face right is known as telescope inverted. **Telescope normal** The position of telescope with face left is known as telescope normal.	01 M 01 M
Q.1	(c) Ans.	**State any four uses transit theodolite.** Following are the uses of transit theodolite. i) To measure horizontal angle. ii) To measure vertical angle. iii) To measure magnetic bearing of survey line. iv) To prolong a straight line.	02 M
Q.1	(d) Ans.	**State any two object of tachometry.** Following are two object of tacheometry i) To obtain horizontal distances from instrument station to staff station from the readings upon stadia rod ii) To obtain vertical distances or RL of staff station from the readings upon stadia rod.	01 M 01 M
Q.1	(e) Ans.	**Enlist the types of curve used in roads and railway alignment.** Following are the curve used in road and railway alignment. **1. Horizontal Curve** i) Simple Curve ii) Compound Curve iii) Reverse Curve iv) Transition Curve v) Lemniscates Curve	01 M

		2. Vertical Curve i) Summit Curve ii) Valley Curve	01 M
Q.1	**(f)** **Ans.**	**State any two features of digital theodolite.** Following are the features of digital theodolite i) Dual side display and keyboard with push button keys ii) Built in illumination for night operation. iii) Rechargeable Ni-Cd battery with auto power cut off. iv) Compatibility with EDMs	Any two 01 M for each
Q.1	**(g)** **Ans.**	**State the object of remote sensing.** Object of remote sensing is to collect and interpret information about terrain and other object from a distance without being in physical contact with the object.	02 M
Q.2		**Attempt any <u>THREE</u> of the following**	**(12)**
Q.2	**(a)** **Ans.**	**State the accessories required for plane table survey along with their use.** Following are the accessories required for plane table survey. **Accessories** / **Use** Drawing board — To fix the sheet on which map should be drawn. Alidade — To bisect the object and to draw the ray. Trough Compass — To mark north direction on the drawing sheet. Plumbing fork or U frame — Used for centering the table. Bubble tube / spirit level — Leveling the table. Drawing sheet — To draw plan or map	Any four 01 M for each
Q.2	**(b)** **Ans.**	**Explain the function of lower tangent screw, upper tangent screw, lower clamping screw and upper clamping screw while measuring horizontal angle using theodolite.** **Screw** / **Function** Lower tangent screw — It controlled fine circular motion.(Without changing reading) Upper tangent screw — It controlled fine circular motion.(changing reading) Lower clamping screw — Clamp the lower plate and outer spindle to the leveling base(instrument rotate without changing reading) Upper clamping screw — It clamp upper and lower plate (Instrument rotate, reading also changes)	04 M (01 M for each)
Q.2	**(c)** **Ans.**	**Differentiate between theodolite and tacheometer. Give any two characteristics of tacheometer.** Difference between theodolite and tacheometer. **Theodolite** / **Tacheometer** Used for measurement of horizontal angle, vertical angle, bearing etc. — Used for computing horizontal distance from instrument station to staff station and RL of staff station. Stadia diaphragm is not essential. — Stadia diaphragm is essential. Anallatic lens is not required. — It is beneficial to have annalitic lens in tacheometer. **Characteristics of tacheometer.** 1. The value of constant f/i = 100 Where, f = focal length i = length of image. 2. The telescope should be powerful, the magnification should be 20 to 30 times the Diameter. 3. The telescope should be fitted with anallatic lens to have the value of f +c = 0	Any two 01 M for each Any two 01 M for

		4. The vision through the telescope should give a clear and bright image at a long distance. 5. The aperture of the objective should be 35 to 45mm in diameter in order to have a Sufficiently bright image.	each
Q.2	**(d)** **Ans.**	**Draw neat sketch of circular curve and show following element:** **i) Tangent length ii) Deflection angle iii) Apex distance iv) Length of long chord**  i) Tangent length - BT1 and BT2 ii) Deflection angle - θ iii) Apex distance – BE iv) Length of long chord – T1DT2 (**Note:** Student may show the element on diagram also)	02 M 02 M
Q.3		**Attempt any <u>THREE</u> of the following**	**(12)**
Q.3	**(a)** **Ans.**	**Explain temporary adjustment of theodolite.** The temporary adjustments have to be carried out at every set-up of instrument before taking observations with the theodolite. **1) Setting up the theodolite:** Setting up of the theodolite include: **a) Centering it over the station:** Procedure: 1) Place the tripod over the stations by spreading its legs at a convenient height. 2) Suspend the plumb bob over the station and bring it exactly over the station point by moving it radially as well as circumferentially, then press the legs firmly into the ground. 3) By this the instrument is approximately levelled also. **2) Levelling up:** Accurate levelling is done with reference to the plate level by means of footscrews. The object of levelling is to make the vertical axis truly vertical. Procedure: 1) Turn the theodolite until the plate bubble is parallel to any one of the pair of footscrews. 2) Turn the theodolite about its centre of its run by turning both, foots crews uniformly.By thumb and forefingers either moves it towards each other or away from each other.	01 M) 01 M

		3) Turn the theodolite until the bubble is perpendicular to the previous position. Now, move the third footscrew until the bubble is brought to the centre of the run. 4) Repeat the process for the other two pairs. 5) Now rotate the theodolite about the vertical axis through 360°. The bubble will remain central provided it is in correct adjustment. The vertical axis is made thus truly vertical. **3) Focussing the eye piece :** Focussing the eye-piece makes the cross hairs on the diaphragm distinct and clear. To do this, direct the telescope towards the sky or hold a sheet of white paper in front of the object glass and move the eye piece circumferentially or in or out until the cross-hairs are seen sharp and black. **4) Focussing the object glass :** Focussing the object glass is to bring the image of the object formed by the object glass exactly in the plane of the cross hair. If not accurately done there is a apparent movement of the image when the observer moves up and down. This is affect of parallax. This can be removed with sharp focusing.	01 M 01 M
Q.3	**(b)** **Ans.**	**State 4 component parts of digital theodolite and state their purpose.** **Components** / **Purpose** Levelling head — Support the theodolite and enable leveling of instrument. Clamping screw — To controlled the circular motion of telescope. Telescope — To bisect the object. Plate level — To check the leveling of instrument. Optical plummet — Centering of the instrument. Display window — Reading horizontal and vertical angle.	Any four 01 M for each
Q.3	**(c)** **Ans.**	**Explain the procedure of measurement of vertical angle using one second micro optic theodolite.** **Procedure:** i) Set up the instrument at station O' as shown in fig. ii) Carry out centering and leveling of the instrument with the help of optical plummet and leveling screw respectively. iii) Bisect the object using micrometer knob. iv) Take a reading of vertical angle on window.  	04 M
Q.3	**(d)**	**Define following terms and give any 2 components of each:**	

		i) GIS ii)GPS	
	Ans.	**i) GIS**	
		GIS ia a system that collects, displays, manages and analyzes geographic information.	01 M
		Component of GIS	
		i) Hardware	01 M for any two
		ii) Software	
		iii)Data	
		iv) People	
		ii)GPS	01 M
		GPS is satellite navigation system used to determine the ground position of an object.	
		Component of GPS	01 M for any two
		i) Ground control station	
		ii) Satellites	
		iii) Receivers	
Q.4		**Attempt any THREE of the following:**	**(12)**
Q.4	a)	**State any four advantages and disadvantages of plane table survey.**	
	Ans:	1. It is the most rapid method of surveying.	
		2. There is no need for a field book as plotting is done along with the field work. So, the problem of mistake in booking field notes does not arise.	
		3. Plotted work can be compared with actual object regardless of whether or not they are properly represented.	Any four 1/2 M for each
		4. There is no possibility of overlooking any important object.	
		5. There is no possibility of overlooking any measurement as plotting is done in the field.	
		6. Irregular objects may be represented accurately.	
		7. It is suitable in magnetic areas.	
		8. The map can be prepared easily, and does not require any great skill.	
		9. Errors in measurement and plotting can be detected by check lines.	
		10. Inaccessible points can be easily located by intersection.	
		Disadvantages :-	
		1. The plane table is not suitable for accurate work as the fitting arrangement is not perfect.	Any four 1/2 M for each
		2. Plane table surveying is not suitable in wet climate, in the rainy season, on foggy mornings and in windy weather.	
		3. The number of accessories required in such survey is large, and they are likely to be lost.	
		4. The instrument is very heavy and difficult to carry.	
		5. The map cannot be re-plotted to a different scale as there is no field book.	
Q.4	(b)	**Find the length and bearing of line AB. If two co- ordinates A & B as below :**	

Point	Co-ordinates
A	**970.50, 850.40**
B	**1200.40, 602.20**

	Ans:	Latitude of line AB = L = 1200.40 – 970.50
		= 229.90 (+)
		Departure of line AB = D = 602.20 – 850.40
		= -248.20 (-)

02 M

As latitude is +ve and departure is –ve, the line lies in IV quadrant.

Bearing of line AB

$tan\theta = D/L$ = 248.20/229.90

θ=**47°11′31.24″ = N 47°11′31.24″ W**

WCB of line AB = 360°0′0″– 47°11′31.24″

= 312°48′28.76″ 01 M

Length of line AB = l = $\sqrt{(L)^2+(D)^2}$

$= \sqrt{(229.90)^2+(-248.20)^2}$ 01 M

l = 338.315 m

Q.4 (c) **Following are the latitudes & departures for closed traverse ABCDE. Compute the missing length & WCB of side EA.**

Line	AB	BC	CD	DE	EA
Length	194.1	201.20	164.40	172.60	?
WCB	$85^0\ 30'$	$15^0\ 30'$	$285^0\ 30'$	$195^0\ 30'$	?

Ans:

Let L=Latitude, D=Departure, l=length and θ= bearing of line DA

Line	Length (m)	Bearing	L = l cosθ	L = l sinθ
AB	194.1	$85^0\ 30'$	15.22	193.501
BC	201.20	$15^0\ 30'$	193.882	53.768
CD	164.40	$285^0\ 30'$	43.934	-158.421
DE	172.6	$195^0\ 30'$	-166.323	-46.125
EA	?	?	L	D

For a closed traverse, ΣL=0 01 M

∴+15.22+193.882+43.934-166.323+L=0

∴L= -86.713 (-)

ΣD=0

∴+193.501+53.768-158.421-46.125+D=0

∴D= -42.723 (-)

As latitude is -ve and departure is –ve, the line lies in III quadrant.

Length of line DA = l = $\sqrt{(L)^2+(D)^2}$ 01 M

$= \sqrt{(-86.713)^2+(-42.723)^2}$

l = 96.666 m 01 M

Bearing of line DA

$tan\theta = D/L$ = 42.723/86.713

θ=**26°13′45.14″ = S 26°13′45.14″ W** 01 M

Q.4 (d) **Following observation were made by tacheometer :**

Distance	25 m	50 m
Stadia Reaing	1.900,1.655, 1.410	2.220, 1.725, 1.230

Ans: **Find the constants of tacheometer.**

Case 1 :

D_1 = f/ i x S_1 + (f + c)

$25 = f/i \times (1.900 - 1.410) + (f + c)$ ----------(1) 01 M

$D_2 = f/i \times S_2 + (f + c)$

$50 = f/i \times (2.220 - 1.230) + (f + c)$ ----------(2) 01 M

Solving equation 1 & 2 simultaneously

f/i = 50 02 M

(f + c) =0.50 m

Q.4 (e) **Calculate the ordinates at 25 m interval to set out a circular curve having a long chord of 300 m and versed sine of 10 m.**

Ans: **Given:** L = 300m,
interval x = 25m,
versed sine = 10m
Versed Sine is the offset of the curve at middle of the long chord = O0
$O0 = R - \sqrt{R^2 + (L/2)^2}$
Where R= Radius of curve, L=Length of long chord 02 M
$10 = R - \sqrt{R^2 + (300/2)^2}$
R = 1130 m
The ordinates at distance x from the midpoint may be calculated by
$Ox = \sqrt{R^2 - (x)^2} - (R - O_0)$
Ordinates at 25 m interval are:
$O25 = \sqrt{1130^2 - (25)^2} - (1130 - 10) = 9.70$ m
$O50 = \sqrt{1130^2 - (50)^2} - (1130 - 10) = 8.89$ m
$O75 = \sqrt{1130^2 - (75)^2} - (1130 - 10) = 7.51$ m 02 M
$O100 = \sqrt{1130^2 - (100)^2} - (1130 - 10) = 5.56$ m
$O125 = \sqrt{1130^2 - (125)^2} - (1130 - 10) = 3.06$ m
$O150 = \sqrt{1130^2 - (150)^2} - (1130 - 10) = 0.00$ m Hence OK

Q.5 **Attempt any TWO of the following :** **(12)**

Q.5 (a) **Calculate independent co-ordinates of all the survey lines of the traverse :**

Line	**AB**	**BC**	**CD**	**DA**
Length (m)	**335**	**850**	**408**	**828**
Bearing	**$180^0 20'$**	**$90^0 20'$**	**357^0**	**365^0**

Ans:

Line	Length (m)	Bearing	R.B	Cons. Co-ordinates		Correction		Corrected cons. Co-ordinates	
				Lat	Dep	Lat	Dep	Lat	Dep
AB	335	$180^0 20'$	$S0^0 20'W$	-334.99	-1.94	123.478	124.377	-458.468	-126.317
BC	850	$90^0 20'$	$S89^0 40'E$	-4.94	849.98	313.303	315.583	-318.243	534.397
CD	408	357^0	$N3^0 00'W$	407.44	21.35	150.385	151.480	257.055	-172.830
DA	828	365^0	$N5^0 00'E$	824.85	72.165	305.194	307.415	519.656	-235.250
TOTAL	2421			892.360	898.855	-892.360	-898.855	0	0

Calculation of reduced bearings :
Line AB, RB = $180^0 20' - 180^0 = S0^0 20'W$

		Line BC, RB = 180^0 - $90^0$40' = S$89^0$40'E Line CD, RB = 360^0 – 357^0 = N$3^0$00'W Line DA, RB = 365^0 – 360^0 = N$5^0$00'E Calculations of latitudes : Latitude = Lcosθ Line AB = 335 x cos($0^0$20') = -334.99 Line BC = 850 x cos($89^0$40') = -4.94 Line CD = 408 x cos($3^0$00') = 407.44 Line DA = 828 x cos($5^0$0') = 824.85 Error in sum of latitudes = 892.360 Correction will have -ve sign Calculation of Departures: departure = Lsinθ Line AB= 335x sin($0^0$20') = - 1.94 Line BC = 850x sin($89^0$40') = 849.98 Line CD = 408x sin(3^0) = - 21.35 Line DA= 828x sin(5^0) = 72.165 Error in sum of departures = 898.855 Correction will have -ve sign Bowditch's Rule: Correction to latitude or departure of any side = total error in latitude or departure x (length of that side/ perimeter of traverse) Perimeter of traverse = 335 + 850 + 408 + 828 =2421 m Corrections to latitudes: Corrected latitudes: Line AB = 892.360x335/2421 = 123.478 Line AB= - 334.99-123.478= -458.468 Line BC = 892.360x 850/2421 = 313.303 Line BC= - 4.94-313.303= -318.243 Line CD = 892.360x408/2421 = 150.385 Line CD= 407.44-150.385= 257.055 Line DA = 892.360x 828/2421 = 305.194 Line DA= 824.85-305.194 = 519.656 Corrections to departure: Corrected departures: Line AB = 898.855x335/2421 = 124.377 Line AB= -1.94- 124.377 = -126.317 Line BC = 898.855x 850/2421 = 315.583 Line BC=849.98 -315.583 = 534.397 Line CD = 898.855x408/2421 = 151.480 Line CD = -21.35-151.480 = -172.830 Line DA = 898.855x 828/2421 = 307.415 Line DA = 72.165-307.415 = -235.250 ***Note: Data given seems to be incorrect, especially bearing of line DA; hence calculated corrections in Latitude and Departure are absurd. Hence just after calculation of Latitudes and Departures of all line, full marks shall be given.***	02 M 02 M 02 M
Q.5	(b) Ans:	**Explain Bowditch Rule as applicable in a theodolite traverse.** 1) The rule, also termed as the compass rule, is used to balance the traverse when the angular and linear measurements are equally precise.	

		2) By this rule, the total error in latitude and in departure is distributed in proportion to the lengths of the sides. 3) This rule is most commonly used in traverse adjustment. Correction to latitude = total error in latitude x (length of that side/ perimeter of traverse). 4) Correction to departure = total error in departure x (length of that side/ perimeter of traverse) 5) If error is negative then correction is positive and vice versa. 6) After applying correction summation all latitudes and departures must be zero.	06 M

Q.5 (c) **A tacheometer fitted with analytic lens was set up at station P and the following readings were obtained on vertically held staff.**

Inst. Stn.	Staff Stn.	Vertical angle	Staff Reading
P	BM	$-12^0 42'$	0.220, 1.000,1.780
P	Q	$+9^0 36'$	0.415, 1.240, 2.065

The RL of BM is 400 m, the constant of tacheometer was 100. Find the horizontal distance PQ and RL of Q.

Ans:

Given: Anallatic lens are provided, (f+c) = 0, f/i = 100, B.M. RL. = 400.000 m

Part I) Distance PQ — 02 M

θ = **9º36'**(Elevation)

S = staff intercept = 2.065 – 0.415 = 1.650 m

Horizontal distance PQ = f/i (S) $\cos^2\theta$ + (f+c) $\cos\theta$

= 100 (1.650) $\cos^2$ 9º 36'+ 0

Horizontal distance PQ = 160.411 m

Part II) RL of station Q — 01 M

V1= Vertical distance between horizontal collimation and axial reading at BM

$V_1 = f/i\ (S) \times \sin 2(\theta/2)$

θ = **-12º42'** (Depression)

h_{bm} = 1.0

S_{BM} = 1.780 – 0.220 = 1.560

$V_{BM} = 100 \times 1.560 \times (\sin 2 \times 12^0\ 42'/2)$

V_{BM} = 33.457 m

RL of instrument station = RL of BM + h_{BM} + V_{BM}

= 400 + 1.0 + 33.46 — 02 M

= 434.46 m

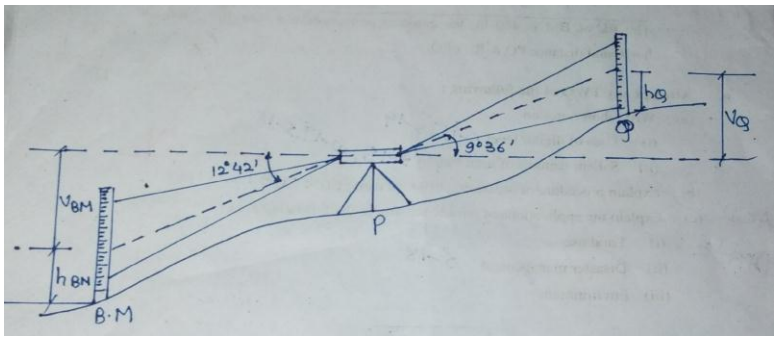
$V_Q = 100 \times (1.65) \times \sin 2 \times 9^0 36'/2$

V_Q = 27.131 m

R.L of Q = RL of instrument station + V_Q - h_Q

= 434.46 + 27.131 – 1.240 — 01 M

= 460.351 m



Q.6 **Attempt any two of the following :** **(12)**

Q.6 (a) **Write short notes on :**

(i) Uses of digital level

(ii) Salient features of total station

Ans: **(i)Uses of digital level.**

1) Digital level can be used to draw maps using interface with computer

2) It is also used for day night work of survey. — 01 M each

3) It can be used for determined the quantity of earth work with interfacing of software.

		4) It is used to prepare a layout map for water supply sanitary or drainage scheme. 5) To prepare a L section and cross section of a project (Roads, Irrigation canal etc.) In order to determine the volume of earth work. 6) To determine altitude of different important points. 7) To prepare a counter map for fixing sights for a different structure. **(ii)Salient features of Total Station.** 1 High accuracy. 2 Long measuring range. 3 Large internal memory. 4 It is water resistance and dust proof. 5 Easy access to any desired programme and mode of selection. 6 Try axis compensation. 7 Easy to read arrangement. 8 Automatic atmospheric correction. 9 Guide message arrangement. 10 Higher distance resolution. 11 Two speed tangent movement. 12 Detachable tribach facility. 13 Eighteen different programmes (modes of measurements).	(any three) 01 M each (any three)
Q.6	(b) Ans:	**Explain procedure of measuring distance using EDM.** Let distance AB is to be measured. 1. Set EDM at station A. Touch ON/OFF switch. Display panel will give reading 0.0. 2. Hold the reflector at B 3. Telescope of EDM sighted towards B with cross hair at center of reflector. **4.** Press Range or Enter switch and in few seconds, distance will be displayed. Distances displayed will be horizontal distance and sloping distance between A and B, also elevation difference between A and B.	06 M
Q.6	(c) Ans:	**Explain the application of remote sensing in the following area :** **(i) Land use** **(ii) Disaster management** **(iii) Environment** **i) Land use or Land cover analysis:** Remote sensing techniques are useful for taking images of large area quickly, and it is cheaper than ground surveying. ii) **Disaster management**: In case of earthquakes, landslides, volcanic eruptions and floods and natural hazards, remote sensing can prevent and minimize the damage by analysing the geological formation of the area, thereby identifying the risk prone areas. It is possible to give specific warning of certain natural hazards and assess the damage caused and thereby help in the rescue and aid operations. iii) **Environment:** • Remote sensing is useful in weather forecasting. • May aspects of ocean becoming better known through remote sensing techniques. • Pollution in the form of oil spills and thermal plumes can easily be monitored. • Study about Ozone layer depletion and global warming can be possible by using remote sensors.	02 M 02 M 02 M