B. Tech.

(SEM. VI) EVEN SEMESTER THEORY EXAMINATION, 2016-17
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Time : 3 Hours   Max. Marks : 100

SECTION-A

1. Explain the following :   (10 × 2 = 20)

a. What is the term planning ?
Ans. Refer Q. 3.1, 2 Marks Questions, Page SQ–6C, Unit-3.

b. Write the classification of scheduling.
Ans. Refer Q. 3.3, 2 Marks Questions, Page SQ–6C, Unit-3.

c. Enumerate the limitations of bar chart.
Ans. Refer Q. 3.16, 2 Marks Questions, Page SQ–8C, Unit-3.

d. Give use of learning curves in estimating duration.
Ans. Refer Q. 3.12, 2 Marks Questions, Page SQ–10C, Unit-3.

e. Define break even cost analysis.
Ans. Refer Q. 5.20, 2 Marks Questions, Page SQ–18C, Unit-5.

f. Brief short notes on total cost curve.
Ans. Refer Q. 5.9, 2 Marks Questions, Page SQ–16C, Unit-5.

g. Define arbitration.
Ans. Arbitration is the process of the settlement of a dispute not by a regular and ordinary court but by impartial references selected or agreed upon by the parties concerned.

h. Describe the term land acquisition.
Ans. Refer Q. 2.5, 2 Marks Questions, Page SQ–4C, Unit-2.

i. Write the methods of tunneling.
Ans. Refer Q. 4.21, 2 Marks Questions, Page SQ–14C, Unit-4.

j. What are the factors affecting the selection equipments ?
Ans. Refer Q. 4.10, 2 Marks Questions, Page SQ–12C, Unit-4.

SECTION-B

2. Attempt any five of the following questions :   (5 × 10 = 50)

a. Define organization and explain its types.
Ans. Refer Q. 3.2, Page 3–4C, Unit-3.

b. Explain the principles of planning. State their advantages and limitations.
Ans. Refer Q. 3.6, Page 3–9C, Unit-3.

c. Draw the network and design the critical path and calculate the completion time of the project whose activities are as follows.

Activity	Duration in days	Preceding
A-B	7	–
B-C	10	A-B
B-D	15	A-B
C-D	7	B-C
C-E	12	B-C
D-E	3	B-D, C-D
E-F	5	C-E, D-E

Ans. Refer Q. 3.24, Page 3–29C, Unit-3.

d. Describe about the depreciation and break even cost analysis of construction projects.
Ans. Depreciation : Refer Q. 5.20, Page 5–20C, Unit-5.
Break Even Cost Analysis : Refer Q. 5.22, Page 5–22C, Unit-5.

e. A project of five activities, whose activity relationships, activity durations (normal and crash) and activity costs (normal and crash) are given in the following table. Estimate the optimum cost and time.

Activity	Normal		Crash	
	Time (Week)	Cost (₹)	Time (Week)	Cost (₹)
10-20	3	12000	2	16000
10-30	6	18000	3	24000
20-40	2	20000	1	23000
30-40	4	16000	2	21000
40-50	5	30000	4	35000

Ans. Refer Q. 3.25, Page 3–31C, Unit-3.

   f. Explain the procedure of opening the tenders, acceptance of tenders and the execution of agreement for carrying out a work.

Ans. Refer Q. 2.24, Page 2–29C, Unit-2.

   g. Explain various types of contract system with advantages and disadvantages.

Ans. Refer Q. 2.20, Page 2–23C, Unit-2.

   h. Explain the various conveying equipments in detail.

Ans. Refer Q. 4.11, Page 4–15C, Unit-4.

SECTION-C

Attempt any **two** of the following questions : (2 × 15 = 30)

3. i. Explain the different classification of scheduling in detail.

Ans. Refer Q. 3.7, Page 3–11C, Unit-3.

   ii. Enumerate the difference between CPM and PERT.

Ans. Refer Q. 3.30, Page 3–35C, Unit-3.

4. i. Compare direct and indirect cost in the construction project.

Ans. Refer Q. 5.3, Page 5–3C, Unit-5.

   ii. Explain the legal aspects of contracts and various laws related to contracts.

Ans. Refer Q. 2.17, Page 2–19C, Unit-2.

5. Explain in detail about various types of earth work equipments with special purpose usage for each equipments.

Ans. Refer Q. 4.9, Page 4–10C, Unit-4.

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B. Tech.
(SEM. VI) EVEN SEMESTER THEORY EXAMINATION, 2017-18
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Time : 3 Hours

Max. Marks : 100

Note : Attempt all Sections. If require any missing data; then choose suitably.

SECTION-A

1. Attempt all questions in brief.

(2 × 10 = 20)

a. What do you mean by project cycle ?
Ans. Refer Q. 3.1, Page 3–2C, Unit-3.

b. Write a short note on 'construction team'.
Ans. Refer Q. 3.10, Page 3–13C, Unit-3.

c. What is bar chart ?
Ans. Refer Q. 3.14, 2 Marks Questions, Page SQ–8C, Unit-3.

d. Define dummy activity.
Ans. Refer Q. 3.9, 2 Marks Questions, Page SQ–7C, Unit-3.

e. What do you mean by depreciation ?
Ans. Refer Q. 5.12, 2 Marks Questions, Page SQ–17C, Unit-5.

f. What is break-even cost analysis ?
Ans. Refer Q. 5.20, 2 Marks Questions, Page SQ–18C, Unit-5.

g. Write a note on project contract.
Ans. Refer Q. 2.4, 2 Marks Questions, Page SQ–4C, Unit-2.

h. What is land acquisition ?
Ans. Refer Q. 2.5, 2 Marks Questions, Page SQ–4C, Unit-2.

i. What is operational cost ?
Ans. Refer Q. 4.9, 2 Marks Questions, Page SQ–12C, Unit-4.

j. What are the various types of crane ?
Ans. Refer Q. 4.17, 2 Marks Questions, Page SQ–13C, Unit-4.

SECTION-B

2. Attempt any three of the following :   (10 × 3 = 30)

a. **What is 'Job Layout' ? Explain factors affecting 'Job Layout'.**

Ans. **Job Layout:** It is a scaled drawing of proposed construction site showing all the relevant features such as entry and exit points to the site, contractor's offices, storage areas for materials areas for keeping equipment such as bar bending area, mixers, labour housing, toilets, washing facilities, etc.

Factors: Following are the affecting factors for job layout :

1. **Nature of the Project :** It plays an important role. If it is a multi-storeyed building project, then it will require a centrally located layout scheme. On other hand if it is a highway construction project, then it will require a number of construction centres at suitable locations.
2. **Construction Methods :** Construction can be either cast in-situ or by precast elements. If it is to be of precast elements then provision for casting yard should be included in the job layout.
3. **Availability of Resources :**
   i. Various types of resources are used in executing a project such as labour, plant and equipment material etc. If labour is from outside area, temporary housing will be taken into account and other facilities required by them.
   ii. Material storage areas are to be so provided such that cross movements are avoided and their lead time is shortest.
4. **Medical Facilities :** If it is a big and complex type of project then it is desirable that a field medical facility is provided.
5. **Contractors and Site Engineer's Offices:** These should be located preferably in a noise free area for better co-ordination.
6. **Provision for Temporary Roads :** These are necessary to transport the necessary plant machinery and material required for the project and also to provide the access to the construction site form the existing nearby roads.
7. **Other Facilities :** Services such as supply of power, water, telephone connection and also repair and maintenance yards should be made.

b. **What do you mean by CPM and PERT ? Illustrate with example the difference between CPM and PERT.**

Ans. CPM : Refer Q. 3.21, Page 3–26C, Unit-3.
PERT : Refer Q. 3.21, 2 Marks Questions, Page SQ–10C, Unit-3.
Difference : Refer Q. 3.30, Page 3–35C, Unit-3

c. **What are the advantages and disadvantages of debt financing ?**

Ans. **Advantages :** Following are the advantages of debt financing :
1. **Tax advantage :** The amount you pay in interest is tax deductible, effectively reducing your net obligation.
2. **Easier planning :** You know well in advance exactly how much principal and interest you will pay back each month. This makes it easier to budget and make financial plans.
3. **Control :** Allow you to have control of your own destiny.
4. The lender(s) from whom you borrow money do not share in your profit.
5. You can apply for a loan that has more favorable terms.

Disadvantages : Following are the disadvantages of debt financing :
1. **Qualification Requirements :** You need a good enough credit rating to receive financing.
2. **Discipline :**
   i. You will need to have the financial discipline to make repayments on time.
   ii. Exercise restraint and use good financial judgment when you use debt.
3. **Collateral :** Lenders will typically demand that certain assets of the company be held as collateral, and the owner is often required to guarantee the loan personally.
4. **Fixed Payments :**
   i. Principal and interest payments must be made on specified dates without fail. Businesses that have unpredictable cash flows might have difficulties making loan payments.
   ii. Declines in sales can create serious problems in meeting loan payment dates.
5. **Cash Flow :**
   i. Taking on too much debt makes the business more likely to have problems meeting loan payments if cash flow declines.
   ii. Investors will also see the company as a higher risk and be reluctant to make additional equity investments.

d. **Write note on the following :**
   i. Tender.
Ans. Refer Q. 2.16, 2 Marks Question, Page 2–5C, Unit-2.

   ii. Earnest money deposit.
Ans. Refer Q. 2.28, Page 2–34C, Unit-2.

   iii. Settlement of dispute.
Ans.
1. Settlement of dispute is the procedure of resolution of the industrial dispute.
2. It is necessary to resolve the dispute because these are harmful to all stakeholders-management, employees, economy, and the society.

3. For management, disputes result in loss of production, revenue, profit and even sickness of the plant.
4. A dispute, therefore, needs to be settled as early as possible.
5. Following are the various methods for resolving disputes:
   i. Collective bargaining.
   ii. Code of discipline.
   iii. Grievance procedure.
   iv. Arbitration.
   v. Conciliation.
   vi. Adjudication.
   vii. Consultative machinery.

iv. Commissioning of project.

Ans.
1. Project commissioning is the stage in which the performance of the structure is evaluated and nature of maintenance and repair is proposed.
2. The purpose of this stage is to ensure that the construction work has been completed as specified in the contract documents.
3. If any changes have been made because of some reasons, they must be recorded for technical performance and financial implications.
4. Following are the various step of project commissioning stage :
   i. Keep various records of the actual work.
   ii. Quality inspection (done to remove the defects, if found).
   iii. Prepare operation and maintenance manuals.
   iv. Carry out the performance test of the structure.
   v. Training and recruitment of staff for commissioning schedule.

e. What are the various types of hauling equipment vehicles? Also write in details their relative advantages and disadvantages.

Ans. Hauling Equipment : Refer Q. 4.9, Page 4–12C, Unit-4.
Advantages and Disadvantages :
A. Side or Rear Dump Truck :
   Advantage :
   1. The key advantages of the side dump are that it allows rapid unloading.
   Disadvantage :
   1. Maneuverability is not good for confined unload.
B. Bottom Dump Trucks :
   Advantage :
   1. The biggest advantage of bottom dump truck is the ability to lay material in a wind row.
   Disadvantage :
   1. A primary disadvantage to this design is that it is not good for large or bulky items.

C. Dumpers :
   Advantage :
   1. **Better Productivity :** It offers an increased rate of productivity by moving unnecessary items from the construction sites.
   2. **Impeccable Services :** It can be used effectively to transport all heavy construction materials quickly and effortlessly.
   3. **Various Sizes :** These trucks are available in a huge range of sizes.
   Disadvantage :
   1. It is a lot larger than other trucks so needs more storage space and room to maneuver.
   2. Does not perform so well in extreme weather conditions.
D. Tractors :
   Advantage :
   1. Can pull heavy loads.
   2. They are built to last many years, and are able to withstand harsh conditions.
   Disadvantages :
   1. Lack speed.
   2. Require careful maintenance.

SECTION-C

3. Attempt any one of the following : (1 × 10 = 10)
   a. What are the advantages and disadvantages of :
   i. Line organization
   ii. Line and staff organization
   Ans. Refer Q. 3.2, Page 3–4C, Unit-3.

b. Explain various type of construction in detail.
   Ans. Refer Q. 3.11, Page 3–14C, Unit-3.

4. Attempt any one of the following : (1 × 10 = 10)
   i. A project consists of eight predecessor relationship as under. Construct the network.

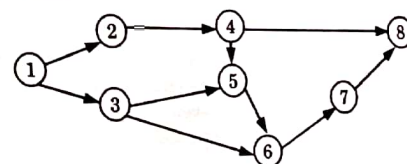| Event	1	2	3	4	5	6	7	8
Immediate Predecessor	–	1	1	2,3	3,4	3,5	6	4,7

Ans. Network :

Fig. 1.

b. Define the following :

i. Direct cost and indirect cost.

Ans. Refer Q. 5.3, Page 5–3C, Unit-5.

ii. Crash time and crash cost.

iii. Cost slope.

iv. Optimum time and optimum cost.

Ans. Refer Q. 5.4, Page 5–4C, Unit-5.

5. Attempt any one of the following :   (1 × 10 = 10)

a. The fixed cost for the year 2013-14 are 60,000 Rs. The estimated sales for the period are valued at 2,00,000 Rs. The variable cost per unit for the single product made is 5 Rs. If each unit sells at 25 Rs and the no. of units involved coincide with the expected volume of output. Construct break-even chart and determine the following :

i. The break-even point.

ii. Margin of safety.

Ans.

Given : Fixed cost = Rs. 60,000, Variable cost = Rs 5/unit, Selling cost = Rs 25/unit, Estimated sell = Rs 2,00,000.

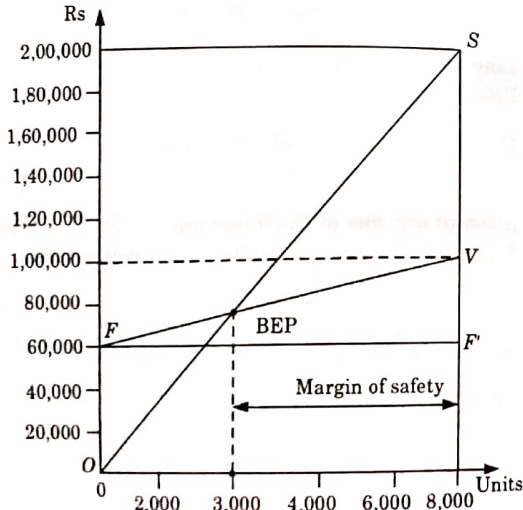To Find : Break-even point and Margin of safety.

1. Break Even Chart :

Fig. 2. Break even chart.

where FF' is representing fixed cost line, FV is the variable cost line, and OS is sale line.

2. Number of output units estimate for the year 2013-14

$$= \frac{2,00,000}{25} = 8,000 \text{ units.}$$

3. Variable cost for total project
$$= 8,000 \times 5 = \text{Rs, } 40,000$$

4. i. The break even point :
At break even point,
$$\text{Total sale} = \text{Total cost}$$
$$S \times x = V \times x + F$$

$$\text{Break even point}(x) = \frac{\text{Fixed cost}}{\text{Selling price/ unit} - \text{Variable cost/ unit}}$$

$$\text{BEP} = \frac{60,000}{25 - 5} = 3,000 \text{ units}$$

ii. $\text{Margin of safety} = \dfrac{\text{Expected Output} - \text{BEP}}{\text{Expected Output}} \times 100$

$$= \frac{8,000 - 3,000}{8,000} \times 100 = 62.5 \%$$

b. What do you mean by cash flow diagram ? How it is classified ?

Ans. **Cash Flow Diagram :** Refer Q. 5.8, Page, Unit-5.
Classification of cash flow diagrams : Following are the five categories of cash flow diagrams.

1. **Single Payment Cash Flow :** This involves a single present or future cash flow.
2. **Uniform Payment Series Cash Flow :** It involves a series of flows of equal amounts at regular intervals.
3. **Linear Gradient Series Cash Flow :** It is a series of flows increasing or decreasing by a fixed amount at regular intervals.
4. **Geometric Gradient Series Cash Flow :** It is a series of flows increasing or decreasing by a fixed percentage at regular intervals.
5. **Irregular Payment Series :** It is one that exhibits no regular overall pattern of cash flow.

6. Attempt any one of the following :   (10 × 1 = 10)

a. What are the plans for labour safety on construction site ?

Ans.

1. Construction sites are dangerous places where injury or death or illness can cause to workers. These can happen due to injuries from tools, equipment and machines etc.
2. Hence the plans for labour safety are to be considered right from the design stage till the completion and handing over of the project.
3. The following guideline give plans for labour safety on construction site :

i. **Managing Safety and Health on Construction Sites :** The employer should make a suitable and sufficient assessment of any risk to the safety and health to which any employee is exposed whilst he is at work.

ii. **Organising the Site :** Make a good planning by gathering as much information about the project and the project site before works begin to ensure safety during construction phase.

iii. **Excavations :** Locate and identify all utility services, such as electrical, water and sewer in the area before beginning to excavate.

iv. **Working at Height :** Ensure that working platform is secure and check that it will support the weight of workers using it and any materials and equipment they are likely to use or store on it.

v. **Moving, Lifting and Handling Loads :** Work site and storage of materials should be planned so that manual handling is reduced to a minimum.

vi. **Site Vehicles and Mobile Plant :** Provide safe site entry and exit points with adequate turning room and good visibility for vehicle drivers.

vii. **Protective Equipment :** Employees on construction sites need specific Personal Protective Equipment (PPE) to ensure their safety and health.

viii. **Emergency Procedures :** Where an employee has suffered injury or illness at work necessitating his removal to his home or to a hospital or other similar institution, the employer shall provide an appropriate means of conveyance for the employee.

b. Describe importance of construction contracts for the successful completion of the civil engineering projects.

Ans.

1. Construction Contracts documents are very important pieces of information that make a binding obligation between two or more parties, thus being evidence that a contract exists.

2. These construction contracts usually take the form of an agreement, some general conditions, drawings, specifications, all sufficient to show the extent and nature of the contract they represent.

3. These construction contracts are used by architects, engineers and contractors to convey technical and legal messages and ideas to various parties to the contract.

4. Due to these reasons, construction contracts are very important for the successful completion of the civil engineering projects.

7. Attempt any one of the following :   (1 × 10 = 10)

a. Estimate the number of dump trucks required for transportation of 1500 cu m of material per day for average load of 5 km with the following data :
Capacity of one dump truck = 20 cu m

Speed during empty haul @ 30 km/hr and loaded haul 25 km/hr
Loading time of one dump truck = 15 minutes

Ans.

Given : Transported material = 1500 cu m/day, Capacity of one dump truck = 20 cu m, Average load = 5 km, Speed of loaded haul = 30 km/hr, Speed of empty haul = 25 km/hr, Loading time = 15 minutes.
To Find : Number of dump truck.

1. **Cycle Time for a Dump Truck :**
   i. Loading time = 15 min

   ii. Hauling time @ 25 km/hr = $\dfrac{5 \times 60}{25} = 12$ min

   iii. Returning time @ 30 km/hr = $\dfrac{5 \times 60}{30} = 10$ min

   iv. Other fixed time = 3 min
   v. Total time = 12 + 10 + 15 + 3 = 40 min

2. For estimating purpose, actual working period is considered as 50 minutes per hour and six hours working period in day.

3. Material transported per hours = $\dfrac{50}{40} \times 20 = 25$ cum

4. Material transported per days = 25 × 6 = 150 cum

5. Number of dump trucks required per day = $\dfrac{1500}{150} = 10$

6. Stand by 10 % = 1
7. Total number of dump trucks = 10 + 1 = 11.

b. Explain a central batching and mixing plant for a very large construction project.

Ans. Central Batching and Mixing Plant :

1. Central mix plant combines all of the required ingredients of concrete at a central location.
2. The final product is then transported to the job site.
3. Central mix plant offer the end user a much more consistent product, since all the ingredient mixing is done in a central location and is computer assisted to ensure uniformity of product.
4. A temporary batch plant can be constructed on a large job site.
   Components: Following are the various components of central batching and mixing plant :

1. **Aggregate Batching Machine :**
   i. The aggregate batching system of ready mix concrete machine includes aggregate supply system, weighing system and electrical control system.

ii. The feeding device is driven by belt.

iii. The batching system is controlled by sensor.

2. **Mixing System :** The center of the concrete batching plant is the mixer. Following are the types of mixer used in central batching plant :

i. **Tilting Drum Mixer :** They are fast and efficient, but can be maintenance intensive since they include several moving part that are subjected to a heavy load.

ii. **Pan Mixer :** Pan mixers are generally lower capacity mixers and used at precast concrete plants.

iii. **Twin Shaft Mixer :**

a. The twin shaft mixer can ensure an even mixture of concrete and large output with high quality.

b. It consists of mixer, with counter rotating shaft, delivers fast mixing action and rapid discharge.

c. It can be used to mix hard-dry concrete and light aggregate concrete.

3. **Cement Silo :**

i. It is a structure used for bulk storage of cement and fly ash at batching plant.

ii. Bolted type and welded type storage silo in various capacities and dimensions are commonly used at plant.

iii. Bolted cement silo with special design can minimize the transport cost.

4. **Control System :**

i. The programmable controller can control the production process with high reliability and stability.

ii. It can control the unloading ingredients, mixing and automatic control of the whole process of the concrete.

iii. Moreover, it also can dynamic display the process of weighing and discharging.

5. **Screw Conveyor :** It is full with a screw inside, and the screw can continually convey material.

6. **Dust Collectors :** It is used to minimize environmental pollution.

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B.Tech.
(SEM. V) ODD SEMESTER THEORY EXAMINATION, 2018-19
QUANTITY ESTIMATION AND MANAGEMENT

Time : 3 Hours   **Max. Marks : 100**

Note : Assume any missing data.

SECTION – A

1. Attempt all questions in brief.   **(7 × 2 = 14)**
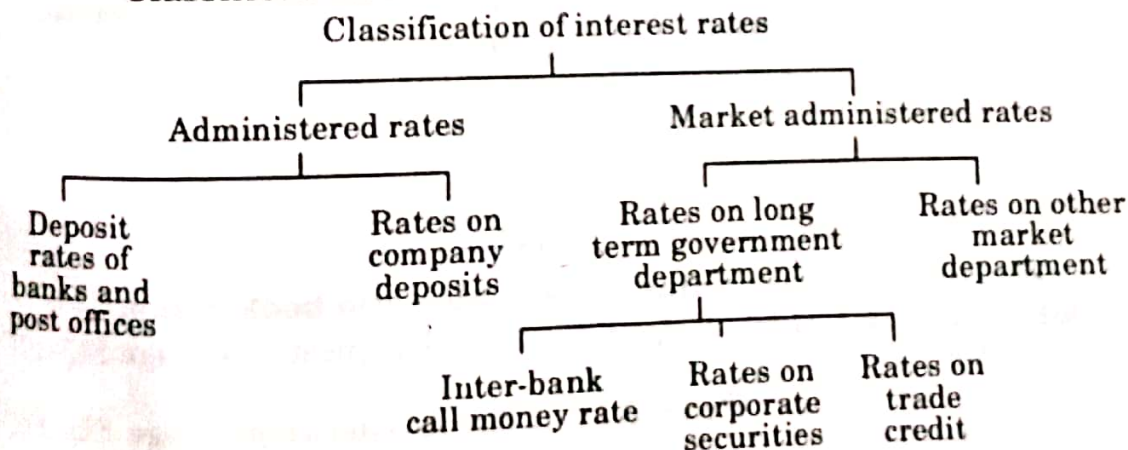
a. What is the use of a dummy in a network ?

Ans. Uses : Following are the uses of dummy in a network :
1. Dummy activities are used to represent a connection between events in order to maintain logic in the network.
2. Dummy activities used to reduce the complexity of a network.
3. It should be used to maintain preceding and succeeding relation.

b. What do you mean by cash flow diagram ?

Ans. Refer Q. 5.4, 2 Marks Questions, Page SQ–15C, Unit-5.

c. Define interest rate. How interest rate can be classified ?

Ans. **Interest Rate :** It is the price paid to borrow debt capital or in other words it is the cost of money. To understand it better we can also say that interest rates transforms money-today into money-tomorrow; it is the rate at which it grows when invested.

Classification :

Classification of interest rates

Administered rates

Market administered rates

Deposit rates of banks and post offices

Rates on company deposits

Rates on long term government department

Rates on other market department

Inter-bank call money rate

Rates on corporate securities

Rates on trade credit

Fig. 1.

d. What is centre line method ?

Ans. Refer Q. 1.6, Page 1–5C, Unit-1.

e. What is Arbitration ?

Ans. Refer Q. 1(g), Page SP–11C, Solved Paper 2016-17.

f. What are the characteristics of a good programme ?

Ans. Following are the characteristics of good programme :

Quantity Estimation & Management

i. Portability.
ii. Flexibility.
iii. Readability.
iv. Structural.
v. Generality.
vi. Efficiency.
vii. Documentation.

g. Define contract.

Ans. Refer Q. 2.4, 2 Marks Questions, Page SQ-4C, Unit-2.

SECTION-B

2 Attempt any three of the following : (7 × 3 = 21)

a. What are the limitations of PERT network ?

Ans. Limitation of PERT Network :

1. PERT has been emphasis only on time, not on costs.
2. The cost of setting up such system is extensive.
3. It is difficult to estimate accurate time and cost of various activities involved in a project error in estimation makes the PERT charts, unreliable as a control aid.
4. These systems will not help managers to solve all their problem.
5. PERT is not easily scalable for smaller projects.
6. The network charts tend to be large and unwieldy requiring several pages to print and requiring special size paper.
7. The lack of a timeframe on most PERT charts makes it harder to show status although colours can help (e.g., specific colour for completed nodes).
8. When the PERT charts become unwieldy, they are no longer used to manage the project.

b. Discuss the concept of time value of money ?

Ans. Refer Q. 5.6, Page 5–7C, Unit-5.

c. Enumerate the factors which affect the output of a dragline.

Ans. The following factors affect the output of dragline :
1. Class of material.
2. Depth of cut.
3. Angle of swing.
4. Size and type of the bucket.
5. Length of the boom.
6. Job conditions.
7. Management conditions.
8. Method of disposal or loading trucks.
9. Size of hauling units, if used.
10. Skill of operator.
11. Physical conditions of the machine.

d. Define salvage value, scrap value and book value.

Ans. Salvage Value : Refer 5.16, 2 Marks Questions, Page SQ-17C, Unit-5.

Scrap Value : Refer 5.17, 2 Marks Questions, Page SQ-17C, Unit-5.

Book Value : Refer 5.18, 2 Marks Questions, Page SQ-18C, Unit-5.

e. Discuss the time cost analysis.

Ans. Refer Q. 5.4, Page 5–4C, Unit-5.

SECTION-C

3 Attempt any one part of the following : (7 × 1 = 7)

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a. Find the critical path and project duration of the given CPM project. Also calculate EST, EFT, LST, LFT and all the floats in a tabular form.
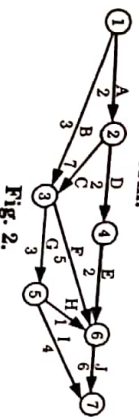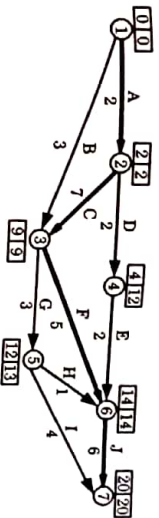
Ans.

Fig. 2.

Fig. 3.

1. Project duration = 20 days
2. Critical path = 1 – 2 – 3 – 6 – 7 or A – C – F – J.
   (Shown by thick line in Fig. 3).
3. Event time comprising EOT and LOT has been indicated in the respective time box of each event.
4. EST, EFT, LST, LFT and TF, FF, IF, INT. F calculated by given formulae :

   i. $(EST)_{i-j} = (EOT)_i$
   ii. $(EFT)_{i-j} = (EOT)_i + t_{i-j}$
   iii. $(LST)_{i-j} = (LOT)_j - t_{i-j}$
   iv. $(LFT)_{i-j} = (LOT)_j$
   v. $TF = LST - EST = LFT - EFT$
   vi. $FF = EST$ of succeeding activity – EFT of the activity under consideration.
   vii. $(IF)_{i-j} = [(EOT)_j - (LOT)_i] - t_{i-j}$
   viii. $(INT. F)_{i-j} = (TF)_{i-j} - (FF)_{i-j}$

5. Calculations of EST, EFT, LST, LFT and TF, FF, IF, INT. F are presented in the following tabular form :

Table. 1. Scheduling

Activity	I-Node	J-Node	Duration (days)	Activity time (days)				Float (days)				Remarks
				EST	EFT	LST	LFT	TF	FF	IF	INT F	
A	1	2	2	0	2	0	2	0	0	0	0	Critical
B	1	3	3	0	3	6	9	6	6	6	0	
C	2	3	7	2	9	2	9	0	0	0	0	Critical
D	2	4	2	2	4	10	12	8	0	0	8	
E	4	6	2	4	6	12	14	8	8	0	0	
F	3	6	5	9	14	9	14	0	0	0	0	Critical
G	3	5	3	9	12	10	13	1	0	0	1	
H	5	6	1	12	13	13	14	1	1	0	0	
I	5	7	4	12	16	16	20	4	4	4	0	
J	6	7	6	14	20	14	20	0	0	0	0	Critical

b. For the given PERT network, determine :
  i. Expected time, standard deviation and variance of the project and show the critical path also.
  ii. Probability of completion of project in 35 days.
  iii. Time duration that will provide 90 % probability (z is 1.32) of its completion in time. (If z is 1, P is 84.13 %), (if z is 0.9, P is 81.59 %), (if z is 1.1, P is 86.43 %)
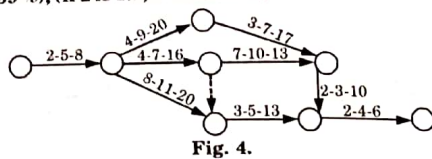
Fig. 4.

Ans.
1. From the three time estimates of each activity, expected mean time (t_e), standard deviation (δ_t) and variance (v_t) of each activity are tabulated by using the following equations,

$$t_e = \frac{t_a + 4\,tm + t_b}{6} \;;\quad \delta_t = \frac{t_b - t_a}{6} \;;\quad v_t = (\delta_t)^2$$
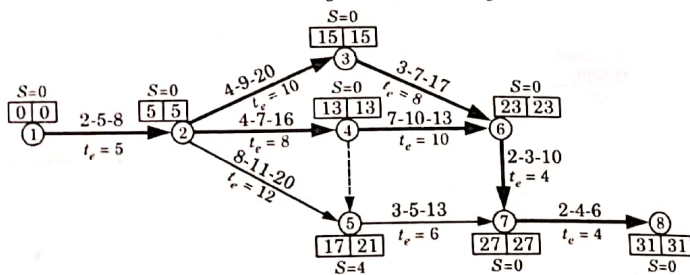
Fig. 5.

2. Earliest expected mean time (T_E) and latest allowable occurrence time (T_L) are marked in time box at each event.
3. Slack $(S) = (T_L - T_E)$ is also mentioned on the network.
4. Since scheduled completion time of project is not mentioned, for the last event (8), $T_L = T_E$ has been taken.

Table. 2.

Activity	Three Time Estimates (days)			t_e (days)	δ_t (days)	V_t (days)
	t_a	t_m	t_b			
1-2	2	5	8	5	1	1
2-3	4	9	20	10	2.67	7.1
2-4	4	7	16	8	2	1
2-5	8	11	20	12	2	4

3-6	3	7	17	8	2.33	5.44
4-6	7	10	13	10	1	1
4-5	0	0	0	0	0	0
5-7	3	5	13	6	1.67	2.78
6-7	2	3	10	4	1.33	1.78
7-8	2	4	6	4	0.67	0.44

  i. Least slack value = 0
    ∴ All the events having zero slack
  ii. Critical path-I = 1 – 2 – 3 – 6 – 7 – 8
  iii. Critical path-II = 1 – 2 – 4 – 6 – 7 – 8
  iv. Expected mean time of project (μ_T) = 31 days
  v. Variance of project along critical path-I
    $(V_{TI}) = 1 + 7.1 + 5.44 + 1.78 + 0.44 = 15.76$
  vi. Variance along critical path-II $(V_{TII}) = 1 + 4 + 1 + 1.78 + 0.44 = 2.86$
  vii. ∴ Variance of the project $(V_T) = 15.76$
  viii. Standard deviation of the project $(\delta_T) = \sqrt{V_T} = \sqrt{15.76} = 3.97$
  ix. Probability factor (z) corresponding to $x = 35$ days

$$z = \frac{x - \mu_T}{\delta_T} = \frac{35 - 31}{3.97} = 1.007 = 1.0$$

    Probability % corresponding to $z = 1.0$
    $pr = 84.13$ %, (For, $z = 1$, probability % = 84.13 %)
  x. For 90 % probability, the value of $z = 1.32$ (From probability table)

$$1.32 = \frac{x - 31}{3.97}$$
$$x = 36.24 \text{ days}$$

4. Attempt any **one** part of the following :   **(7 × 1 = 7)**
  a. Write short notes on : clamshell, Hoe, scraper and bulldozer.
Ans. Refer Q. 4.8, Page 4–10C, Unit-4.

  b. Explain in detail factors affecting the economic life of an equipment.
Ans. The economic life may be defined as the age in years and replacement that maximize the profit return from the equipments.
  Factors : Following are the factors affecting the economic life of an equipment :
1. **Depreciation Costs and Replacement :** In terms of equipment, the depreciation is the loss in value of equipment from the time it is purchased to the time it is out of service or replaced.
2. **Inflation :** Economic inflation is defined as the loss in buying power of the national currency, and industrial inflation is the change in construction costs due to long and short-term fluctuations in commodity pricing.

3. **Investment Costs :** Investment costs include interest, insurance, taxes, and license fees beyond the initial acquisition cost of equipment. Investment cost can be reduced to a percentage of initial equipment cost.

4. **Maintenance and Repair Costs :** Maintenance and repair costs are the crux of the equipment replacement decision and result from the cost of labour and parts used to maintain and repair the given piece of equipment.

5. **Downtime :** Downtime is the time when equipment does not work due to repairs or mechanical adjustments. Downtime leads to increase as equipment usage increases. The downtime cost includes the ownership cost, operating cost, operator cost, and productivity loss caused by the loss of equipment availability.

6. **Obsolescence :** Obsolescence is the reduction in value and marketability due to the competition between newer and more productive models. Obsolescence is an extremely important factor to be considered in the highly competitive construction industry. Owning the latest technology equipment gives a contractor an edge over the competition in that enhanced technology generally equates with increased rates of production, translating into decreased production costs.

5. Attempt any **one** part of the following :   (7 × 1 = 7)

a. **Alpha industry is planning to expand its production. It has identified three different technologies for meeting the goal. The initial outlay and annual revenue with respect to each of the technologies are summarized in table. Suggest the best technology which is to be implemented on the present worth method of comparison assuming 20 % IR, compounded annually.**

Technology	Initial Outlay (Rs.)	Annual Revenue (Rs.)	Life (year)
Technology 1	12,00,000	4,00,000	10
Technology 2	20,00,000	6,00,000	10
Technology 3	18,00,000	5,00,000	10

Ans.

Given : Interest rate, R = 20 %, Life n = 10 year
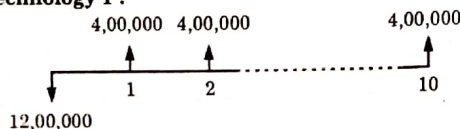**To Find :** Choose best technology on the basis of present worth method

1. **Technology 1 :**

          4,00,000 4,00,000   4,00,000

               1   2   10

      12,00,000

Fig. 3.

$P(1)$ = 12,00,000 – 4,00,000
      = 12,00,000 – 4,00,000 [P/A, 20%, 10]
$P(1)$ = Rs. – 4,76,989

2. **Technology 2 :**

          6,00,000 6,00,000   6,00,000
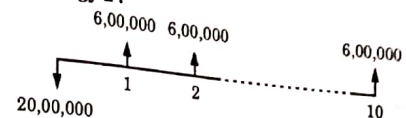
               1   2   10

      20,00,000

Fig. 4.

$P(2)$ = 20,00,000 – 6,00,000 [$(1.2^{10} - 1)/(0.2 \times 1.2^{10})$]
$P(2)$ = Rs. – 5,15,484

3. **Technology 3 :**

          5,00,000 5,00,000   5,00,000
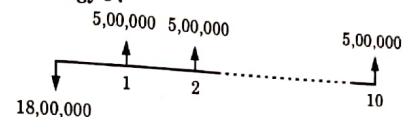
               1   2   10

      18,00,000

Fig. 5.

$P(3)$ = 18,00,000 – 5,00,000 [$(1.2^{10} - 1)/(0.2 \times 1.2^{10})$]
$P(2)$ = Rs. – 2,96,236

Technology-2 > Technology-1 > Technology-3

i. Technology - 2 generates more revenue.
ii. Hence, select Technology-2

b. **What is depreciation ? Also discuss the methods of calculate the depreciation.**

Ans. Depreciation : Refer Q. 5.20, Page 5–20C, Unit-5.
Methods : Refer Q. 5.21, Page 5–20C, Unit-5.

6. Attempt any **one** part of the following :   (7 × 1 = 7)

a. **Write short notes on : Tender, Earnest money deposit and Commissioning of project.**

Ans. Tender : Refer Q. 2.16, 2 Marks Questions, Page SQ–5C, Unit-2.
Earnest Money Deposit : Refer Q. 2.28, Page 2–34C, Unit-2.
Commissioning of Project : Refer Q. 2(d), Page SP–16C, Solved Paper 2017-18.

b. **What are the elements of tender preparation?**
Ans. Refer Q. 2.21, Page 2–26C, Unit-2.

7. Attempt any **one** part of the following :   (7 × 1 = 7)

a. **Discuss the methods of estimating.**
Ans. Refer Q. 1.6, Page 1–5C, Unit-1.

b. **Estimate the quantities of the following items of a two roomed building from the given plan and section :**
i. **Earthwork in excavation in foundation.**
ii. **Lime concrete in foundation.**
iii. **1st class brickwork in cement mortar 1 : 6 in foundation and plinth.**

iv. 2.5 cm c.c. D.P.C
v. 1st class brickwork in line mortar in superstructure.
All walls are of same section, lintels over doors, windows and shelves are 15 cm thick.
Doors D-1.20 m × 2.10 m
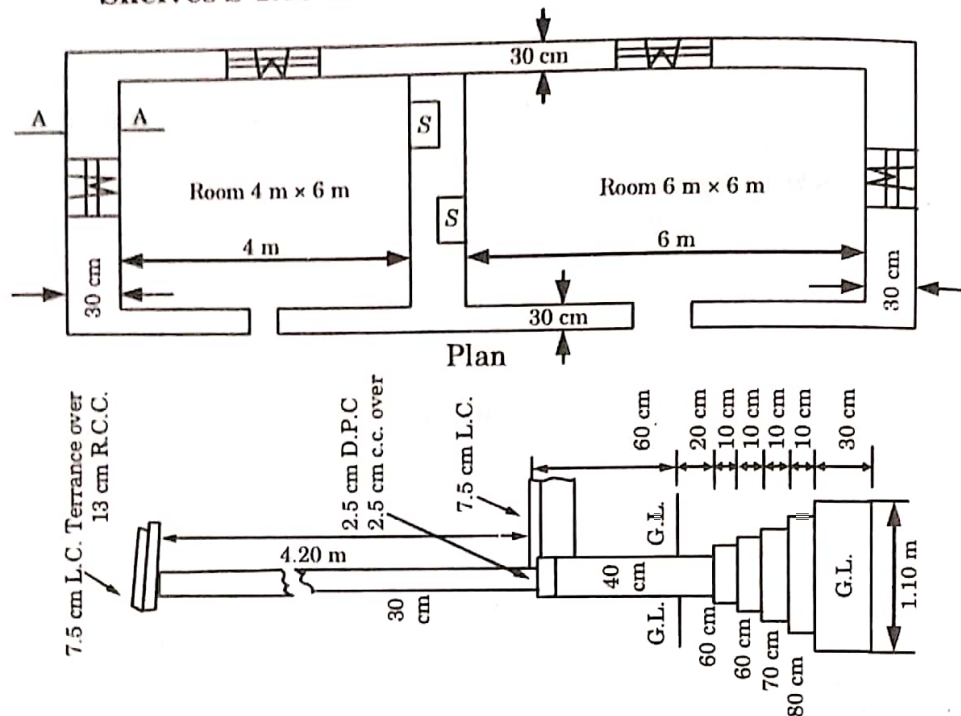Windows W-1.00 m × 1.50 m
Shelves S-1.00 m × 1.50 m

Fig. 6.

Ans. Refer Q. 1.11, Page 1–14C, Unit-1.
Details of Measurement and Calculation of Quantities :

Item No.	Particulars of Items	No.	Length	Breadth	Height or Depth	Quantities	Explanatory notes
8.	Deduct —						
	Door openings	2	1.20 m	0.30 m	2.10 m	1.51	
	Window openings	4	1.00 m	0.30 m	1.50 m	1.80	
	Shelves	2	1.00 m	0.20 m	1.50 m	1.60	Back of shelves 10 cm thick wall
	Lintels over doors	2	1.50 m	0.30 m	0.50 m	0.14	Bearing 15 cm
	Lintels over windows	4	1.30 m	0.30 m	0.15 m	0.23	Bearing 15 cm
	Lintels over shelves	2	1.30 m	0.30 m	0.15 m	0.12	Bearing 15 cm
			Total of	deduction		4.40	cu m
			Net		Total	45.75	cu m

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