SUMMER– 18 EXAMINATION

Subject Name: SURVEYING **Model Answer** Subject Code: 17310

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.	Answers	Marking Scheme
Q.1	A) (a) Ans	***Attempt any SIX of the following.*** ***Write-four uses of surveying.*** **Uses of surveying**. 1. To record relative positions of various points on the surface of earth. 2. Prepare plans and maps required for various works. 3. Layout of various engineering works. 4. Compute areas and volumes using survey data required for various purposes. 5. To prepare a topographic map 6. To prepare military map 7. To prepare a archeological map	Any four 1/2 M for each
Q.1	A)(b) Ans	***State the primary classification of survey.*** **Primary classification of survey**. 1. Geodetic survey: The survey in which curvature of earth is considered. 2. Plane survey: The survey in which earth surface is assumed as plane.	01 M for each
Q.1	A)(c) Ans	***Define Ranging. State types of ranging.*** **Ranging**: It is process of locating points on ground along straight line. **Types of ranging**: 1. Direct ranging. 2. Indirect ranging	01 M 01 M
Q.1	A)(d) Ans	***Define: (i) True meridian (ii) Magnetic meridian*** i. **True meridian**: It is line of intersection of plane passing through North Pole, South Pole and point under consideration. ii. **Magnetic meridian**: Magnetic meridian at point is direction shown by freely suspended magnetic needle at that point.	01 M 01 M
Q.1	A)(e) Ans	***Define: (i) Long offset (ii) Short offset*** i. **Long offset**: The offset whose length is more than 15 m. ii. **Short offset**: The offset whose length is less than or equal to 15 m.	01 M 01 M

Q.1 A)(f) Ans — ***Give any four code of signals used to direct assistant in ranging.*** — Any four 1/2 M for each

Sr. No.	Signal	Action
1	Rapid sweep with right hand	Move right fast
2	Slow sweep with right hand	Move right slowly
3	Right hand extended	Continue moving to right
4	Rapid sweep with left hand	Move left fast
5	Slow sweep with left hand	Move left slowly
6	Left hand extended	Continue moving to left
7	Both hands above head and moved down	Correct position
8	Both hands forward and brought down	Fix the point

Q.1 A)(g) Ans — ***Define Local attraction.*** — 02 M

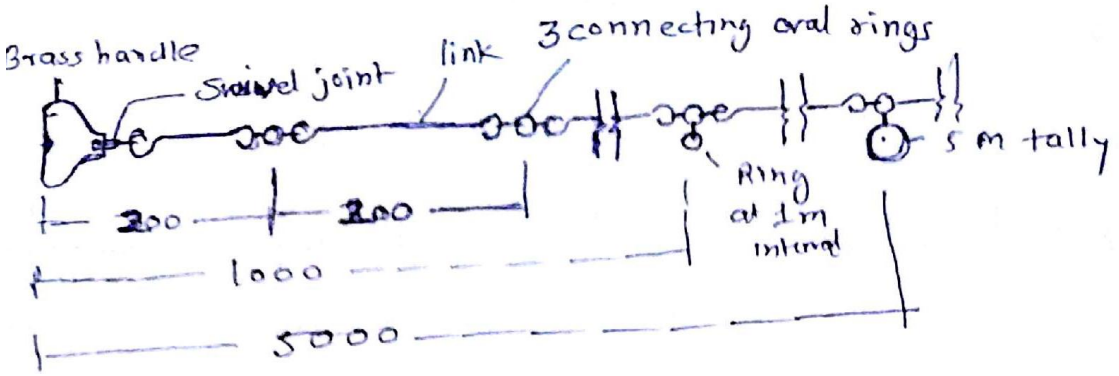
Local attraction: Local attraction can be defined as the deviation of magnetic needle due to external magnetic influence from its original position.

Q.1 A)(h) Ans — ***List any four accessories required for plane table survey.*** — Any four 1/2 M for each

1. Plane table.
2. Plumbing U-fork.
3. Alidade.
4. Spirit level.
5. Trough compass.
6. Plumb bob.

Q.1 B) (a) Ans — ***Attempt any TWO of the following:*** — 02 M

Draw a "well labelled diagram of 30 m metric chain & state the function of swivel joint & oval rings.



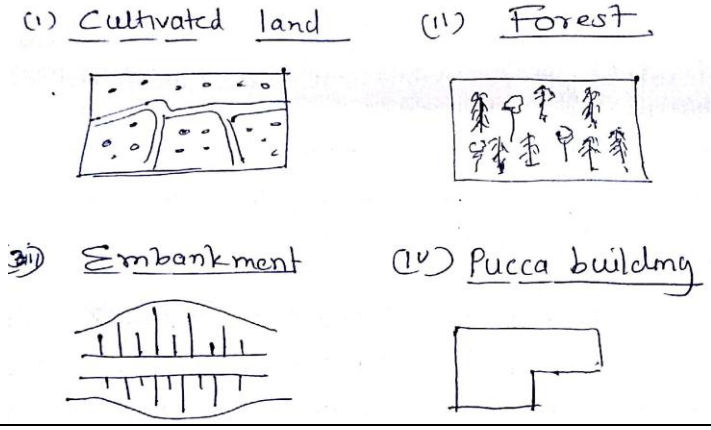
Swivel joint: To turn the handle without twisting the chain. — 01 M

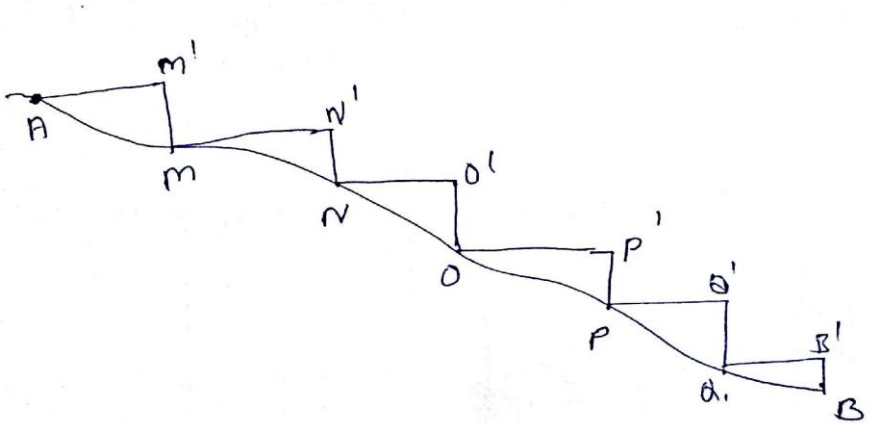
Oval ring: To provide flexibility and fold the chain. — 01 M

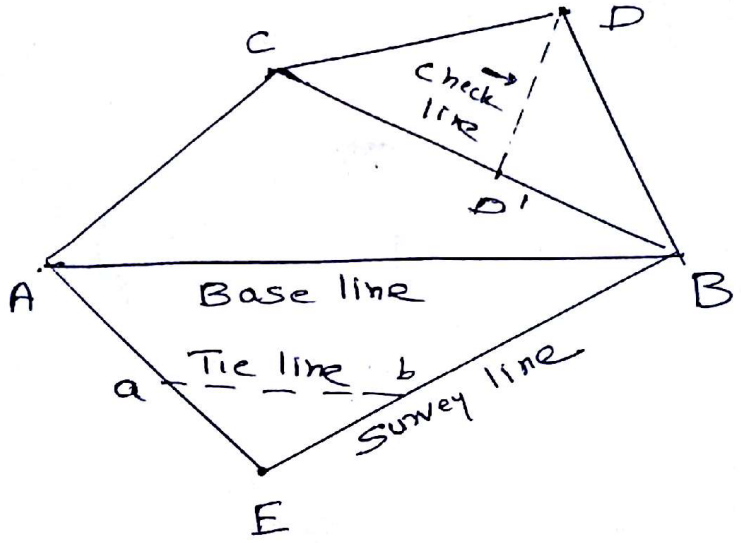
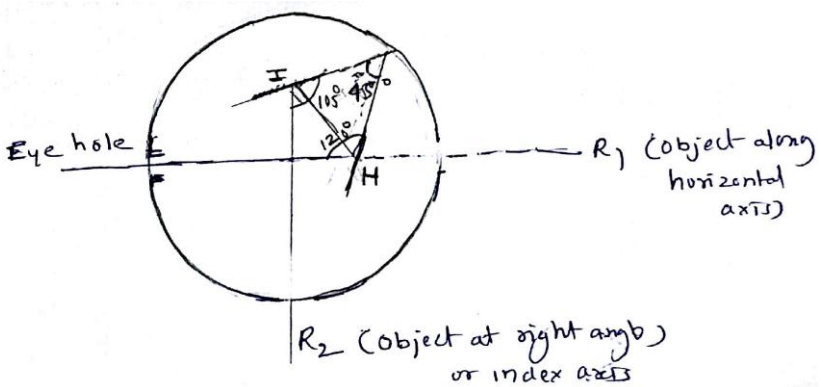
Q.1 B)(b) Ans — ***Draw conventional symbol for*** — 01 M for each

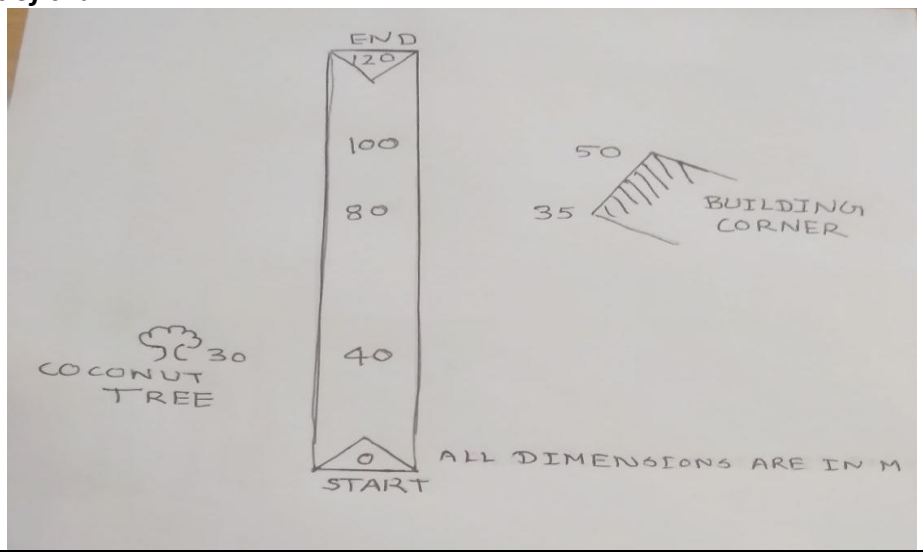
(i) Cultivated Land (ii) Forest (iii) Embankment (iv) Building

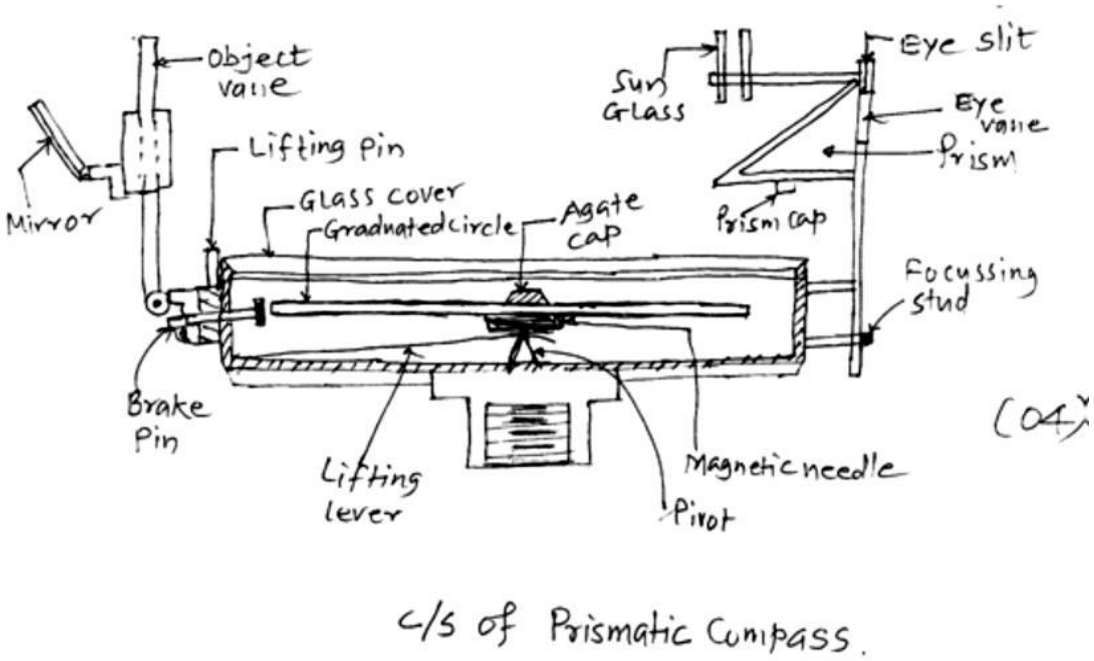
Pucca Conventional symbols:

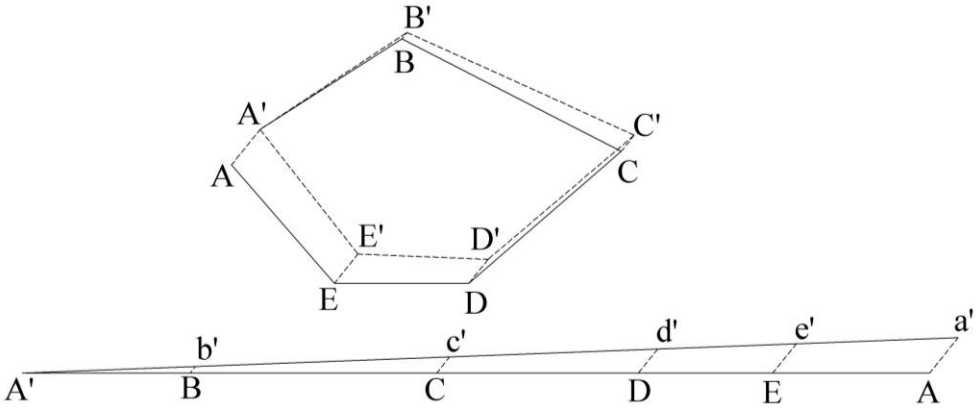


Q.1	B)(c)	***Explain in brief linear measurements using:*** ***{i) Chaining (ii) Digital Tape*** Ans i. **Chaining**: a. Linear measurement with chain carried out by two chainmen-Leader and follower. b. The follower keeps the chain handle at starting station point, holds firmly it and directs the leader along the line. c. Leader holds ranging rod at end of chain, facing the follower for instructions for ranging. d. Putting the chain in ranged direction, the leader inserts arrow at the end of chain. e. The process of ranging, bringing chain in line and inserting arrow is repeated. Along forward direction till the end station. f. The last part of line, less than chain length is measured by reading tally and number of links. ii**. Linear measurement by digital tape**: a. Place the digital tape at one end of line and then direct the laser beam so that it obstructs the object at the other end. b. If there is no wall or pole at the other end, put the target there to hit the laser beam. c. Once laser is at right spot, press the button and tape measures, calculates and displays distance on screen.	02 M 02 M
Q.2	(a)	***Attempt any FOUR of the following:*** ***Explain the process of chaining on sloping ground by stepping method with neat sketch.*** Ans The procedure to measure horizontal distance between the points A and B on sloping ground is as follows. 1. Two persons-leader and follower are required for chaining. 2. The follower holds the end of chain at A. The leader goes along the line with selected length of chain and ranging rod and faces the follower. 3. The selected chain length is such that it can be held truly horizontal. Once the chain is held horizontal, the point M' of end of selected chain length is transferred to ground at M by plumb bob or dropping stone. 4. The process is repeated starting at M to get points N, O, P, Q till the end B is reached. Total horizontal distance between A and b L = AM, + MN' + NO' + OP' + PQ' + QB'  	1/2 M for each 02 M
Q.2	(b)	***A 20 m chain was found to be 10 cm too short after chaining 1000 m It was found to be***	

	Ans	***20 cm too short after chaining 1800 m. If the chain was correct before commencement of the work find the true distance.*** Average error in chain for 1000 m length = (0 + 10) / 2 = 5 cm = 0.05 m too short True length up to 1000 m = (20 – 0.05) x 1000 / 20 = **997.5 m**. Average error in chain from 1000 m to 1800 m length = (10 + 20) / 2 = 15 cm = 0.15 m too short True length from 1000 m to 1800 m length = (20 – 0.15) x 800 / 20 = **794.0 m**. True distance = 997.5 + 794 = **1791.5 m**.	02 M 02 M
Q.2	(c) Ans	***State the points to be considered while selecting survey stations.*** Points to be considered while selecting survey stations. 1. Stations shall be inter visible. 2. Stations shall be so selected that well conditional triangles should be formed. 3. Stations shall be so selected that there is least difficulty in ranging and chaining. 4. Stations shall be so selected that they run as close to details to be established as possible and only short offsets are needed.	01 M for each
Q.2	(d) Ans	***Draw the sketch of chain triangulation and label different lines.***  AB – Base line AC, CD, DE, AE, EB - main survey lines DD' – Check line. ab – Tie line.	Showing each line properly – 01 M for each
Q.2	(e) Ans	***Explain principle of optical square with neat sketch.***  I – Index glass H – Horizon glass	02 M

		Principle: According to the principle of reflecting surfaces , the angle between the first Incident ray and last reflected ray is twice the angle between the mirrors/reflecting surfaces. In optical square the angle between horizon sight and index sight will be 90°.	02 M
Q.2	(f) Ans	***Explain temporary adjustment of plane table survey.*** 1. Setting over the station: The plane table is fixed on tripod and adjust the table in such a way that table is approximately level. 2. Leveling the table: The tubular or spirit level is placed in two perpendicular directions and tripod legs are adjusted to bring the bubble in center. 3. Centering the table: Place the plumb bob with upper leg of U-fork on sheet and its pointed end over the station mark. If it is not over the station mark, adjust the legs of tripod to bring plumb bob exactly over the station mark. 4. Orientating the plane table: It is to be carried out if table is to be set up at more than one station. The table can be oriented in two ways. i. Using trough compass. ii. By back sighting.	01 M for each step
Q.3	(a) Ans	***Attempt any FOUR of the following:*** ***Prepare a page of field book showing chain line with following details :'*** ***(i) Length of base line 120 m.*** ***(ii) The coconut tree is 30 m perpendicular from chainage 40 m at left.*** ***(iii) The corners of building are 35 m and 50 m from chainage 80 m and 100 m to the right of chain.***  	04 M
Q.3	(b) Ans	***Convert the following R.B. to W.C.B.*** ***(i) N 60° 30' W (ii) S 59° 30' E (iii) N 45° 0' E (iv) S 43° 30' W*** i)R.B= N 60°30′ W W.C.B =360°-60°30′=**299°30′** ii) R.B= S 59°30′ E W.C.B= 180°-59°30′ =**120°30′**	01 M for each

		iii) R.B = N 45°0′E W.C.B = **45°0′** iv) R.B= S 43°30′ W W.C.B= 180°+43°30′= **223°30′**	
Q.3	(c) Ans	***Draw a neat sketch of prismatic compass and label its component parts***  (04) c/s of Prismatic Compass.	02 M for fig. and 02 M for labeling
Q.3	(d) Ans	***Find the back bearing of the following lines having fore bearing as given below:*** ***(i) PQ = N 55° 0' E (ii) EF == 280° 0' (iii) CD = S 58° 30' W (iv) OM= 180° 0'*** i) F.B OF PQ = N 55°0′E B.B Of PQ = **S 55°0′W** ii) F.B. Of EF = 280°0′ B.B OF EF = F.B -180°= 280°0′-180° = **100°0′** iii) F.B OF CD = S 58°30′W B.B OF CD = **N 58°30′E** iv) F.B OF GH = 180° B.B OF GH = F.B -180°=180°-180°= **0°**	01 M for each
Q.3	(e) Ans	***What is meant by closing error? Explain graphical method of adjustment of closing error.*** **Closing error:** The distance by which the traverse fails to close is called closing error	01 M

		 Procedure: 1. Plot the traverse e.g. A'BCDEA to suitable scale and obtain magnitude and direction of closing error. 2. Draw a straight line A'BCDEA to some suitable scale representing the total length of traverse lines. 3. Mark on this straight line, closing error AA' as Aa' but to scale of traverse. 4. Join A' with a' as shown in fig. 5. Draw lines parallel to Aa' through points B,C,D and E giving points b' c' d' and e'. 6. Bb', Cc', Dd' and Ee' directly gives correction at stations B,C,D and E respectively. Mark the corrections in same direction of AA' at plotted points and locate new position of station points to give correct traverse A'B'C'D'E'A'.	01 M 02 M
Q.3	(f) Ans	***Explain the terms magnetic declination and dip of needle.*** **Magnetic Declination:** The horizontal angle between the magnetic meridian and true meridian is known as magnetic declination. When the north end of magnetic needle is pointed towards west side of true meridian, the position is termed Declination West (θW). When the north end of magnetic needle is pointed towards east side of true meridian, the position is termed Declination East (θE). **Dip of needle**. If the needle is perfectly balanced before magnetization, it does not remain in the balanced position after it is magnetized .This is due to the magnetic influence of the earth. The needle is found to be inclined towards the pole. This inclination of needle with the horizontal is known as deep of needle. The amount of deep of needle is not constants but it varies from place to place, in northern hemisphere north end of the needle is deflected downwards and southern hemisphere south end of the needle is deflected downwards.	02 M 02 M
Q.4	(a) Ans	***Attempt any FOUR of the following:*** ***The following bearings were taken in traverse survey conducted with a prismatic compass at a place where local attraction was suspected. At what station do you suspect local attraction? Find the correct bearing of the lines.*** The difference of fore bearing and back bearing of only line CD is Exactly 180° Hence station C & D are free from local attraction. At station A & B local attraction is	

Line	*Fore Bearing*	*Back Bearing*
AB	$44^0\ 30'$	$226^0\ 30'$
BC	$124^0\ 30'$	$303^0\ 15'$
CD	$181^0\ 00'$	$1^0\ 0'$
DA	$289^0\ 30'$	$108^0\ 45'$

suspected.
At the line CD, FB. of DC –BB. of CD = 181°00' – 1°00'= 180°
Therefore C and D are free from local attraction

Line	F.B	B.B	Difference	Correction	Corrected		Remark
					F.B	B.B	
AB	44° 30'	226°30'	182°	0°45' at A	45°15'	225°15'	Station C and D are free from local attraction
BC	124° 15'	303° 15'	179°	-1°15' at B	123°15'	303° 15'	
CD	181° 00'	1°00'	180°	0° At C	181° 00'	1°00'	
DA	289° 30'	108°45'	180°45'	0° At D	289° 30'	109°30'	

Corrected FB of DA = 289°30'
Corrected Back bearing Of DA = Corrected FB of DA - 180°
= 289° 30' - 180°= 109°30'
Correction at A =Corrected Back bearing of DA – Observed Back bearing of DA
= 109°30'- 108°45'= 0° 45'
Corrected FB of AB = Obs. FB of AB + correction at A
= 44°30' + 0°45' = 45°15'
Corrected BB of AB = 45° 15' + 180°= 225°15'
Correction at B = 225°15'- 226° 30' = -1°15'
Corrected FB of BC = 124°30' - 1°15' = 123° 15'
Corrected BB of BC = 123° 15' + 180°= 303°15' = Observed BB of BC
O.K. Check is Verified

Identification of stations 01 M, sample calculation 01 M, Corrected FB And BB 02 M

Q.4 (b) Ans

What are the sources of errors in plane tabling?

The following are the sources of errors in plane tabling
1) The board not being horizontal
2) The table not being accurately centered
3) The table not being Correctly oriented
4) The objects not being sited accurately
5) The alidade not being correctly centered on the station point on the paper
6) The rays not being accurately drawn through the station point
7) Inaccuracy in plotting
8) The expansion and contraction of the paper

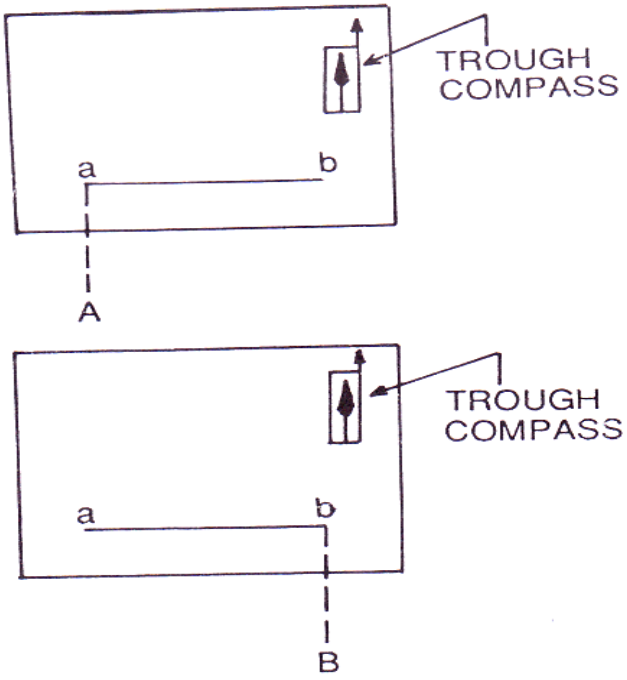
Any four 01 M for each

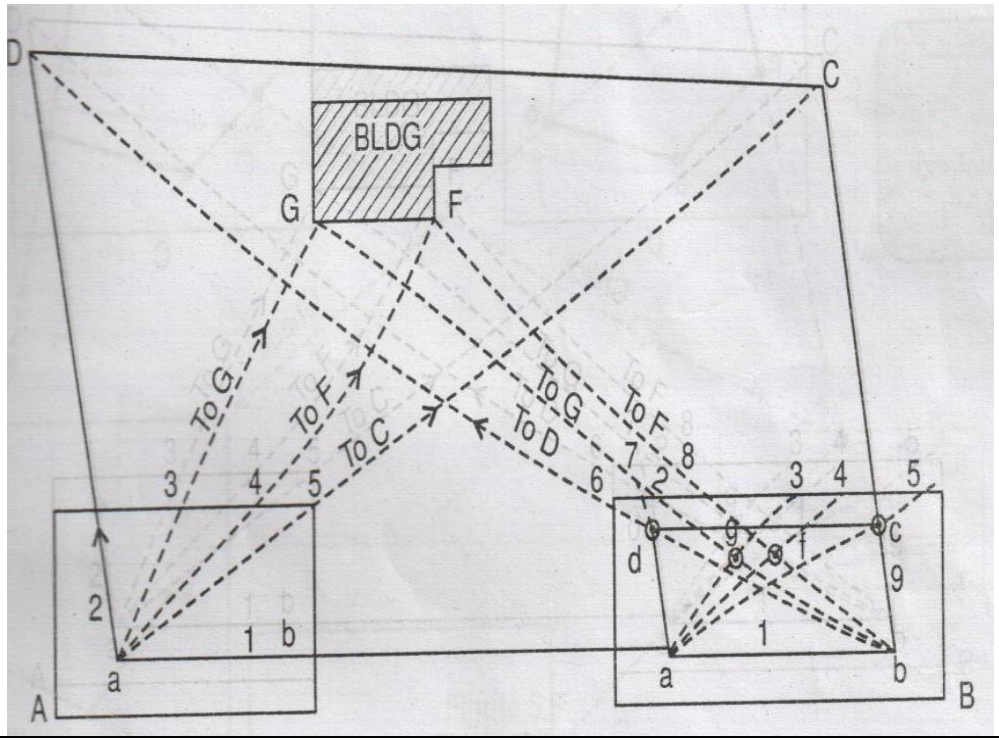
Q.4 (c) Ans

State four advantages and four disadvantages of plane table survey.

Advantages :-
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.
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.

Any four 1/2 M for each

		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. 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.	Any four 1/2 M for each
Q.4	(d) Ans	***What is meant by orientation? Explain orientation by back sighting method.*** **Orientation:** The method of setting up the plane table at each of the successive stations parallel to the position it occupied at the starting station is known as orientation. **Orientation by back sighting: Procedure**- Ref Fig. bellow a) Suppose A and B are two stations. The plane table is set up over A. the table is leveled by spirit level and centered by U-fork so that point 'a' is just over station A. The north line is marked on the right hand top corner of the sheet by trough compass. b) With the alidade touching 'a', the ranging rod at B is bisected and a ray is drawn. The distance AB is measured and plotted to any suitable scale. So the point 'b' represents station B. c) The table is shifted and set up over B. It is leveled and centered so that 'b' just over B. Now the alidade is placed along the line 'ba', and the ranging rod at A is bisected by turning the table clockwise or anticlockwise. When the centering, leveling and bisection of the ranging rod at A are perfect, then the orientation is said to be perfect.  	01 M 03 M
Q.4	(e) Ans	***Explain intersection method of plane survey.*** Intersection method of plane tabling- 1. Lay out a base line AB and measure it and Plot a distance 'ab' on sheet using any	

		scale. 2.Set up instrument at 'A' with 'a' over 'A' 3.Orient the table by placing alidade 'ab' and turn table until ranging rod at 'B' is bisected and clamp it. 4. With alidade touching point 'a' draw rays ab, ad, ag, af, ac of indefinite length as shown in figure below. 5. The table is then moved to station 'B' orient by back sighting on 'A' say ray ba. Draw rays towards points previously sighted rays bd, bg, bf, bc are drawn to determine points intersection, d, g, f, c.  	03 M 01 M
Q.4	(f) Ans	***Define the following terms:*** ***(i) Level surface {ii) Datum line (iii) Reduced level (iv) Axis of telescope*** **i)Level Surface** : Any surface is parallel to mean spheroidal surface of earth is said to be a level surface. The water surface of still lake is also considered to be level surface. **ii) Datum line:** This is an imaginary line from which the vertical distances of different points (above or below the line)are measured. **iii) Reduce Level:** The vertical distance of point above or below the datum line is known as reduce level (RL)of that point. **IV) Axis Of Telescope:** This axis is an imaginary line passing through the optical Centre of object glass and optical Centre of the eye piece.	01 M for each
Q.5	(a) Ans	***Attempt any FOUR of the following:*** ***State the important points kept in mind while recording the readings in level pages with respect first reading, intermediate readings, last reading, and change point, carry forward from one page to next page - Remarks.*** The following points should be kept in mind while recording the reading in level pages.	

1. The first reading should be always noted as back sight (B.S.)
2. All the intermediate readings should be recorded as intermediate sight (I.S.)
3. The last reading with any set up of level should be recorded as fore sight (F.S.).
4. On a change point two readings are taken, first one is recorded as F.S. taken from previous set up and the second one is to be noted as B.S. taken from next set up.
5. In case the last reading in a level page book is intermediate sight then it has to be noted in both I.S. and F.S. in the last row of the page and recorded as I.S. and B.S. in the first row of following page.
6. In the remark column information of Bench mark, Change point or last point should be entered.
7. Every horizontal line represents only one station.
8. Readings of each station should be in one line only.

04 M

Q.5 (b) Ans.

Differentiate between 'H.I. method' and 'Rise and Fall method' with respect to time, checks, application and simplicity.

Sr. No.	Point of difference	H.I. method	Rise and fall method
1.	Time	Less time required for calculations of RLs.	More time is required for calculations of RLs.
2.	Check	Arithmetic check performed is ΣBS - ΣFS = Last RL – 1st RL. Gives check only of corrections of starting point and last point. Correction of RL of intermediate points is not checked.	Arithmetic check performed is ΣBS - ΣFS = Last RL – 1st RL = ΣRise – ΣFall. RLs of all points are checked in this method.
3.	Application	H.I method is applied for profile leveling, road survey, canal survey, etc.	Rise and fall method is applied for check leveling, fly leveling, etc.
4.	Simplicity	More simple, rapid involving less calculation.	Involves several calculations hence more laborious and time consuming.

01 M for each point

Q.5 (c) Ans.

Define the following:
(i) Height of instrument (i) Back sight (iii) Fore sight (iv) Axis of bubble tube

i. Height of instrument: It is the reduced level of line of collimation when the leveling instrument is properly leveled. It is obtained by adding the BS reading to RL of bench mark or change point on which the staff reading was taken.

ii. Back sight: It is the first staff reading taken in any set up of the instrument after the leveling has been perfectly done. It is always taken on a point of known RL i.e. on bench mark or change point.

iii. Fore sight: It is the last staff reading in any set up of instrument and indicates the shifting of the level or end of the leveling work.

iv. Axis of bubble tube: It is an imaginary line tangential to the longitudinal curve of the bubble tube when the bubble is at the center of its run i.e. at middle point of the tube.

01 M for each

Q.5 (d) Ans.

Explain importance of Bench mark in leveling and state the types of Bench mark.

Bench marks are fixed points or marks of known RL determined with reference to the datum line. These are very important points which serve as reference points for finding RLs of new points or for conducting leveling operations in projects involving roads, railways etc. — 02 M

Types of bench mark: — 02 M

1. GTS bench mark.
2. Permanent bench mark.
3. Arbitrary bench mark.
4. Temporary bench mark.

Q.5 (e) Ans.

State four advantages of auto level.

Advantages of auto level: — Any four 01 M for each

1. More precise/accurate leveling can be done using these levels.
2. The telescope of this instrument needs only be approximately leveled over the tripod and then the compensating device automatically provides horizontal line of sight.
3. Leveling work can be speedily carried out using these levels.
4. Due to simplicity in leveling of instrument it reduces operational fatigue.
5. Clear and erect image.
6. Light weight and compact.

Q.5 (f) Ans.

The following consecutive readings were taken by a dumpy level and a leveling staff. 1.904, 2.653, 3.906, 4.026, 1.964, 1.702, 1.592, 1.261, 2.542, 2.006, 3.145. The level was shifted after 4th and 7th reading. The first reading was obtained on staff held on B.M. of R.L. 100.000 m. Rule out a page of level book enter all the staff readings and calculate R.L. of all staff station points. Apply usual checks.

Station point	B.S.	I.S.	F.S.	R.L. of collimation line (HI)	R.L.	Remark
1	1.904			101.904	100.00	B.M.
2		2.653			99.251	
3		3.906			97.998	
4	1.964		4.026	99.842	97.878	CP_1
5		1.702			98.140	
6	1.261		1.592	99.511	98.250	CP_2
7		2.542			96.969	
8		2.006			97.505	
9			3.145		96.366	Last Pt.
	ΣBS=5.129		ΣFS=8.763			

01 M for table
02 M for correct calculation
01 M for check

Arithmetic check : ΣBS – ΣFS = 5.129 – 8.763 = - 3.634

Last RL – First RL = 96.366 – 100.00 = - 3.634

ΣBS – ΣFS = Last RL – First RL = - 3.634

Hence checked and found O.K.

OR

OR

By rise and fall method

Station point	B.S.	I.S.	F.S.	Rise (+)	Fall (-)	R.L.	Remark
1	1.904			--	--	100.00	B.M.
2		2.653		--	0.749	99.251	

01 M for

3		3.906		--	1.253	97.998	
4	1.964		4.026	--	0.12	97.878	CP_1
5		1.702		0.262	--	98.140	
6	1.261		1.592	0.110	--	98.250	CP_2
7		2.542		--	1.281	96.969	
8		2.006		0.536	--	97.505	
9			3.145	--	1.139	96.366	Last Pt.
	ΣBS= 5.129		ΣFS= 8.763	ΣRise= 0.908	ΣFall= 4.542		

table
02 M for correct calculation
01 M for check

Arithmetic check : ΣBS – ΣFS = 5.129 – 8.763 = - 3.634

ΣRise – Σfall = 0.908 - 4.542 = - 3.634

Last RL – First RL = 96.366 – 100.00 = - 3.634

ΣBS – ΣFS = ΣRise – Σfall = Last RL – First RL = - 3.634

Hence checked and found O.K.

Q.6

Attempt any TWO of the following

(a) ***The following bearings were taken in traversing with respect to compass. Calculate back bearings and included angles in a closed traverse PQRSP. Apply usual check.***

Line	***F.B.***
PQ	***124^0 30'***
QR	***68^0 15'***
RS	***310^0 30'***
SP	***200^0 15'***

Ans.

Line	F.B.	B.B.	Included angle
PQ	124^0 30'	304^0 30'	<P = BB of SP – FB of PQ = $104^0$15'
QR	68^0 15'	248^0 15'	<Q = $304^0$30' – $68^0$15'= $236^0$15'>180^0 = 360^0 - $236^0$15 = $123^0$45'
RS	310^0 30'	130^0 30'	<R = $310^0$30' – $248^0$15'= $62^0$15'
SP	200^0 15'	20^0 15'	<S = $200^0$15' – $130^0$30'= $69^0$45'

02 M for correct BB
02 M for correct included angles

Check on sum of included angles.

ΣIncluded angles, <P + <Q + <R + <S = $104^0$15' + $123^0$45' + $62^0$15' + $69^0$45' = 360^0

And (2n – 4) x 9o = (2 x 4 – 4) x 90 = 360^0

02 M

Calculation steps:

1. BB of PQ = FB of PQ + 180^0 = 124^0 30' + 180^0 = 304^0 30'
2. BB of QR = FB of QR + 180^0 = 68^0 15' + 180^0 = 248^0 15'
3. BB of RS = FB of RS - 180^0 = 310^0 30'- 180^0 = 130^0 30'
4. BB of SP = FB of SP - 180^0 = 200^0 15'- 180^0 = 20^0 15'
5. Included angles:

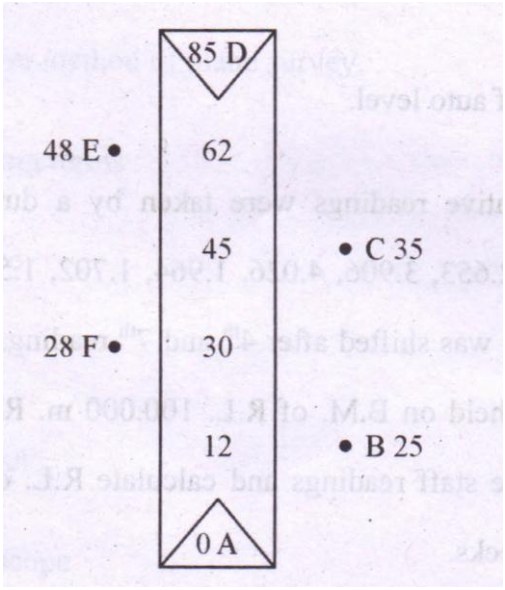
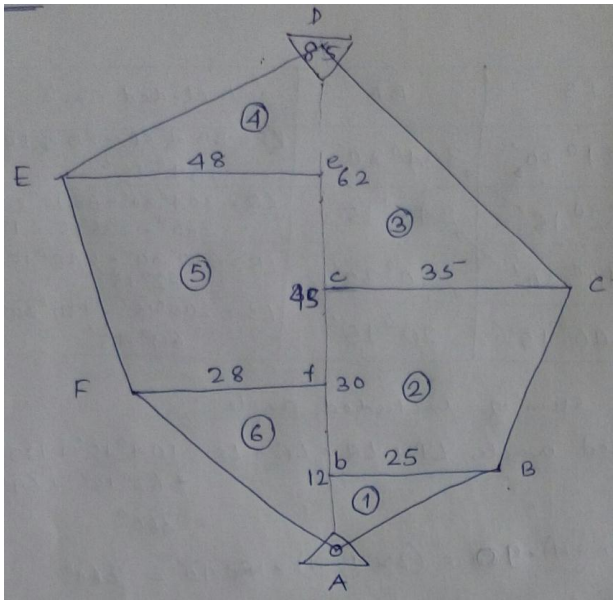
i. <P = BB of SP – FB of PQ
= 20^0 15' -124^0 30' = $104^0$15'

ii. <Q = BB of PQ – FB of QR
= 304^0 30'- 68^0 15'= $236^0$15'>180^0 –Exterior angle
<Q = 360^0 - $236^0$15' = $123^0$45'

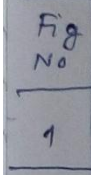
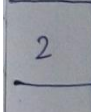
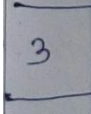
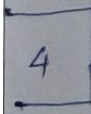
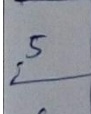
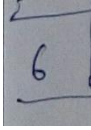
iii. <R = BB of QR – FB of RS
= 248^0 15'-310^0 30'= $62^0$15'

iv. <S = BB of RS – FB of SP

02 M for calculation steps

		$= 130^0\ 30' - 200^0\ 15' = 69^0 45'$	
Q.6	(b)	***Find the area of the plot ABCDEFA from the data collected in chain and cross staff survey in hectares from the following fig.*** 	
	Ans.		02 M

Cross staff survey area table: — 04 M

Fig No	Fig	Chainages	Base	Offsets	Mean offset	Area (m^2) +	Area (m^2) −
1		0 & 12	12	0 & 25	12·5	150	
2		12 & 45	33	25 & 35	30	990	
3		45 & 85	40	35 & 0	17·5	700	
4		62 & 85	23	48 & 0	24	552	
5		30 & 62	32	28 & 48	38	1216	
6		0 & 30	30	0 & 28	14	420	
						4028 Sq.m.	

02 M

1 Sq m = (1 / 10000) Sq. Hector
Area in Hector is 0.4028 Hector.

Q.6 (c) — ***The following page of old level book having few staff readings missing. Find out the missing reading and rewrite the page. Apply usual checks.***

Station	***Staff Reading***			***H.I.***	***R.L.***	***Remark***
	B.S.	***I.S.***	***F.S.***			
1	***2.650***			***X***	***100.000***	***B.M.***
2		***X***			***98.910***	
		3.830			***98.820***	
	4.640		***X***	***X***	***98.380***	***CP_1***
		0.380			***X***	
	1.640		***X***	***103.700***	***102.060***	***CP_2***
		2.840			***100.860***	
	X		***3.480***	***104.900***	***100.220***	***CP_3***
			X		***102.700***	***End St^n.***

Ans.

Station	Staff Reading			H.I.	R.L.	Remark
	B.S.	I.S.	F.S.			
1	2.650			X_1	100.000	B.M.
2		X_2			98.910	
3		3.830			98.820	
4	4.640		X_3	X_4	98.380	CP_1
5		0.380			X5	
6	1.640		X_6	103.700	102.060	CP_2
7		2.840			100.860	
8	X_7		3.480	104.900	100.220	CP_3
9			X_8		102.700	End St^n.

		1. X1=RL of BM+BS == 100.000+2.650= 102.650 2. X2= X1-98.910= 102.650-98.910 = 3.740 3. X3=X1-98.380= 102.650-98.380 = 4.270 4. X4=98.380+ 4.640= 98.380+ 4.640= 103.020 5. X5=X4-98.380= 103.020-98.380= 102.640 6. X6=X4-102.060= 103.020-102.060= 0.960 7. X7=104.900-100.220= 104.900-100.220= 4.680 8. X8=104.900-102.700= 104.900-102.700= 2.200	04 M

Station Pt	Staff Readings			HI	RL	Remark
	BS	IS	FS			
1	2.650			**102.650**	100.000	BM
2		**3.740**			98.910	
3		3.830			98.820	
4	4.640		**4.270**	**103.020**	98.380	CP1
5		0.380			**102.640**	
6	1.640		**0.960**	103.700	102.060	CP2
7		2.840			100.860	
8	**4.680**		3.480	104.900	100.220	CP3
9			**2.200**		102.700	End Point

02 M

Check: ΣBS – ΣFS = 13.61 – 10.91 = 2.7

Last RL – First RL = 102.700 – 100.00 = 2.7

ΣBS – ΣFS = Last RL – First RL = 2.7 — 02 M

Hence checked and found O.K.