

**Note:** There are 7 questions. Attempt any 6.

- Q. Consider the network of 6 nodes (A,B,C,D,E,F). Bidirectional link costs are as follows. A-B is 1, A-F is 1, B-F is 3, B-E is 3, B-C is 1, F-E is 2, C-E is 1, and C-D is 1.

- (a) Use Dijkstra's link state algorithm as discussed in class to build the routing table at node D. Dijkstra's algorithm is to be run step by step (iteration by iteration) and results are to be recorded in following table format (Table.3).

Table 1: Table fields Dijkstra's algorithm

StepNo.	N'	D(A),p(A)	D(B),p(B)	D(C),p(C)	D(E),p(E)	D(F),p(F)
---------	----	-----------	-----------	-----------	-----------	-----------

- (b) Based on your computed table in part (a), what path would be used for packet travelling from node D to node F.

- (c) Explain briefly the OSPF protocol highlighting how link state broadcasts are sent and concept of areas within autonomous system.

2. (a) Consider a network running a distance vector routing protocol. The routing table for Router-3 is given figure.1 (Table.2)

Table 2: Routing table for Router-3

Router 3		
Destination	Next Hop	Cost
1	1	8
2	2	3
3	-	0
4	4	3
5	2	7

Table 3: Distance vectors from neighboring routers

Router 1		Router 2		Router 3	
Destination	Cost	Destination	Cost	Destination	Cost
1	0	1	3	1	7
2	7	2	0	2	8
3	8	3	3	3	3
4	2	4	6	4	0
5	7	5	4	5	2

Figure 1: Tables for question 2(a)

- The distance vectors are obtained from each of the neighboring routers are given in figure.1(Table.3). What will be the updated routing table for Router-3 based on this information?
  - After a while, Router-4 stops sending its distance vector (the link to Router-4 is dead) while the others keep sending the same distance vectors. Then, what will be the new routing table for Router-3?
- (b) Taking a suitable example explain the "count to infinity" problem. How can it be solved? Explain using the same example you have taken for description of the problem.
3. Consider the network given in figure.2. Each router is labeled with the names of its interfaces (e.g., eth0) and the IP addresses assigned to each. Each network is labeled with its network name and prefix length.
- Configure the routing table at Router R1. Your Routing table should have four fields; Destination Network, Subnet mask, Next hop, Interface id.
  - Suppose the IP packet (source IP: 187.200.4.165, destination IP: 187.200.4.83) arrived at a router R1. Which entry in the forwarding table would it match?
  - On which port on R1 must the packet above have arrived?

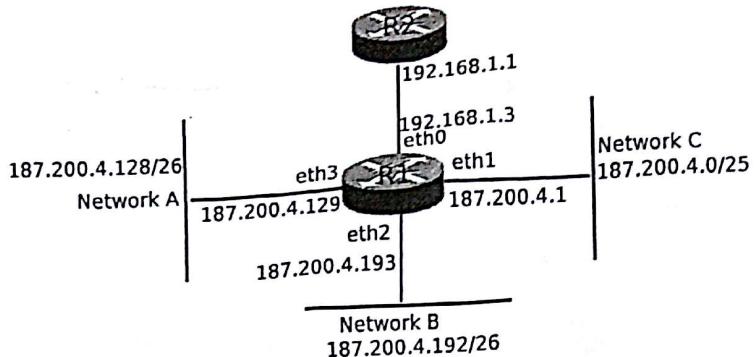


Figure 2: Figure for question 3

- (d) How many hosts can network C accommodate (assuming unique IP addresses were the only constraint)?
- (e) Imagine R2 uses aggregation to maintain precisely one entry in its forwarding table to describe networks A, B, and C. What would that entry look like?
6. Consider a network link with the following characteristics: Link speed = 1Gbps, RTT = 100ms, and Data packet size = 1000 bytes. Assume all traffic is transmitted using a TCP-like window-based transmission protocol with the following congestion control algorithm: (1) Congestion avoidance,  $cwnd = cwnd + 1$  after one RTT, and (2) Fast recovery,  $cwnd = cwnd/2$  when loss occurs.
- (a) What is the congestion window size  $W_0$  such that when the traffic is transmitted using this window size, the network link is fully utilized?
- (b) Suppose exactly when the congestion window size  $W$  reaches  $W_0$ , a loss occurs and the sender immediately (assume the loss is instantaneously known by the sender) activates the fast recovery algorithm. What is the average throughput of this transmission?
7. (a) Explain in brief the relation of VLSM and CIDR with example.
- (b) There are four routers for four different subnets. The host requirements of these four subnets are 54, 10, 10 and 24. Router having 24 hosts is connected to other three routers by serial interface. Design addressing scheme for all the subnets using VLSM. You have to provide the IP addresses for the router interfaces also.
8. (a) You are hired to design a reliable byte-stream protocol that uses a sliding window (like TCP). This protocol will run over a 1-Gbps network. The RTT of the network is 140 ms, and the maximum segment lifetime is 60 seconds. How many bits would you include in the AdvertisedWindow and SequenceNum fields of your protocol header? B
- (b) If two hosts initiate TCP active open to each other at the same time, how many TCP connections will they establish? Explain all possible cases.
- (c) What is the Nagle algorithm used for? Describe it briefly.
- (d) Karn's Algorithm is a solution for the retransmission ambiguity problem. Explain this comment with an example.
9. Write short technical notes on:
- (a) Network Address Translation
  - (b) TCP options: PAWS and Window scaling
  - (c) BGP focussing on the usage of eBGP and iBGP TCP sessions
  - (d) Hot potato routing with example.

**Motilal Nehru National Institute of Technology Allahabad**  
*Department of Computer Science & Engineering*  
**End Semester Examination 2017-18**  
Cryptography (CS1506), B.Tech (CS/IT) – 5<sup>th</sup> Sem

**Duration- 03 Hours.**

**Max Marks: 60**

Note: All questions are compulsory. State assumptions very clearly.

1. **(a)** Draw a detailed structure of an X.509 certificate. Also, discuss the fields used in X.509 certificate. (3)  
**(b)** Write an elaborate note on Certificate revocation list. (3)
2. **(a)** Explain all steps of the Elliptic Curve Digital Signature Algorithm (ECDSA) with a neat diagram with correctness. (3)  
**(b)** Elaborate all properties of Message Authentication Codes. (3)
3. **(a)** Explain Diffie- Hellman Key exchange between Alice and Bob. Show, how Man in the middle attack performed in between by Oscar, and Message manipulation after Man in the middle attack. Show all three parts in separate elaborate diagram. (3)  
**(b)** Compute a session key in a Diffie- Hellman Key exchange (DHKE) protocol based on elliptic curves. Your private key is  $a = 6$ . You receive Bob's public key  $B = (5, 9)$ . The elliptic curve being used is defined by  $y^2 \equiv x^3 + x + 6 \pmod{11}$ . (3)
4. What is hashing? What are the properties of cryptographic hash function? Compare MD5, SHA1, and SHA 2 and its variants, with respect to Input and output bits, number of rounds and other relevant parameter. Prefer to draw a table for comparison. (6)
5. Compare the RSA signature scheme with the Elgamal signature scheme. What are their relative advantages and drawbacks? (6)
6. **(a)** What is the difference between diffusion and confusion? Also, name the operations which are part of diffusion in AES. (3)  
**(b)** Show how Digital Signature Algorithm (DSA) can be attacked if the same ephemeral key is used to sign two different messages. (3)
7. Show that the condition  $4a^3 + 27b^2 \equiv 0 \pmod{p}$  is fulfilled for the curve  $y^2 \equiv x^3 + 2x + 2 \pmod{17}$ . If this is true then calculate the order of the curve by using Hasse's theorem. (6)
8. Given is an Elgamal signature scheme with  $p = 31$ ,  $\alpha = 3$  and  $\beta = 6$ . You receive the message  $x = 10$  twice with the signatures  $(r, s)$ :  
(i) (17, 5)      (ii) (13, 15)  
a.) Are both signatures valid?  
b.) How many valid signatures are there for each message  $x$  and the specific parameters chosen above?  
$$(3+3=6)$$
9. Imagine a peer-to-peer network where 1000 users want to communicate in an authenticated and confidential way without a central Trusted Third Party (TTP). (3+3=6)
  - a. How many keys are collectively needed, if symmetric algorithms are deployed?
  - b. How these numbers are changed, if we bring in a central instance (Key Distribution Center, KDC)?

**P.T.O**

- ✓ 10. We consider RSA encryption with certificates in which Bob has the RSA keys. Oscar manages to send Alice a verification key  $k_{pr,CA}$  which is, in fact, Oscar's key. Show an active attack by which he can decipher encrypted messages that Alice sends to Bob. Should Oscar run a man in the middle attack or should he set up a session only between himself and Alice? (6)

**Department of Computer Science and Engineering  
Motilal Nehru National Institute of Technology  
Allahabad, Uttar Pradesh, India**

**Object Oriented Modeling (CS1504) + Object Based Modeling (CA3305)  
B. Tech. (V Semester(CS+IT) and MCA-III Semester.**

**End Semester Exam**      **Max Marks:60**      **Max Time: Three Hours**

- 
- If you need to make any assumptions, state them clearly.
  - Questions carry marks shown against them.

**Q1.** You are required to develop a small stock-trading system. Customers place buy and sell orders and securities transfer with service representative; then, the service representative enter those orders into the system. The system is closed, meaning that all buy orders are matched with sell orders within the system. (This system does not use orders placed with any other system.) A security transfer moves stock or cash into or out of the system. Each transfer includes the customer's account number and either the amount of cash, or stock name and number of shares that is being transferred. A service representative also creates the accounts at customers' requests. Each order includes the customer's account number, the name of the stock and the number of shares to be bought or sold, whether the order is buy or sell and the price customer is willing to pay or receive. (Orders must include a price because this system does not employ market prices.) Optionally, an order may include an expiration time indicating the date and time after which the order is no longer valid.

When an order is entered in the system, the service representative is given a unique order number for that order. Orders have a status. When they are placed, buy and sell orders are registered as open. When a buy order is matched with one or more sell orders, the involved buy and sell orders are registered as executed. An order that expires without being exercised is registered as expired. An order that is cancelled is registered as cancelled. By supplying an order number, a service representative may request the status of an order and any other relevant information about the order.

This system does not employ settlement period or short sales. To execute the buy or sell order, the customer's account must have sufficient fund or stock to cover the trade. You may match any number of buy orders to any number of sell orders. The only requirements are that in any match: the total number of buy orders shares equals the total number of sell order shares (That is, you do not match partial orders), and the asking price of any sell orders is no higher than offering price of any buy order. (When the two prices do not match, the final price may be anything between asking and the offering prices.) Design the Use-case, Class and Sequence Diagram for the above stock trading system along with code snippets in Java/C++.

[15]

**Q2(A)** Distinguish between static and dynamic binding. The compiler has the whole code, why it is not possible for compiler to decide the binding of messages to methods in some cases statically, by performing analysis of the code. [03]

**P.T.O**

**(A)** Are private members of super class available in subclasses, if yes, why they are there if these being private can not be accessed in subclasses. [03]

**(C)** Show with an example code how the messages gets bound to appropriate methods. Explain also how it is decided what messages can be received by an object. [03]

**(D)** Describe various types of data members and method members of a class along with the accessibility of one member from the other. [03]

**(E)** Enumerate different ways to overload a function. Why are functions not overloaded through return types? [03]

**Q3.** **(A)** Consider a method being used in an application class as Serve(Serviceable x). We have an interface Serviceable which has methods f() and g(). A totally unrelated class X has methods m() and n() already implemented which has behavior of f() and g(). Design all solutions which make use of m() and n() methods for Serviceable and let method call Serve(x) working without any error in application class. [03]

**(B)** Describe how with the help of hooks/primitive methods a template pattern is implemented. Define template and primitive methods and differentiate between them. [03]

**(C)** List various ways to add operations in a class along with the constraints which necessitates them, if you are aware about that some operations need to be added in the class before designing the class but you don't know how many and which operations. Decl/Adapt [03]

**(D)** Identify the basic principles of object orientation used in creating the design pattern. Justify your answer. LC, Tcoh [03]

**(E)** Define and classify the design pattern along with the examples of each class. [03]

**Q4. (A)** Describe two kinds of reuse in object oriented modeling, which supports higher reuse and why? Poly [05]

**(B)** Why java supports both abstract classes as well as interfaces. Can we do away with one, justify your answer. [02]

**(C)** Consider an order processing system for an international e-commerce company. This system must be able to process sales orders in many countries. The functions of the sales order object is allow to fill out the order with GUI, Handle tax calculations, Process the order and Print the sales receipt. Supposing after writing the applications I receive a request to change the way of handling the tax. Earlier the application has been written to calculate the tax using Indian tax rules. Now it is required that it should be able to handle the tax calculations according to rules in United States or United Kingdom and many more. For handling these new rules which design pattern is most appropriate and why, also draw its class diagram. [04]

**(D)** Describe the need of multiple interfaces and single implementation with the example code illustrating the various design principles used in the above example. [04]

Motilal Nehru National Institute of Technology Allahabad  
Department of Computer Science & Engineering  
End Semester (Odd) Examination 2017-18

Subject- Operating Systems (CS 1502), B. Tech (IT) - V Sem.

Duration- 3:00 hours

Max. Marks: 60

All questions are compulsory. Assume if something missing.

1. (a) What are three objective of an operating system design? Define the essential properties of the Batch and Time sharing of operating systems. (3)  
(b) Explain thrashing. How working-set model is helpful to prevent thrashing. (3)

2. The Thirsty Person Problem (adapted from the Cigarette Smokers Problem): To drink, a thirsty person must have three things: water, ice, and a glass. There are three thirsty people, each having a different one (and only one) of the three required items. A fourth person, a server, has an unlimited supply of all three items. If nobody is drinking, the server places two of the three items (chosen at random) onto a table. The thirsty person who can make a drink from those two items will pick them up and drink a glass of ice water. When done, the thirsty person will notify the server and the process will repeat. Write a monitor to control the thirsty people and server in the following program: (6)

```
// -----
// Server
// -----
while ( true )
{
    drinkers.Serve ( );
}
// -----
// Drinker (type is water or ice or glass)
// -----
while (true)
{
    drinkers.GetIngredients ( type );
    drink ( );
    drinkers.NotifyServer ( type );
}
```

3. The Sleeping-Barber Problem. There is a barber shop with n chairs for waiting customers, one barber's chair and one barber. If a customer enters the store and there are no free chairs, the customer leaves. If a customer enters the store and the barber is sleeping, the customer wakes up the barber and gets a haircut. Otherwise, a customer enters the store, take a seat, and waits. If the barber finishes a haircut and there are waiting customers, the barber cuts the hair of the next customer. Otherwise, the barber goes to sleep in his chair. Using semaphores, write the function to control the actions of customers and the barber. (6)
4. Compare the segmented paging scheme with the hashed page table scheme for handling large address spaces. Under what circumstances is one scheme preferable to the other? (6)

P.T.O

5. Consider the structure of process  $P_i$  in Peterson's solution. (6)

```

do {
    flag [i] = TRUE;
    turn = j;
    while (flag[j] && turn == j);
        /* critical section */
    flag [i] = FALSE;
    /* remainder section */
} while (TRUE);

```

Show that the above Peterson's solution satisfies the requirements of a mechanism to control access to a critical section.

6. Consider the following set of processes, with the length of the CPU burst given in milliseconds. A larger priority number has higher priority. (3+3=6)

- Draw a grant chart that illustrate the execution of these processes using the following scheduling algorithms: Preemptive Shortest job first, Non-preemptive Shortest job first.
- What is the turnaround time and waiting time of each process for each of the scheduling algorithms in part a?

Process	Arrival Time	Burst Time	Priority
P1	0.0000	4	3
P2	1.0001	3	4
P3	2.0001	3	6
P4	3.0001	5	5

7. Given the following state for the Banker's Algorithm. (6)

6 processes P0 through P5

4 resource types: A (15 instances); B (6 instances)

C (9 instances); D (10 instances)

Snapshot at time T0:

Available			
A	B	C	D
6	3	5	4

P.T.O

Process	Current Allocation				Maximum Demand			
	A	B	C	D	A	B	C	D
P0	2	0	2	1	9	5	5	5
P1	0	1	1	1	2	2	3	3
P2	4	1	0	2	7	5	4	4
P3	1	0	0	1	3	3	3	2
P4	1	1	0	0	5	2	2	1
P5	1	0	1	1	4	4	4	4

a. Show that the current state is safe, that is, show a safe sequence of processes. In addition, to the sequence show how the Available (working array) changes as each process terminates.

b. Given the request (3, 2, 3, 3) from Process P5. Should this request be granted? Why or why not?

8. A processor uses 2-level page tables for virtual to physical address translation. Page tables for both levels are stored in the main memory. Virtual and physical addresses are both 32 bits wide. The memory is byte addressable. For virtual to physical address translation, the 10 most significant bits of the virtual address are used as index into the first level page table while the next 10 bits are used as index into the second level page table. The 12 least significant bits of the virtual address are used as offset within the page. Assume that the page table entries in both levels of page tables are 4 bytes wide. Further, the processor has a translation look-aside buffer (TLB), with a hit rate of 96%. The TLB caches recently used virtual page numbers and the corresponding physical page numbers. The processor also has a physically addressed cache with a hit rate of 90%. Main memory access time is 10 ns, cache access time is 1 ns, and TLB access time is also 1 ns. Assuming that no page faults occur. Calculate the average time taken to access a virtual address. (6)

9. A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1.

If Second chance page replacement policy is used, how many page faults occur for the above reference string? (6)

10. (a) A disk has 200 tracks (numbered 0 through 199). At a given time, it was servicing the request of reading data from track 120, and at the previous request, service was for track 90. The pending requests (in order of their arrival) are for track numbers. 30 70 115 130 110 80 20 25. How many times will the head change its direction for the Shortest Seek Time First (SSTF) scheduling policy? (3)

(b) Write **short notes** on the followings: (1×3=3)

- I. External Fragmentation
- II. Race Condition
- III. Multithreading

----- END -----

Name:.....

Reg. No. ....

Department of Computer Science &amp; Engineering

Motilal Nehru National Institute of Technology, Allahabad

\*End Semester ( Theory ) Examination (ODD-Semester) 2017-18\*

Class: B.Tech.(V) Semester(Information Technology) 2017-18

M.M. : 60

Subject: Computer Graphics (CS-1507)

M. Hrs: Three

**Note:** 1. Attempt any FIVE (05) questions including Q.No.(1) which is COMPULSORY to ALL. Q.No.1 Carries 20 Marks and rest questions carry 10 Marks each.

2. All parts of a question should be answered in one attempt serially NOT here & there.
3. Write to the point, exactly what is asked.

**Q.No.1(COMPULSORY to ALL)**

1-(A) Define the following terms in brief:

- (i) Computer Graphics (ii) GUI (iii) Simulation (iv) Image Processing (v) Virtual Reality
  - (vi) Snap Shot (vii) Frame (viii) Frame Buffer (ix) Pixel (x) Video Clip (xi) Raster-Scan Systems (xii) Persistence (xiii) Resolution (xiv) Brightness (xv) Intensity
  - (xvi) Daisy Wheal (xvii) Toner (xviii) Refresh Buffer (xix) Anti-Aliasing (xx) Ray Casting
- $(20 \times \frac{1}{2} = 10)$

1-(B) Derive the Transformation Matrix for 2-D rotation about an Arbitrary POINT.

1-(C) Compare point wise DDA Line Tracing Algorithm Vs Bresenham's Line Tracing Algorithm. In which case the Line traced will be smoother & why? Justify Properly.

1-(D) Explain point wise the working of the following :

- (i) Laser Printer (ii) Image Scanner (iii) Touch Screen

 $(10 + 02 + 02 + 3 \times 2 = 20)$ **Q.No.2-(A) Compare point wise the followings :**

- (i) LCD Monitors Vs CRT Monitors (ii) Constant Shading Vs Gouraud Shading

2-(B) Consider a Raster System with Resolution 1280 by 1024. What size of Frame buffer is needed for given system to store 24 bits per pixel? How many colors are possible in given system? What is the access time per pixel if refreshing rate is 60 frames per second?

2-(C) If a TV screen has 525 scan lines & an Aspect Ratio of 3 : 4, and if each pixel Contains 8-bits worth of Intensity Information, how many bits per second are required to show 30 Frames each second?  
 $(2 \frac{1}{2} \times 2 + 03 + 02 = 10)$

Q.No.3-(A) How long would it take to load a 1280 by 1024 Frame Buffer with 12 bits per pixel if Transfer Rate is 1 MBPS?

3-(B) How much memory is needed for Frame Buffer to store a 640 X 400 display 16 gray levels?

3-(C) How much time is spent scanning across each row of pixels during screen refreshing a Raster System with a Resolution of 640 X 480 and refresh raster of 60 frames per second?

3-(D) In a 600 X 400 pixel, how many K bytes does a Frame Buffer need?

3-(E) Compute the Resolution of an 4 X 4 inch IMAGE that has 256 X 256 pixels.

 $(02 + 02 + 02 + 03 + 01 = 10)$ 

(Contd. on PAGE No.2)

~~Q.No. 4-(A)~~ Explain point wise the Mid Point Circle Tracing Algorithm.

4-(B) Compute & Tabulate points to be illuminated for tracing a Circle with Radius  $r = 10$  in the circle Octant in the first Quadrant from  $x=0$  to  $x=y$  using Mid Point Circle Tracing Algorithm.

4-(C) Using Bresenham's line drawing Algorithm compute the points to be illuminated for tracing a line from P1 (11,21) to P2 (18, 25).

4-(D) What is a blurred IMAGE?

(03+03+03 +01=10)

~~Q.No.5-(A)~~ What is Transformation? Define in brief ALL the 2-D Transformations & write their relevant transformation Matrix.

5-(B) Why exactly we need Homogeneous Coordinate System in 2-D Transformations?

5-(C) How exactly the two successive 2-D Rotations about origin are Commutative? Prove.

5-(D) Explain in brief the : CMY Color Model

(03+02+03+02=10)

Q.No. 6-(A) Show how reflection in line  $y=x$  & in the line  $y= -x$  can be performed by a scaling operation followed by a Rotation.

6-(B) Show that 2D reflection through X axis followed by 2D reflection through the line  $Y= -X$  is equivalent to a pure Rotation about the Origin.

6-(C) Magnify Triangle ABC with vertices A(0,0), B (1,1) , C( 5, 2) to thrice its size, while keeping B(1,1) fixed. Finally find out the vertices of the magnified Triangle.

6-(D) Explain in brief : HSV Color Model.

(03+03+02+02=10)

Q.No.7-(A) Define: Image Space & Object Space Algorithm for Back face removal.

7-(B) Write down point wise the Depth Buffer Algorithm for detecting visible Surfaces.  
Why it is called Z-Buffer Algorithm too? What are its limitations?

7- (C) Write down point wise the A- Buffer Algorithm for detecting visible Surfaces.  
How it may also work for Transparent surfaces?

7-(D) Explain point wise Painters Algorithm. What are its limitations? (01+03+03+03=10)

~~Q.No.8-(A)~~ Write down point wise the "Cohen-Sutherland Algorithm" Line Clipping Algorithm.

8-(B) Use Cohen-Sutherland Algorithm to find the visible portion of the line P(40,80) Q(120,30) inside the window. The Window is defined as ABCD:A(20,20),B(60,20),C(60,40) & D(20,40).

8-(C) Out of the Clipping Algorithms studied by you which one of them you find easy to implement? Justify your reply. (04+04+02=10)

Q.No.9 Write Short notes on any five of the followings:

(A) Dot Matrix Printer (B) Bezier Curves (C) B-Spline Curves (D) Working of Optical Mouse (E)Working of BAR Code Reader (F) WARNOCK's Algorithm (G)Parallel Projections (H) Perspective Projections (I) Plasma Panel Display (J) Inkjet Printer

(05 X 02 =10)

\* END \*

Motilal Nehru National Institute of Technology, Allahabad  
Department of Computer Science & Engineering

End Semester (Odd) Examination 2017

Programme: B.Tech (Computer Sc, Information Technology)

Name of the Course and Subject Code:

Session (July 2017)

Semester V

Operations Research:CS (1505)

Time: 3 hrs

M.Marks:60

Note: Answer All the Questions .Assume suitably missing data (if any) and write it before answering that question in your copy.

~~Q1~~ The presence table for activities involved in producing a computer game is shown below. An activity on arc network is to be drawn to model this production process.

(i) Explain why it is necessary to use atleast two dummy activities when drawing the activity network?

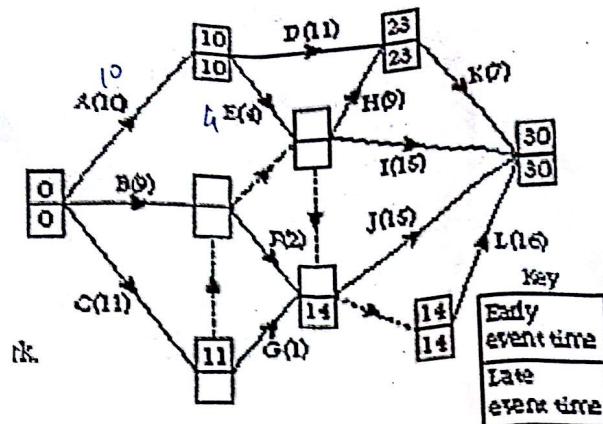
~~(ii)~~ Draw the activity network using exactly two dummies. Also label the nodes.

Activity	Must be preceded by
A	—
B	—
C	B
D	A, C
E	A
F	E
G	E
H	G
I	D, F
J	G, I
K	G, I
L	H, K

(6)

~~Q2~~ The network shows the activities that need to be undertaken to complete the project. Each activity is represented by an arc. The number in the bracket is the duration of the activity in days. The early and late event times are to be shown at each vertex and some have been completed for you.

~~(i)~~ calculate the missing early and late times ~~(iii)~~ List two critical paths for this network.  
~~(iii)~~ Explain what is meant by critical path. ~~(iv)~~ List all critical activities



(8)

Q3 Solve following by Simplex Method

$$\text{Maximize } 3X_1 + 2X_2 + 1X_3$$

Subject to

$$2X_1 + X_2 + X_3 = 12$$

$$3X_1 + 4X_2 = 11$$

and  $X_1$  is unrestricted

$$X_2 \geq 0, X_3 \geq 0$$

(8)

Q4

A company has 5 jobs to be done. The following matrix shows the return in terms of rupees on assigning  $i^{th}$  ( $i = 1, 2, 3, 4, 5$ ) machine to the  $j^{th}$  job ( $j = A, B, C, D, E$ ). Assign the five machines so as to maximize the total expected profit.

	Jobs				
Machines	A	B	C	D	E
1	5	11	10	12	4
2	2	4	6	3	5
3	3	12	5	14	6
4	6	14	4	11	7
5	7	9	8	12	5

(8)

(8)

Q5

Cars are shipped from three distribution centers to five dealers. The shipping cost is based on the mileage between the sources and the destinations, and is independent of whether the truck makes the trip with partial or full loads. Table 1 summarizes the mileage between the distribution centers and the dealers together with the monthly supply and demand figures given in number of cars. A full truckload includes 18 cars. The transportation cost per truck mile is \$25.

- (a) Formulate the associated transportation model.
- (b) Determine the optimal shipping schedule.

Table for milage chart and supply demand

	Dealer					
	1	2	3	4	5	Supply
Center 1	100	150	200	140	35	400
	50	70	60	65	80	200
	40	90	100	150	130	150
Demand	100	200	150	160	140	

(8)

Q6 Explain the difference between

- (i) Sensitivity analysis and postoptimal analysis
- (ii) Simplex method and Revised simplex method
- (iii) Basic solution and non basic solution
- (iv) Degenerate and non degenerate solutions
- (v) CPM and PERT

(6)

Q7 What is inventory management? Discuss various relevant costs associated with it with example. Metalco produces draft deflector for use in home fireplaces during the months of December to March. The demand starts slow, peaks in the middle of season, and tapers off toward the end. Because of the popularity of the product, Metalco may use overtime to satisfy the demand. The following table provides the production capacities and the demands for the four winter months. Find the associated total cost. Assuming that the unit production and holding costs are as given in the following table.

Unit Production cost in any period is \$6 during regular time and \$9 during Overtime

Period i	Regular time unit cost(\$)	Overtime unit cost(\$)	Demand	Unit holding cost(\$) to period i+1
1	5.00	7.50	100	.10
2	3.00	4.50	190	.15
3	4.00	6.00	210	.12
4	1.00	1.50	160	.20

(8)

**Q8** An airlines organization has one reservation clerk on duty in its local branch at any given time. The clerk handles information regarding passenger reservation and flight timings. Assume that the number of customers arriving during any given period is Poisson distributed with an arrival rate of eight per hour and that the reservation clerk service customer is six minutes on average, with an exponentially distributed service time.

- What is the probability that the system is busy?
- What is the average time a customer spends in the system?
- What is the average length of the queue and what is the number of customers in the system?

(8)