MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)
(ISO/IEC-27001-2005 Certified)

WINTER-12 EXAMINATION

**Model Answer**

Q. No. 1 a) Attempt any **THREE** of the following: (12)

**i) Purpose of estimating and costing:** (any four points: 4 x 1 = 04)

- To ascertain necessary amount of money required by owner to complete the proposed work.
- To ascertain quantities of materials required in order to programme their timely procurement.
- To calculate the no. of different categories of workers required for work.
- To assess the requirements of tools, plants and equipments required for work.
- To fix up completion period from volume of works involved in the estimate.
- To draw up a construction schedule and programme and also to arrange the funds required according to the programming.
- To justify the investment from benefit-cost ratio.
- To invite tenders and prepare bills for payment.

**ii) Different types of approximate estimates:** (any four: 4 x ½ = 02)

- Plinth area method
- Cubical content method
- Service unit method
- Typical bay method
- Approximate quantity method

The description of any one of the above method. (02)

iii) Factors to be considered while preparing detailed estimate.(any four points: 4 x 1=04)

- Quantity of materials
- Availability of materials
- Transportation of materials
- Location of site
- Local labour charges.

iv) **Revised Estimate:** A revised estimate is a detailed estimate for the revised quantities and rates of items of works originally provided in the estimate prepared and submitted for fresh technical sanction. It is required to be prepared for the following reasons: (any two points)

- When sanctioned estimate is likely to exceed by more than 5% either from the rates being found insufficient or from any cause whatsoever except important structural alterations.
- When the expenditure of work exceeds or is likely to exceed more than 10% of the administrative approval.
- When there are material deviations from the original proposal but not due to material deviation of a structural nature.
- When it is found that sanctioned estimate is more than actual requirement. (02)

**Supplementary Estimate:** While a work is in progress, some changes or additional works due to material deviation of a structural nature from the design originally approved may be thought necessary for the development of a project. An estimate is then prepared to include all such works. This is known as supplementary estimate. (02)

**Q.No.1**. b) Attempt any **one** of the following. (06)

i) Approximate estimate of office premises = Total built up area X Rate/$m^2$
= 120 x 6500
= Rs. 7, 80, 000/- (03)

Approximate estimate of workshop = Total built up area X Rate/$m^2$

= 3 x 32 x 4000
= Rs. 3, 84,000/- (03)

ii) **Unit quantity method:** By using this method, estimate can be prepared quickly and easily. This method requires record of unit quantity rate of similar structure in same locality with similar specification. The points to be considered are as price level variation, specifications required, location of site, no. of units in structure, foundation and soil condition. This method is used for preparing preliminary estimate. (03)

**Total quantity method:** With the help of detailed drawings, total quantity of various items is calculated. Items can be obtained by dividing whole structure in to different components. The total quantity of each item is multiplied with the rates of respective items which can be obtained from PWD district schedule of rates. (03)

**Q. No. 2.** Attempt any **two** of the following (16)

**a)**

| Item No. | Description of Item | No | Length | B | H | Quantity |
|---|---|---|---|---|---|---|
| 1 | Internal Plaster: wall<br>wall<br>ceiling | 2<br>2<br>1 | 6<br>4.9<br>6 | <br><br>4.9 | 3.1<br>3.1 | 37.2<br>30.38 |
| | Gross quantity: | | | | | 96.98 $m^2$ |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Deductions D<br>W | 1<br>1 | 1.0<br>1.8 | | 2.0<br>1.2 | 2.0<br>2.16 |
| | Total Deductions | | | | | 4.16 $m^2$ |
| | Net Quantity of internal plaster: | | | | | 96.98-4.16=92.82 $m^2$ |

Gross quantity of plaster: 04 marks
Deductions: 02 marks
Net quantity of plaster: 02 marks

**Q. No. 2 b):** Work out
i)

| Sr. No. | Description | No | Length | Quantity | Total Quantity |
|---|---|---|---|---|---|
| 1 | Steel reinforcement for **Lintel**<br>**i) Main bars 4-12¢:**<br>Length of straight bars:1.2 + 0.3 -2 x 0.04 + 2 x 9 x 12/1000 | 4 | 1.636 | 6.544m | 6.544m<br>i.e. **5.824 kg** |
| | **ii) Anchor bars: 2-10¢**<br>Length = 1.5 – 0.08+2 x 9 x 10/1000 | 2 | 1.6 | 3.2m | 3.2m<br>i.e. **0.992kg** |
| | iii)**Stirrups:** 8¢@150 c/c<br>no. of stirrups = 11<br>length of one stirrup = 2(158 + 228) +2 x 12 x 8 = 964mm | 11 | 0.964 | 10.604m | 10.604m<br>i.e. 4.135 kg |
| 2 | Steel reinforcement for **Chajja**<br>i)**Main bars** 8¢@150 c/c<br>Length = 0.6 + 0.23 – 0.08 + 18 x 8/1000 = 0.894 m<br>No. of bars = 11 | 11 | 0.894 | 9.834m | 9.834m<br>i.e. 3.835 kg |
| | iii)Distribution steel: 8¢@100 c/c<br>Length = 1.5 – 0.08 + 18 x 8/1000<br>= 1.564 m<br>No. of bars = 9 | 9 | 1.564 | 14.076m | 14.076m<br>i.e. 5.489kg |
| | **Total quantity of steel reinforcement for lintel and Chajja** | | | | **20.275kg** |

Steel reinforcement for lintel: 02 marks
Steel reinforcement for Chajja: 02 marks

**Q. No. 2 b)**

**ii)** Quantity of concrete in lintel and Chajja

| Item No. | Description of Item | No | Length | B | H | Quantity |
|---|---|---|---|---|---|---|
| 1 | Lintel concrete | 1 | 1.5 | 0.23 | 0.3 | $0.1035m^3$ |
| 2 | Chajja concrete<br>1 x 0.6 x 0.075 x 1.2<br>Total quantity for Lintel & chajja | 1 | 1.2 | 0.60 | 0.075 | $0.054m^3$<br>$0.027m^3$<br>$0.1845m^3$ |

Concrete quantity for lintel: 02 marks

Concrete quantity for lint: 02 marks

**Q. No. 2 c)**

| **Item No.** | **Description of Item** | **No** | **Length** | **B** | **H** | **Quantity** |
|---|---|---|---|---|---|---|
| 1 | Excavation for foundation | | | | | |
| | Long walls | 3 | 4.93 | 1.2 | 1.65 | 29.28 |
| | | 1 | 3.23 | 1.2 | 1.65 | 06.39 |
| | | 1 | 4.43 | 1.2 | 1.65 | 08.77 |
| | Short wall | 2 | 2.203 | 1.2 | 1.65 | 8.71 |
| | | 1 | 3.28 | 1.2 | 1.65 | 6.49 |
| | | 1 | 3.03 | 1.2 | 1.65 | 5.99 |
| | | 1 | 1.83 | 1.2 | 1.65 | 3.62 |
| | | | | | | ---------- |
| | **Total Quantity of excavation** | | | | | **$69.25m^3$** |
| 2 | UCR masonry in plinth and foundation | | | | | |
| | i)Step I: Long wall | 3 | 4.63 | 0.9 | 0.4 | 5.00 |
| | | 1 | 3.23 | 0.9 | 0.4 | 1.16 |
| | | 1 | 4.13 | 0.9 | 0.4 | 1.48 |
| | Short wall | 2 | 2.33 | 0.9 | 0.4 | 1.67 |
| | | 1 | 3.58 | 0.9 | 0.4 | 1.28 |
| | | 1 | 3.33 | 0.9 | 0.4 | 1.19 |
| | | 1 | 2.43 | 0.9 | 0.4 | 0.87 |
| | ii)Step II: Long wall | 3 | 4.18 | 0.45 | 1.05 | 5.92 |
| | | 1 | 3.23 | 0.45 | 1.05 | 1.52 |
| | | 1 | 3.68 | 0.45 | 1.05 | 1.73 |
| | | 2 | 2.78 | 0.45 | 1.05 | 2.62 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 1<br>1<br>1 | 4.03<br>3.78<br>3.35 | 0.45<br>0.45<br>0.45 | 1.05<br>1.05<br>1.05 | 1.90<br>1.78<br>1.58<br>---------- |
| | **Total Qty. of UCR masonry** | | | | | **29.7 $m^3$** |

Excavation quantity: 04 mark
UCR quantity: 04 mark

**Q. No. 3:**

a) **Measurement Sheet-** It is prescribed form in which quantities of different items are Calculated and entered.

| Item No. | Description of Item | No | Length | B | H | Quantity |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |

$(1\frac{1}{2})$

**Abstract Sheet-** It is a prescribed form in which cost of each item of work is calculated and entered.

| Item No. | Description of Item | Quantity | Unit | Rate | Amount |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

$(1\frac{1}{2})$

**Face Sheet-** It is a page showing list of items and title of work of which estimating is to be done. (1)

b) Any item of work is not to be missed while doing estimate.

- To follow the logical sequence of work while executing the work.
- It is useful for item wise planning of work
  - collection of material
  - management of labour
  - Time management (4)

c) i) meter-m
ii) square meter- sqm
iii) cubic meter- cum
iv) Lumsum (one mark each point) (4)

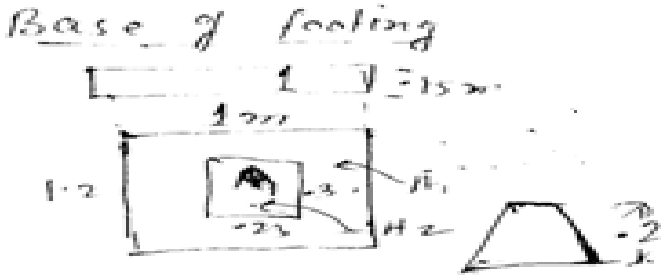
d) Rules of deductions of openings for masonry-

No deductions -
i) for openings upto 0.1 sq.m

ii) For ends of joints, beams, lintels, posts, rafters, purlins, steps etc.
iii) Wall plates, Bedplates, bearing of slab, chajja's etc.
iv)The structures of other than masonry having thickness less than 10 cm and bearing more than wall thickness.
Above 0.1 Sqm area of opening, deduction should be made as per actual size of opening.
(One mark each point) (4)

e) Refer fig. no.4 in Question Paper

Quantity of concrete in footing.




1) Base of footing

| L | B | D | Quantity of concrete |
|---|---|---|---|
| 1 | 1.2 | 1.5 | 0.180 |

(1)

2)

$$V=\frac{L}{6}[A_1 + A_2 + 4\ A_m]$$

$A_1 = 1x\ 1.2 = 1.2$

$A_2 = 0.23 \times 0.3 = 0.069$

$$A_m = \frac{1.2+0.069}{2}$$

$= 0.6345$

$$V=\frac{L}{6}[A_1 + A_2 + 4\ A_m]$$

$$V=\frac{0.2}{6}[1.2 + 0.069 + 4 \times 0.6345]$$

$= 0.033 \times 3.807$

$= 0.1256$ (2)

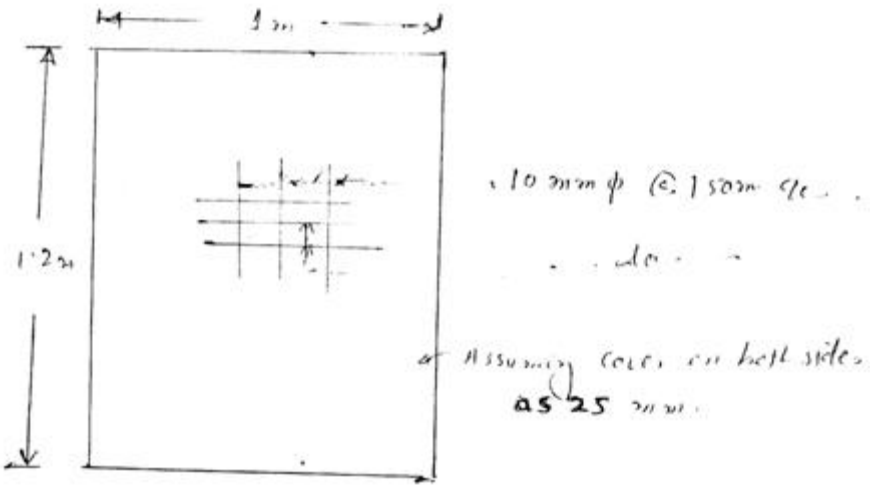
Total quantity for 1 column = 0.3056 $m^3$
Total quantity for 7 columns = 2.1392 $m^3$ (1)

**Q. No 4 –**

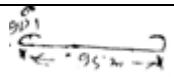
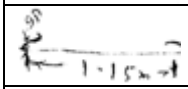
a) **Attempt any THREE** (12)



i)




Schedule of Bar

| Description of Bar | Shape of Bar in bending | No of Bars | Length of Bar | Total Length | Weight in kg of bar per meter length | Weight in kg of bars for one column | Weight in kg of bars for seven column |
|---|---|---|---|---|---|---|---|
| Mild steel bars both ways in Column footing |  | 9 | 1.13 | 10.17 | 0.69 | 7.02 | 49.14 |
| |  | 8 | 1.33 | 10.64 | 0.69 | 7.34 | 51.38 |
| | | | | | | 14.36 | **100.52 kg** |

For No. of bars – 1 Mark
For total length- 1 Mark
For quantity of steel- 1 Mark
For schedule of bars- 1 Mark

ii) **Rate analysis of P. C. C. (1:2:4)**

Consider 10 $m^3$ of P. C. C. (1:2:4)
Volume of wet concrete =10 $m^3$
Total dry volume of concrete = 1.52 x 10 $m^3$ = 15.2 $m^3$
Quantity of materials:

i) Aggregate quantity $= \frac{15.2}{1+2+4}$ X 4 =8.8 $m^3$

ii) Sand quantity $= \frac{15.2}{1+2+4}$ X 2 =4.4 $m^3$

iii) Quantity of cement = $\frac{15.2}{1+2+4}$ X 1= 2.2 $m^3$

No of bags of cement = $\frac{2.2}{0.35}$ = 63 bags (1)

| | Particulars | Quantity | Rate per | Amount in Rupees | Marks |
|---|---|---|---|---|---|
| I. Materials | | | | | |
| i | Coarse Aggregate | 8.8 $m^3$ | 700 per $m^3$ | 6160 | (01) |
| ii | Sand | 4.4$m^3$ | 1800 per $m^3$ | 7920 | |
| iii | Cement | 63 bags | 230 per bag | 14490 | |
| | | | | 28570 | |
| II. Labour | | | | | |
| i | Head Mason | 1/2 | 500 per day | 250 | |
| ii | Mason | 2 | 400 per day | 800 | |
| iii | Male Mazdoor | 12 | 250 per day | 3000 | |
| iv | Female Mazdoor | 20 | 200 per day | 4000 | |
| v | Bhisti | 4 | 250 per day | 1000 | (01) |
| vi | Sundries , T & P | Lumsum | | 1000 | |
| | | | Rs | 10050 | |

Total cost of material and labour = 28570 + 10050 = 38620 Rs

Add $1\frac{1}{2}$ % for water charges = 579 Rs

Add 10 % for water charges = 3862 Rs

Rate of PCC per 10 $m^3$ = 43061 Rs

Rate of PCC per 1 $m^3$ = 4306 Rs

Cost of 25 cum = 4306 x 25 = 107650 Rs.

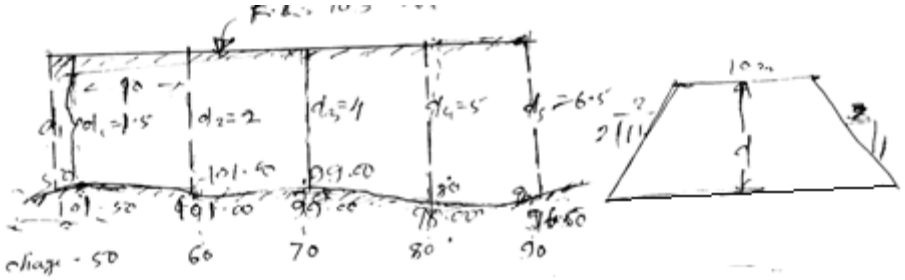
(01)

iii) **Definition of Rate Analysis** – To determine the rate per unit of a particular item from the cost of quantities of materials, the labour charges and petty expenses and 10 % contractors profit (2)

Factors affecting rate analysis:

- Specification of work and material
- Quality of material
- Method of construction
- Labour charges
- Location of site (2)

**iv) Computation of volume by mean area method**



| Chainage | Depth of filling | Area ($Bd+Sd_m^2$) | Mean area | Length | Quantity = Mean area x Length |
|---|---|---|---|---|---|
| | m | $m^2$ | $m^2$ | m | $m^3$ |
| 50 | 1.5 | 19.5 | | | |
| 60 | 2 | 28 | 23.75 | 10 | 237.5 |
| 70 | 4 | 72 | 50 | 10 | 500 |
| 80 | 5 | 100 | 86 | 10 | 860 |
| 90 | 6.5 | 149.5 | 124.5 | 10 | 1247.5 |
| | | | | | 2845 |

Calculation of Depth – (1)
Calculation of Area- (1)
Calculation of Mean Area- (1)
Calculation of Quantity- (1)

Q. No 4 (b) **Attempt any ONE**

i) Rate analysis of one cubic meter of BBM (1:6)

No of bricks of size 20 x 10 x 10 cm per cum of brickwork is 500 Nos.

Consider 10 $m^3$ of brickwork,

No of bricks required = 500 x 10= 5000 Nos,

Mortar required –

Dry volume of mortar required is 32 % of brickwork i.e. 10 x 32/100 =3.2 $m^3$

Volume of cement for 3.2 $m^3$ mortar (1:6)

$= 3.2 \times \frac{1}{7} = 0.45\ m^3$

= (0.45/0.035)= 13 bags

Volume of sand required for 1:6 mortar

$= \frac{3.2}{7} \times 6$

$=2.7\ m^3$ (1)

| Particulars | Quantity | Rate per | Total Amount in Rs | Marks |
|---|---|---|---|---|
| Materials | | | | |
| i) Bricks –Ist Class | 5000 No | Rs 5000 /1000 No | 25000 | |
| ii)Cement | 13 bags | Rs 230 / bag | 2990 | |
| iii) Sand | 2.7 $m^3$ | Rs 1800/ $m^3$ | 4860 | |
| | | Total I. | 32850 | (2) |
| II.Labours | | | | |
| i) Head Mason | ½ No | Rs 500 per day | 250 | |
| ii) Mason | 10 Nos. | Rs 400 per day | 4000 | |
| iii)Male Mazdoor | 7 Nos. | Rs. 200 per day | 2000 | |
| iv)Female Mazdoor | 10 Nos. | Rs. 200 per day | 2000 | |
| v) Bhisti | 2 Nos. | Rs. 200 per day | 400 | |
| vi)Sundries, T&p | L.S. | | 1000 | (2) |
| | | Total II. | 9750 | |

Total of I and II (cost of material and labour) = 42600 Rs

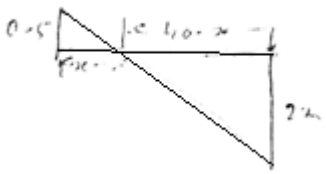
Add $1\frac{1}{2}$ % for water charges = 639 Rs

Add 10 % for water charges = 4260 Rs

Rate of BBM per 10 $m^3$ = 47499 Rs

Rate of BBM per 1 $m^3$ = 4750 Rs (1)

**Q.4 b ii)**



$$\frac{x}{0.5} = \frac{40-x}{2}$$ X= 8 m, B= 10 m, S=2

| Chainage | Depth in m | Bd | $Sd^2$ | Sectional Area = $Bd+ Sd_m^2$ | Mean Area $A_m$ | Length m | Q= $A_m$ x L | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Embankment In Cum | Cutting In Cum |
| 160 | 0.6 | 6 | 0.72 | 6.72 | | | | |
| 200 | 0.5 | 5 | 0.50 | 5.5 | 6.11 | 40 | 244.40 | |
| 208 | 0 | 0 | 0 | 0 | 2.75 | 8 | 22.0 | |
| 240 | 2.0 | 20 | 80 | 28 | 14 | 32 | | 448 |
| 280 | 3.2 | 32 | 20.48 | 52.48 | 40.2 | 40 | | 1608 |
| 320 | 4.1 | 41 | 33.62 | 74.62 | 63.55 | 40 | | 2542 |
| 360 | 4.8 | 48 | 46 | 94.00 | 84.31 | 40 | | 3372 |
| 400 | 5.4 | 54 | 58.32 | 112.32 | 103.16 | 40 | | 4126.4 |
| | | | | | | Total | 266.4 | 12096.4 |

Quantity in Embankment = 0266.40 Cum
Quantity in Cutting =12096.40 Cum

Calculate F.L and depth- (2)
Calculate area- (2)
Calculate Quantities- (2)

## Q.No. 5.

**a)** D = 60mm = 0.6m H = 4500mm = 4.5m

Diameter of main steel = 12mm = 0.012m

Volume of main steel = Area of steel * Length of bar = 8*( $\pi$ /4 )* 0.012*4.5 = 4.7*$10^{-3}$ (01)

**Volume of Links**

Number of links = (Height of column □ Spacing) +1= (4500/125)+1 = 37 No's
(01)

Diameter of Link = 6mm =0.006m

Volume of Link = area of links* length of links

Length of link = $\pi$(600-2*40) + (24*6) = 1.778m (01)

Volume of links = 37* $\pi$/4*$(0.06)^2$ *1.778 = 1.859*$10^{-3}$cum

Weight of Links = 1.859*$10^3$ *78.5= 14.59kg (02)

For unit (01)

**Q.5.b) i) R.C.C**. 1:2:4

Volume of concrete = 25 cum

Add 55% extra for voids wastage

Dry Volume = 25+ (25*55/100) = 38.75cum (01)

Volume of cement or volume of one part of concrete = 38.75/7=5.5357cum (01)

Quantity of no; of cement bags = 5.5357/0.035 = 158.16 = 159bags (01)

Quantity of fine aggregate = 2*5.5357= 11.0714

Quantity of coarse aggregate = 4*5.5357= 22.1428cum (01)

**Q.5.b) ii) Plaster (1:6) Area of plaster** = 100 $m^2$

Assume 12mm thick plaster. Volume of plaster = 100*0.012 = 1.2 $m^3$ (01)

Add 50% for voids & 10% for unevenness

Dry volume of mortar = 1.2(1.2*60/100) = 1.92 cum (01)

One part of mortar = 1.92/7= 0.2743 cum (01)

No. of cement bags = 0.2743/0.035= 7.8367= 8 bags

Quantity of fine sand= 6*0.2743= 1.6458 cum (01)

**Q.5.c)**

| **Sr.no** | **Description** | **No** | **L(m)** | **B(m)** | **H(m)** | **Qty (cum)** | **Total Qty (cum)** | **Marks** |
|---|---|---|---|---|---|---|---|---|
| 1 | Excavation<br>B=3.3+0.4+0.4 | 01 | 6.8 | 4.1 | 2.2 | 61.336 | 61.336 | 02 |
| **2** | P.C.C. | 01 | 6.8 | 4.1 | 0.2 | 5.5760 | 5.5760 | 02 |
| **3** | B.B.M.<br>Long Wall=6.4m | 2 | 6.4 | 0.2 | 2.0 | 5.120 | | 02 |
| **4** | Short Wall= 2.9m | 2 | 2.9 | 0.2 | 2.0 | 2-320 | 7.44 | 02 |

**Q.6.a)**

i) The measurement shall be taken in order of sequence length, breadth or width, & height or depth.

ii) Dimensions shall be measured to the nearest to 0.01m

iii) Area shall be worked out to the nearest 0.01$m^2$

iv) Cubic contents shall be worked to the nearest to 0.01 $m^2$

v) The same work done under different conditions shall be measured separately stating the conditions the lift & lead wherever possible.

(any four) (01 mark to each 01*4)

**Q.6.b)**

i) **Centage charges;-** when the engineering department takes up the work of other department a percentage amount of 10% to 15% of the estimated cost is charged to meet the expenses of establishment , designing, planning, supervision etc. & this percentage charge is known as centage charges. (02)

ii) **Contingencies: -** During the execution of works there will be some miscellaneous expenditure which cannot be classified under any subhead or any item. These are expenses of

miscellaneous character. To meet such expenses 3% to 5% of estimated cost is provided which is known as contingencies. (02)

**Q.6.c)**

Method of calculating earth for road

**i) Mid sectional area method**

| Length or chainage | Depth or height (d)m | Mean depth dm | Area 0f central rectangular portion (B*d)m | Area of side triangles $Sdm^2$ | Length (L) | Quantity $Bdm+Sd^2$ | |
|---|---|---|---|---|---|---|---|
| | | | | | | Embankment (+)ve | Cutting (-)ve |
| | | | | | | | |

**ii) Mean sectional area method**

| Length or chainage | Depth or height (d)m | Area 0f central portion (B*d)m | Area of sides $Sd^2$ | Total sectional area $(bd+Sd^2)$ | Mean sectional area | Length (L) | Quantity $Bdm+Sd^2$ | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Embankment (+)ve | Cutting (-)ve |
| | | | | | | | | |

iii) Prismoidal formula Q = (L/6)(A1+A2+4Am) Where Am- mid sectional area

iv) Trapezoidal formula V = D/2*((A0+An)/2+A1+A2+A3+A4+---------+An)

(01 mark each)

**Q.6.d)**

The area of cross section at both the ends & mid section is calculated by the following formula

Q= L/6*(A1+A2+4Am) (02)

Where A1 & A2 are the cross sections at ends & Am is the area at mid section

V= D/3*(A0+An+4(A1+A3+A5+------+An-1)+2(A2+A4+------+An-2)

In this case of Prismoidal formula it is necessary to have odd number of sectional areas. If there are even numbers of sections, the en strip should be calculated separately & the remaining strip should be calculated. (02)

**Q.6.e)**

**i) Lead: -** it is defined as the horizontal distance up to which a contractor will haul the material excavated & is included in the rates of excavation. This lead is 30m & called as normal or standard lead. (01)

**Lift: -** it is defined as the vertical distance travelled by material, normally lift is taken as 1.5m. (01)

**ii) Task work: -** The capacity of doing work by a skilled labour in the form of work per day is known as task work.

The task varies according to nature size & location of work. As per the types & experience of labour output of work is varying from skilled to unskilled worker. (02)