

Title : Question Paper

FF No. 868

[Reg. No.] \_\_\_\_\_

Bansilal Ramnath Agarwal Charitable Trust's  
**VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.**  
 (An Autonomous Institute Affiliated to Savitribai Phule Pune University)

(6)

Examination: ESE

**Year:** SY**Branch:** Computer Engineering**Subject:** Operating Systems**Subject Code:** CS2008**Max. Marks:** 100**Total Pages of Question Paper:** 03**Day & Date:** Friday & 3/5/2019**Time:** 2.30 to 5.30 p.m.**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

**Q.1 Attempt following.****Marks**

CO1 a. Elaborate the architecture of Android operating system with a neat labeled diagram. 8

CO1 b. Illustrate the basic functions of an operating system with suitable example. 8

**Q.2 Attempt any Three of the following.**

CO2 a. Construct a system call sequence to copy contents of one file to another file. 6

CO2 b. Write a shell script to perform following operations on a given number.
 

- i) To find Sum of its digits
- ii) Reverse the number

CO2 c. List out difference between User level thread and Kernel level thread. 6

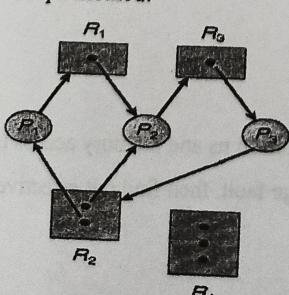
CO3 d. Compare FCFS, SJF and SRTF with respective to following parameters. 6

- i) Starvation
- ii) Practical Implementation
- iii) Throughput

**Q.3 Attempt any Two of the following.**

CO4 a. Illustrate four necessary conditions of deadlock in operating system 8

CO4 b. Determine following system consist deadlock or not ? Use Resource Allocation Graph method. 8



- CO4** c. Determine safe sequences of processes in following system using Bankers Algorithm. Assume E,F,G are system resources.

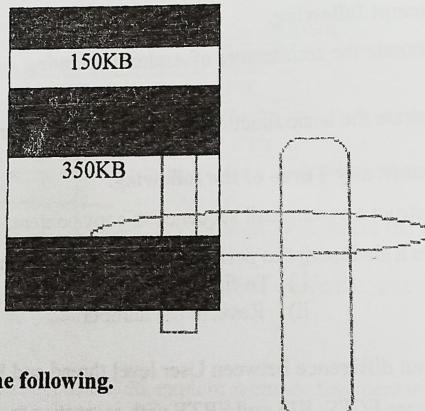
Process	Allocation			Max Need			Current Available		
	E	F	G	E	F	G	E	F	G
P0	1	0	1	4	3	1	3	3	0
P1	1	1	2	2	1	4			
P2	1	0	3	1	3	3			
P3	2	0	0	5	4	1			

**Q.4** Attempt following.

- CO5** a. List out merits and demerits of Fixed Size partitioning and Variable size partitioning contiguous allocation memory management with suitable example.

- CO5** b. The sequences of requests for blocks of sizes 300K, 25K, 125K, 50K respectively. Find out above requests could satisfy with following algorithms.

a) First Fit b) Next Fit c) Best Fit d) Worst Fit



**Q.5** Attempt any Two of the following.

- CO5** a. Assume following data in memory management system:

$$\text{Page Size} = 2^{15} \text{ Byte}$$

$$\text{No. of Pages} = 2^7$$

$$\text{Page table Size} = 256 \text{ Byte}$$

Find out:

- i.) Logical address space
- ii.) Physical address space
- iii) No. of bits in Logical Address
- iv) No. of bits in Physical Address
- v) No. of bits in page offset field
- vi) No. of Frames
- vii) Page table Entry Size.

- CO5** b. A paging scheme uses TLB. A TLB access takes 10 ns and memory access takes 50 ns. If TLB hit ratio is 90% and there is no page fault, then find out effective access time?

- CO5 c. A system uses 3 frames for storing pages of a process in main memory .It uses the optimal page replacement algorithm. Find out total number of page faults that will occur while processing the page references string given below. Assume we are using demand paging.

8



Page references string : 4,7,6,1,7,6,1,2,7,2

**Q.6      Attempt following.**

- CO6 a. Classify different types of buffering mechanisms used by I/O management. Illustrate their use with the help of suitable diagrams.

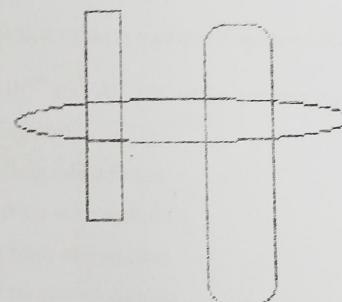
6

- CO6 b. Elaborate different disk scheduling algorithms with suitable example.

6

- CO6 c. A disk contains 200 tracks (0-199). Request queue contains track number 82,170,43,140,24,16,190 respectively. Current position of R/W head=50.Caluate total number of tracks movement by head using FCFS Disk Scheduling algorithms.

6



Title : Question Paper

FF No. 868

Reg.No. | | | | | | | | | |

(1)

Bansilal Rammath Agarwal Charitable Trust's  
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.  
( An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: ESE

Year: TY

Branch: Computer Engineering

Subject: Operating Systems

Subject Code: CS3024

Max. Marks: 100

Total Pages of Question Paper: 03

Day & Date: Tuesday & 30/4/2019

Time: 10.00 to 1.00 p.m.

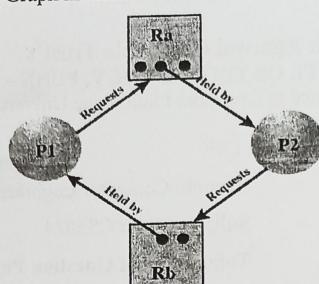
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Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1	Attempt following.	Marks
CO1	a. Illustrate the basic functions of an operating system with suitable examples.	8
CO1	b. Elaborate the concept of virtual machines with suitable diagram.	8
Q.2	Attempt any Three of the following.	
CO2	a. Compare process and threads in operating system.	6
CO2	b. Write a shell script to perform following operations on a given number. i) Sum of n even numbers ii) Arithmetic operation on n1 and n2 numbers	6
CO2	c. Give scenarios when the following transitions would happen: i) Blocked/Suspended to Blocked ii) Ready/Suspended to Ready iii) Running to Ready/Suspended iv) Blocked to Exit	6
CO3	d. Elaborate various following time related to process. i) Response time ii) Turn-around time iii) Waiting time iv) Burst time v) Schedule length vi) Throughput	6
Q.3	Attempt any Two of the following.	
CO4	a. Identify the necessary and sufficient conditions for a deadlock to occur. Describe deadlock prevention strategies to achieve the following: i) Disable hold & wait ii) Preemption	8

- CO4 b.** Determine following system consist deadlock or not ? Use Resource Allocation Graph method.



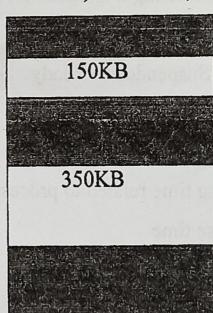
- CO4 c.** Determine safe sequences of processes in following system using Bankers Algorithm. Assume E,F,G are system resources.

Process	Allocation			Max Need			Current Available		
	E	F	G	E	F	G	E	F	G
P0	1	0	1	4	3	1	3	3	0
P1	1	1	2	2	1	4			
P2	1	0	3	1	3	3			
P3	2	0	0	5	4	1			

**Q.4** Attempt following.

- CO5 a.** Compare Contiguous, Single level paging and Multi level paging with suitable example.
- CO5 b.** The sequences of requests for blocks of sizes 300K, 50K, 125K ,25K respectively. Find out above requests could satisfy with following algorithms.

- a) First Fit b) Next Fit c) Best Fit d)Worst Fit



**Q.5** Attempt any Two of the following.

- CO5 a.** Assume following data in memory management system:

$$\text{Page Size} = 2^{12} \text{ Byte}$$

$$\text{No. of Pages} = 2^{10}$$

$$\text{No. of Frames} = 2^9$$

Find out:

i.) Logical address space

ii.)Physical address space

(2)

- iii) No. of bits in Logical Address
- iv) No. of bits in Physical Address
- v) No. of bits in page offset field
- vi) Page table Size
- vii) Page table Entry Size.

**CO5 b.** A computer System implements 8 KB pages and 32 bit physical address space. Each page table entry contains a dirty bit, a P/A bit, a 3 permission bits and the translation information. If maximum size of process is 24 MB, then determine length of logical address supported by byte addressable system. 8

**CO5 c.** A system uses 3 frames for storing pages of a process in main memory .It uses the FIFO page replacement algorithm. Find out total number of page faults that will occur while processing the page references string given below. Assume we are using demand paging. 8

Page references string : 4,7,6,1,7,6,1,2,7,2

**Q.6      Attempt following.**

**CO6 a.** Classify different types of buffering mechanisms used by I/O management. 6  
Illustrate their use with the help of suitable diagrams.

**CO6 b.** Illustrate the design principles for the windows 7 operating system. 6

**CO6 c.** A disk contains 200 tracks (0-199). Request queue contains track number 82,170,43,140,24,16,190 respectively. Current position of R/W head=50.Caluate total number of tracks movement by head using SSTF Scheduling algorithms. 6

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15

**Examination: ESE**

**Year: SY**

**Branch: Computer Engineering**

**Subject: Computer Networks**

**Subject Code: CS2010**

**Max. Marks: 100**

**Total Pages of Question Paper:**

**Day & Date: Thursday 09/05/2019**

**Time: 2.30 PM To 5.30 PM**

**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

**Q1a** Various framing methods are used to break the bit stream up into frames. elaborate these various methods of framing? 9

**OR**

**Q1b** Design the error detection system to calculate the CRC/FCS/Checksum using modulo-2 division method for generator polynomial of  $x^4+x+1$  and message 1101011011? Send the frame to the destination and check the correctness of frame. 9

**Q1c** Suppose a 128 Kbps point to point link is set up between Earth and a rover on Mars. The distance from Earth to Mars is approximately 55 Gm, and data travels over the link at the speed of light  $3 \times 10^8$  m/s. 5

- a. Calculate the minimum RTT for the link.
- b. Calculate the delay \* Bandwidth product for the link.

**Q1d** PPP is based closely on HDLC, which uses bit stuffing to prevent accidental flag bytes within the payload from causing confusion. Give at least one reason why PPP uses byte stuffing instead. 4

**Q2a** How CSMA/CD protocol is used to detect collisions? 8

**OR**

**Q2b** Design a protocol for the transmission of data such that if a frame will lost between the transmission or frame is bad and discarded. When the sender times out only the oldest unacknowledged frame is retransmitted. Also consider the two way communication and comment on piggybacking. 8

**Q2c** What are the problems with basic bit map protocol? How these problems will be overcome? Which collision free protocol is used for this? 5

**Q2d** Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Justify your answer. 3

**Q3a** Consider that a sub network has following distance in each pair A-B(4), B-C(2), C-D(3), A-E(5), E-F(8) F-D(7), B-F(6) and E-C(1). These are bidirectional links with the same distance metric. If the distance vector routing is used, and the following vectors have just come into router C: from B(5,0,8,12,6,2); from D: (16,12,6,0,9,10); and from E: (7,6,3,9,0,4). The measured delays to B, D, and E are 6,3, and 5 respectively. What is C's new routing table? Give both the outgoing line to use and expected delay. 8

**OR**

**Q3b** One of the CIDR IP address allocated to the organization is 167.199.170.82/27. Find the IP block size, netmask, first IP address and last IP address for the block. 8

- Q3c** How token bucket is useful for traffic shaping?
- Q3d** Why is it difficult to provide QoS for User Datagram Protocol (UDP) in UDP/IP protocol stack?
- Q4a** How ARP protocol is used to communicate the unknown host in the network?  
**OR**
- Q4b** Draw the structure of IP header frame format. How this frame format supports for heterogeneous networks in TCP/IP model? How it follows norms of the engineering practice to accommodate maximum file size?
- Q4c** How DNS protocol helps to resolve URL into IP address in the Internet?
- Q4d** How UDP works without flow and error control?
- Q5a** How do SMTP and POP protocols make the use MIME while sending and accessing a mail?  
**OR**
- Q5b** How three way of handshaking is used to establish the connection? And How two army problem occurs in the release of connection?
- Q5c** How DHCP protocol assigns the IP address from the given pool to mobile devices such as laptop?
- Q5d** How is BGP protocol route the traffic for UDP datagram's?
- Q6a** Suppose organization has IP address 24.75.0.0/16. It needs to distribute this address to three departments. First department has 32 Labs and each lab needs 256 addresses. Second department has 64 Labs each lab needs 128 addresses. Third department has 128 Labs and each lab need 64 Addresses. Design the sub-blocks and find out how many addresses will be available after these allocation.
- Q6b** Which protocol is used to report the unexpected events in internet router ?
- Q6c** How buffer management is implemented for TCP and UDP protocol in the Internet?

**Year:** 2018-19 **SE**

**Subject:** Computer Network

**Max. Marks :** 100

**Day & Date :** Friday ,03.05.2019

**Branch:** Information Technology

**Subject Code:** IT2008

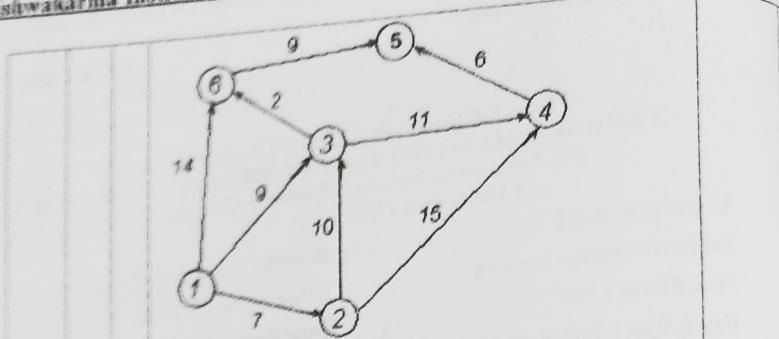
**Total Pages of Question Paper :** 3

**Time :** [ 2.30 P.M. - 5.30 P.M. ] **3 Hours**

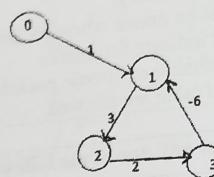
**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

<b>Q. 1.</b>	a)	<b>Attempt any one of the following.</b>	<b>Marks</b>	<b>CO1</b>
		i) Demonstrate OSI layered step by step processing Model with example?		
	ii)	Elaborate following Devices with the help of 1. Working 2. Layer at which it works 3. Model diagram	8	
	b)	Identify the fields in the HDLC frame 01111110 10100011 01100010 11000011 01010101 01111110 as well as Identify the type of frame from the control field and subfields within the control field (a)10111010 (b)01010111 (c)11000000	4	M
	c)	For the network, Data Rate: 6 Kbps, RTT = 20 ms, Efficiency/Utilization = 60%. Find frame size?	4D	D
<b>Q. 2.</b>	a)	<b>Attempt any one of the following.</b>	<b>18</b>	<b>CO2</b>
		i) Prove Binary Back off Algorithm with example.		
	ii)	Write a C function to implement Stop and Wait Protocol with Timeout Timer.	8	
	b)	In GB3, if every 3 <sup>rd</sup> packet that is being transmitted is lost and if we have to send 18 packets, then how many transmissions are required? ( Explain with Timeline Diagram)	4	M
	c)	Consider the following network, where MTUs are excluding the LAN header: Demonstrate the Fragmentation with calculations.	6	D
		A — MTU 1500 — R1 — MTU 1000 — R2 — MTU 400 — R3 — MTU 1500 — B		
<b>Q. 3.</b>	a)	<b>Attempt the following.</b>	<b>16</b>	<b>CO3</b>
		i) Compute the shortest path between nodes 1 to 5 by using Dijkstra's centralized algorithm.		



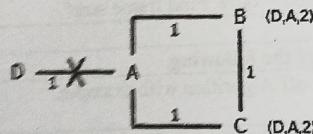
- b) Detect if there is a negative weight cycle in following graph? 4



- c) Calculate Network ID, Limited Broadcast Address and Directed Broadcast Address for following IP addresses. 4
1. 1.2.3.4
  2. 150.0.150.150
  3. 220.15.1.10
  4. 300.1.2.3

**Q. 4. a) Attempt the following.** 16 CO

- i) Detect if there is a Split Horizon in the following network. 8



- b) How to solve "what port am I on?" problem. Solve it with Example. 4 M

- c) A computer on a 10-Mbps is regulated by a token bucket. The Token Bucket is filled at rate of 2 Mbps. It is initially filled to capacity with 20 Megabits. How long can the computer transmit at the full 10-Mbps (in seconds)? 4 D

OR

Consider a frame relay network having a capacity of 1Mb of data is arriving at the rate of 25mbps for 40msec. The Token arrival rate is 2mbps and the capacity of bucket is 500 kb with maximum output rate 25mbps. Calculate 1. The Burst Length. 2. Total output time

**Q. 5. a) Attempt any one of the following.** 18 COS

- i) How DHCP Works? Elaborate process with neat diagram 8 R

- ii) The simplicity in information exchange has made the SNMP as widely accepted protocol. The main reason being concise set of commands. Give SNMP basic commands. 8

- iii) How to resolve www.vit.edu domain name? give resolution 6 M

		process in detail		
	c)	Suppose page E is made of 12 small resources while page F is made of one resource which is 12 times larger the small resource. In experiment I page E is fetched once with HTTP/1.1. In experiment II, page F is fetched once with HTTP/1.0. Which experiment would be faster and why?	4	D
Q. 6.	a)	<b>Attempt any one of the following.</b>	16	CO5,6
	i)	Create a datagram socket in the internet domain and use the default protocol (UDP). Basically the client connects to the server, the server sends the message "Hello World", and the client prints the received message. <b>OR</b>	8	R
	ii)	Create a datagram socket in the internet domain and use the default protocol (TCP). Basically the client connects to the server, the server sends the message "Hello World", and the client prints the received message.	8	
	b)	Explain Address Resolution protocol ( <b>ARP</b> )? <b>(Give Command)</b>	4	M
	c)	Explain default type of remote web server resolution with example.	4	D

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(27)

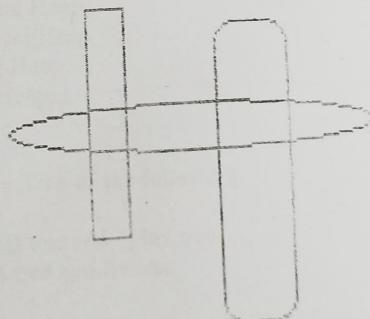
**Examination: MSE****Year:** SY**Branch:** Information Technology**Subject:** Operating Systems**Subject Code:** IT2009**Max. Marks:** 30**Total Pages of Question Paper:** 3**Day & Date:** Tuesday, 7 May 2019**Time:** 2.30 pm to 5.30pm**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

<b>Q.1.</b>				Marks																				
	a)	Narrate the high-level services provided by an Operating system.		8 CO1																				
<b>OR</b>																								
	a)	With the help of neat labeled diagram, illustrate the architecture of Android Operating System.		8 CO1																				
	b)	Apply synchronization technique using semaphores to solve the classical Dining Philosopher problem.		5 CO1																				
	c)	Compare process and thread.		4 CO1																				
<b>Q.2.</b>																								
	a)	With the help of suitable diagram illustrate 7-state process transition diagram.		8 CO2																				
	b)	How PCB is useful during the context switch of a process. Draw suitable diagram.		5 CO2																				
	c)	Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Process</th><th>Arrival Time</th><th>Burst Time</th><th>Priority</th></tr> </thead> <tbody> <tr> <td>P1</td><td>0</td><td>1</td><td>3</td></tr> <tr> <td>P2</td><td>1</td><td>7</td><td>3</td></tr> <tr> <td>P3</td><td>3</td><td>1</td><td>2</td></tr> <tr> <td>P4</td><td>3</td><td>7</td><td>1</td></tr> </tbody> </table> Draw the Gantt charts illustrating the execution of these processes using 1. FCFS 2. SJF -Nonpreemptive. Compute Finish, Turnaround, Waiting time of each process for above cases.	Process	Arrival Time	Burst Time	Priority	P1	0	1	3	P2	1	7	3	P3	3	1	2	P4	3	7	1		4 CO3
Process	Arrival Time	Burst Time	Priority																					
P1	0	1	3																					
P2	1	7	3																					
P3	3	1	2																					
P4	3	7	1																					
<b>Q. 3.</b>																								
	a)	Illustrate the four necessary conditions for occurrence of deadlock. Justify - Cycle is necessary as well as sufficient condition for the occurrence of a deadlock.		8 CO4																				
		<b>OR</b>																						



		<p>The shaded areas are allocated blocks; the white areas are free blocks. The next three memory requests are for 40M, 20M and 10M. Indicate the starting address for each of the requests using the following placement algorithms:</p> <ul style="list-style-type: none"><li>i) First fit</li><li>ii) Best fit</li><li>iii) Worst fit</li></ul>	
	b)	Compare different file allocation methods.	4 CO6



D.Q.N.O.

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(14)

**Examination : END SEMESTER EXAMINATION**

**Year:** TY (2018-19)

**Branch:** Computer Engineering

**Subject :** Design and Analysis of Algorithms    **Subject Code :** CS304 TH

**Max. Marks:** 100

**Total Pages of Question Paper :** 3

**Day & Date :** 6 May 2019

**Time:** 10 AM- 1 PM

**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of non-programmable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

**Q. 1.      a) Answer the following.**

6

Given two n bit binary numbers  $N_1$  and  $N_2$  give an efficient algorithm to compute the product of  $N_1$  and  $N_2$ . Your algorithm should have running time *strictly better* than  $\Theta(n^2)$ . Analyze the time complexity of your algorithm.

**b) Answer any ONE of the following.**

8

- (i) Given an array of n integers  $A[1], A[2], \dots, A[n]$  design an efficient algorithm to determine a contiguous sub-array  $A[i], A[i+1], \dots, A[j]$  for which the sum of elements in it is maximized. For example, if the array  $A[1-7]=\{-6, 12, -7, 0, 14, -7, 5\}$  then the contiguous sub-array with largest sum is  $A[2-5]$  with sum =  $19 = 12 + 0 + 14$ .

Prove the correctness of your algorithm and analyze time complexity. Full credit will be given to an algorithm which has time complexity  $O(n)$  or better.

- (ii) What is min-heap? Explain  $O(\log n)$  time algorithm for inserting an element, extracting minimum element from a min-heap with n elements. Using the above operations give  $O(n \log n)$  time algorithm to sort an array of n numbers. (you are only allowed to use  $O(1)$  extra space).

Can you build a min-heap of n elements in  $O(n)$  time? If yes give brief analysis supporting your claim.

**Q. 2.      a) Answer any ONE of the following.**

6

- (i) State the Master's theorem for the solution of recurrence relations. Use it to give a tight asymptotic bounds for the following recurrences:

$$1. f(n) = f(n/2) + n$$

$$2. f(n) = 3f(n/2) + n$$

- (ii) Prove that any comparison based sorting algorithm must perform  $\Omega(n \log n)$  comparisons to sort n numbers.

8

**b) Answer the following.**

(*Longest Zig-Zag Subsequence*) Let  $A[1...n]$  be an array with n distinct positive numbers. A zig-zag subsequence of  $A$  of length k is a sequence of indices  $1 \leq i_1 < i_2 < \dots < i_k \leq n$  for some k such that  $A[i_1] < A[i_2] > A[i_3] < A[i_4] \dots A[i_k]$  or  $A[i_1] > A[i_2] < A[i_3] > A[i_4] \dots A[i_k]$ . (For example 2, 10, 5, 7, 4 and 20, 10, 15, 11, 13 are zig-zag sequences) Design an algorithm based on dynamic programming to compute length of a *longest zig-zag sub-sequence* of  $A$ , proceeding along the following steps. First give correct

- Q. 3.** **a)** **Answer any ONE of the following.** 6
- (i) Consider a text over alphabet {a,b,c,d,e,f,g} relative frequencies of the characters are 10, 8, 20, 12, 42, 3, 5 respectively. Find Huffman encoding for each of the seven characters. Suppose original text contains total 1 million characters what will be size of the text in bits after encoding.  
What is significance of prefix-free property of Huffman codes?
- (ii) Given a natural number  $n$  as input, design an efficient algorithm to test if  $n$  is a perfect power. We say a number  $n$  is a perfect power if  $n = a^b$  for  $a, b > 1$ . (For example  $32=2^5$ ,  $27=3^3$  are perfect powers but 15 is not). Your algorithm should run in time  $O((\log n)^c)$  for an absolute constant  $c$ .
- b)** **Answer the following.** 8
- Explain Kruskal's algorithm for computing Minimum Weight Spanning tree of a graph. Explain in details disjoint set data structure (also called as union-find) and its use in an efficient implementation of Kruskal's algorithm. Analyze the time complexity of the algorithm.
- Q. 4.** **a)** **Answer any FIVE of the following.** 15
1. State Cook's theorem (sometime referred as Cook-Levin theorem) and give a sketch of the proof.
  2. Prove that any problem in NP has a deterministic algorithm with complexity  $O(2^{(n^c)})$  for an absolute constant  $c$ .
  3. What do we mean when we say a decision problem reduces to other decision problem? (particularly explain polynomial-time many one reductions)
  4. Show that if  $P=NP$  then  $NP=coNP$
  5. Define and explain the notions of NP-completeness. What is  $P$  versus  $NP$  problem, explain its relevance in the context of  $NP$ -completeness?
  6. Define complexity classes  $P$ ,  $NP$ ,  $coNP$  and for each class give an example of a decision problem characterizing the class.
- b)** **Answer any ONE of the following.** 7
- (i) Consider the following decision problem:  
 $S\text{-SUM} = \{ (S, m) | S \text{ is a set of integers, } m \text{ is an integer such that there exist a subset of } S \text{ whose element sum to } m \}$   
For example  $\{(2, -4, 7, 1), 5\}$  is an YES instance since for the subset  $\{2, -4, 7\}$  the sum of elements  $2 + (-4) + 7$  is 5.  
Show that  $S\text{-SUM}$  is  $NP$ -complete.
- (ii) Consider the following decision problem:  
 $IS = \{ (G, k) | G \text{ is an undirected graph which has an independent set of size at least } k \}$   
Recall that a set of vertices  $S$  is called an independent set if every edge of  $G$  is incident upon at most one vertex in  $S$ .  
Prove that  $IS$  is  $NP$ -complete (Hint: reduction from Clique).  
If input graph  $G$  is a tree, give an efficient (polynomial time) algorithm to solve the Independent Set problem.
- Q. 5.** **a)** **Answer the following.** 6
- What do we mean by an approximation algorithm for an  $NP$  optimization problem? Give a factor-2 approximation algorithm for Vertex Cover problem. Prove the correctness of your algorithm. Give an example of graph for which your algorithm gives sub-optimal result.
- b)** **Answer any TWO of the following.** 8\*2
- (i) In MIN-CUT problem, given an undirected graph  $G$ , goal is to find size of smallest Cut in  $G$ . Explain Karger's Min-Cut algorithm and analyze it in details. Give an example of graph for which the algorithm exhibits worst case behaviour.
- (ii) Let  $G$  be an undirected complete graph on  $n$  nodes (in a

complete graph each pair of vertices are connected by an edge). We are going to perform a random walk on the graph. Suppose to we start with a vertex  $u$  in the graph. Suppose at  $k$ th step we are at vertex  $v_k$ . Let degree of vertex  $v_k$  is  $d_k$ . In the  $k+1$  th step we pick one of the neighbouring vertex  $v$  of  $v_k$  uniformly at random ( with probability  $1/d_k$  ) and set  $v_{k+1} = v$ . We stop the walk when we visit all the vertices of  $G$  at least once. Determine the expected number of steps in the walk. Give detailed analysis.

- (iii) What is metric-TSP? Design factor-2 approximation algorithm for metric-TSP, prove correctness of your algorithm.

**Q. 6**

7\*2

**Answer any TWO of the following.**

- (i)(Josephus problem) Let  $n$  people numbered from 1 to  $n$  are standing round a circle with the first person holding the sword. Each person holding a sword kills the next alive person in clockwise direction and pass on the sword to the next alive person. Game stops when only one person is left and that person is called as winner of the game. Let  $f(n)$  denote the index of the winner. E.g.  $f(3)=3$ ,  $f(6)=5$ . On input  $n$ , give an algorithm to compute  $f(n)$ . The time complexity of your algorithm must be  $O((\log n)^c)$  for an absolute constant  $c$ . Give detailed analysis of the complexity and prove the correctness of your algorithm. (Note: proof of correctness carries half of the marks, Hint: circular queue based solution will not work! )

What is  $f(107)$  ?

- (ii) Given natural numbers  $a, b, n$  as input give an efficient algorithm to compute  $a^b \% n$ . Where  $a^b \% n$  is the remainder obtained on dividing  $a^b$  by  $n$ . Analyze the time complexity of your algorithm. Full credit is given for an algorithm with complexity  $O((\log a + \log b + \log n)^c)$  for an absolute constant  $c$ , or better.

Using this algorithm or otherwise compute last 2 digits of  $23^{129}$ .

- (iii) Suppose you are given a collection of  $n$  points in the plane with co-ordinates  $(x_i, y_i)$  for integers  $x_i, y_i$  for  $i=1$  to  $n$ . All the points are in first quadrant, i.e.  $x_i, y_i \geq 0$ . No two points have same  $x$  or  $y$  co-ordinate. We say a point  $(x_i, y_i)$  is frontier point if for every  $j$  not equal to  $i$ , the rectangle formed using origin and  $(x_j, y_j)$  as its digonal vertices doesn't contain the point  $(x_i, y_i)$ . ( i.e. for frontier point  $(x_i, y_i)$  for every  $j$  not equal to  $i$ ,  $x_i > x_j$  or  $y_i > y_j$  or both). Give an efficient algorithm to find all frontier points in the given collection. Prove the correctness of your algorithm. Your algorithm must be asymptotically *strictly better* than obvious  $\Theta(n^2)$  time algorithm.

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(10)

## Examination : ESE

Year: 2018-19 **TE**

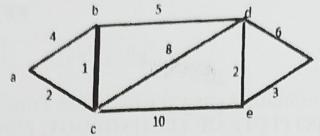
Branch: Information Technology

**Subject:** Computer Network**Subject Code:** IT3008**Max. Marks :** 100**Total Pages of Question Paper :** 3**Day & Date :** Friday ,03.05.2019**Time :** 10.00 a.m to 1.00 p.m **3 Hours**

## Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

			Mar ks	
<b>Q. 1.</b>	a)	<b>Attempt any one of the following.</b>	16	<b>CO1</b>
	i)	A point-to-point satellite transmission line connecting two computers uses a stop and wait protocol and has the following properties  Data Transmission Rate (DTR) = 64 kbps, Frame Size = 2048 bytes One Way Propagation Delay = 180 ms Acknowledgement Size = 10 bytes ,Processing Delay of one computer = 25 ms. Determine the throughput and Utilization. <b>OR</b> Elaborate OSI Model in detail with the help of working and Data unit.	8	R
	b)	Data Rate: 4 Kbps, Propagation delay = 20ms, Efficiency/Utilization = 50% = 0.5. Find frame size?	4	M
	c)	Discuss any one problem of wireless LAN. i) Hidden Terminals. ii) Exposed Terminal.	4	D
<b>Q. 2.</b>	a)	<b>Attempt the following.</b>	18	<b>CO2</b>
	i)	Given Data word <b>1101101</b> and divisor <b>10101</b> . i) Generate sender data with CRC bits. ii) Do error checking of code word at receiver side if code word received is <b>11011010011</b> . <b>OR</b> Write a C function to implement Sliding window Protocol, read input as Transmission time and propagation delay and display output as total time required for the transmission.	8	R
	b)	Demonstrate Collision resolution mechanism in Ethernet with example?	4	M
	c)	Justify the factors affecting Network Efficiency in switched Ethernet?	6	D
<b>Q. 3.</b>	a)	<b>Attempt the following.</b>	16	<b>CO3</b>
	i)	Compute the shortest path between node a to z by using Distance Vector Routing Protocol.	8	R



b)	What is CIDR? How it reduce the wastage of IP addresses as compared to classful IP addressing? How CIDR assigns block of 2,4,8, and 16 IP addresses using IPv4? Provide the values of n for a,b,c,d/n for the block size 2,4,8 and 16.	4	M	
c)	Consider the following network, where MTUs are excluding the LAN header: Demonstrate the Fragmentation with calculations.  A — MTU 1500 — R1 — MTU 1000 — R2 — MTU 400 — R3 — MTU 1500 — B	4	D	
<b>Q. 4.</b>	<p><b>Attempt the following.</b></p> <p>i) TCP Connection Establishment. ii) TCP Connection Release.</p>	16	CQ	
b)	Create a datagram socket in the internet domain and use the default protocol (UDP). Basically the client connects to the server, the server sends the file "HelloWorld.c", and the client prints the received message.	4	M	
	<b>OR</b>			
	Suppose two programs use TCP to establish a connection, communicate, terminate the connection, and then open a new connection. Further suppose a FIN message sent to shut down the first connection is duplicated and delayed until the second connection has been established. If a copy of the old FIN is delivered, will TCP terminate the new connection? <b>Justify.</b>			
c)	A computer on a 10-Mbps is regulated by a token bucket. The Token Bucket is filled at rate of 2 Mbps. It is initially filled to capacity with 20 Megabits. How long can the computer transmit at the full 10-Mbps (in seconds)?	4	D	
<b>Q. 5.</b>	<p><b>Attempt any one of the following.</b></p> <p>i) How DHCP Works? Elaborate process with neat diagram</p>	18	CQ 6	
	ii) The simplicity in information exchange has made the SNMP as widely accepted protocol. The main reason being concise set of commands. Give SNMP basic commands.	8	R	
b)	How to resolve www.vit.edu domain name? give resolution process in detail	6	M	
c)	Suppose page E is made of 12 small resources while page F is made of one resource which is 12 times larger the small resource. In experiment I page E is fetched once with HTTP/1.1. In experiment II, page F is fetched once with HTTP/1.0. Which experiment would be faster and why?	4	D	
<b>Q. 6.</b>	<p><b>Attempt any one of the following.</b></p> <p>i) What is the Gateway? How application gateway can be different than IP gateway?</p>	16	CQ 6	
	ii) What are different categories or type of VLAN? How does a trunk work in VLAN?	8	R	
b)	Explain Address Resolution protocol (ARP)? <b>(Give Command)</b>	4	M	
c)	Elaborate FTP protocol in detail with neat diagram	4	D	

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(9)

Examination: ESE

Year: TY

Branch: Computer Engineering

Subject: Computer Networks

Subject Code: CS3025

Max. Marks: 100

Total Pages of Question Paper: 2

Day & Date: 3<sup>rd</sup> May 2019

Time: 10 AM To 1 PM

**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

**Q1a** What is need of sliding window protocol? How does it increase the bandwidth utilization? 9

**OR**

**Q1b** Design the error detection system to calculate the CRC/FCS/Checksum using modulo-2 division method for generator polynomial of  $x^4+x+1$  and message 1101011011? Send the frame to the destination and check the correctness of frame. 9

**Q1c** Why the minimum frame size of 10Base5 Ethernet Network is 64 bytes and maximum frame size is 1518 bytes excluding synchronization and preamble bytes? 5

**Q1d** Show that the persistent and non persistent CSMA methods improves the performance over ALOHA methods. 4

**Q2a** How CSMA/CA protocol is used to avoid collisions for air as a transmission medium among the number of clients? 8

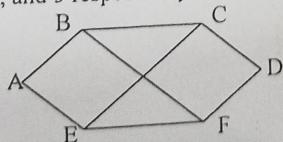
**OR**

**Q2b** Consider a link with Data rate of 1 Mbps and one way latency of 40ms. Assume a packet size of 1000 bytes. Calculate the sending window size in packets over this link. 8

**Q2c** Justify the following statement:  
“Network diameter reduces as the network bandwidth increases in wired LAN” 5

**Q2d** Why PPP is more popular than HDLC protocol? 3

**Q3a** Consider the subnet of following figure. Distance vector routing is used and the following vectors have just come in to router C: from B( 5,0,8,12,6,2); from D(16,12,6,0,9,10); and from E(7,6,3,9,0,4). The measured delays to B, D, and E are 6, 3, and 5 respectively. What is C's new routing table? 8



**OR**

**Q3b** One of the CIDR IP address allocated to the organization is 167.199.130.83/25. Find the IP block size, netmask, first IP address and last IP address for the block. 8

Justice Joseph said.  
CONTINUED ON PAGE 2

- Q3c Give the packet format of ARP protocol. How ARP supports for address resolution in Intranet? 5
- Q3d What is tunneling? Why it is important in internetworking? 3
- Q4a If a host on internet in VIT Campus wants to communicate with a host in IIT for live lectures. If both are expected to have reliable communication over the internet. Before sending first data packet few other packets needs to be send from either the side. Can you remember the name of these packet exchanges? Illustrate this with neat diagram 8
- OR
- Q4b Draw the structure of IP header frame format. How this frame format supports for heterogeneous networks in TCP/IP model? How it follows norms of the engineering practice to accommodate maximum file size? 8
- Q4c How DNS protocol helps to resolve URL into IP address in the Internet? 5
- Q4d How UDP works without flow and error control? 3
- Q5a How do SMTP and POP protocols make the use MIME while sending and accessing a mail? 8
- OR
- Q5b How OSPF works in the network layer of TCP/IP model 8
- Q5c How DHCP protocol assigns the IP address from the given pool to mobile devices such as laptop? 5
- Q5d How is BGP protocol route the traffic for UDP datagram's? 3
- Q6a Illustrate the roles of foreign agent and home agent in the routing for mobile host. 9
- Q6b Justify the following statement:  
"RIP protocol is not suitable for wide area network routing" 5
- Q6c How crash recovery is done at the transport layer in the Internet? 4

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(23)

Examination : ESE

Year: T.Y.

Branch: IT

Subject: Operating Systems

Subject Code: IT320THP

Max. Marks: 100

Total Pages of Question Paper: 02

Day & Date: Wednesday, 8 May 2019

Time: 10.00 am to 1.00 pm

**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

<b>Q. 1.</b>				Marks												
	a)		<b>Attempt any ONE of the following.</b>													
		i)	Narrate the high-level services provided by an Operating system.	8												
		ii)	With the help of neat labeled diagram, discuss the architecture of Android Operating System.	8												
	b)		Describe the following types of operating systems along with the motivations that led operating systems to evolve through these types over time: Multiprogramming, Parallel, Real time operating system.	4												
	c)		Define System call. Why application programmers refer API's rather than system call?	4												
<b>Q.2.</b>																
	a)		<b>Attempt any ONE of the following.</b>													
		i)	What is a PCB? Describe its various elements with the help of a suitable diagram.	8												
		ii)	Illustrate the 5-state process transition diagram with the help of suitable diagram.	8												
	b)		Why there is necessity of suspended state in a process? What are the reasons for the process suspension?	4												
	c)		Apply synchronization technique using semaphores to solve the classical Producer-Consumer problem.	4												
<b>Q.3.</b>																
	a)		<b>Attempt any ONE of the following.</b>													
		i)	Explain the various types of scheduling in connection to the process state model with the help of a neat diagram. Which one happens most frequently and when?	8												
		ii)	Explain the design issues for multiprocessor scheduling. State the four approaches for multiprocessor thread scheduling.	8												
	b)		Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:	6												
			<table border="1"> <thead> <tr> <th>Process</th><th>Arrival Time</th><th>Burst Time</th><th>Priority</th></tr> </thead> <tbody> <tr> <td>P1</td><td>0</td><td>3</td><td>2</td></tr> <tr> <td>P2</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	Process	Arrival Time	Burst Time	Priority	P1	0	3	2	P2	1	1	1	
Process	Arrival Time	Burst Time	Priority													
P1	0	3	2													
P2	1	1	1													

P3	2	7	3
P4	3	4	4

Draw the Gantt charts illustrating the execution of these processes using

1. FCFS
2. SJF -Nonpreemptive
3. SJF -Preemptive

Compute Finish, Turnaround, Waiting time of each process for above cases.

c) In Round Robin scheduling, how length of time quantum becomes principal design issue? 4

**Q. 4. a)** Attempt any ONE of the following.

i) What are the four necessary conditions for deadlock to exist?  
What are different types of resources? Give suitable examples. 8

ii) Illustrate the different methods used for recovery of deadlock. 8

b) Given the following state for the Banker's Algorithm,  
Snapshot at time T0:  
Available: [ 1, 5, 2, 0 ] 6

PID	Allocation				Request			
	A	B	C	D	A	B	C	D
P1	0	0	1	2	0	0	1	2
P2	1	0	0	0	1	7	5	0
P3	1	3	5	4	2	3	5	6
P4	0	6	3	2	0	6	5	2
P5	0	0	1	4	0	6	5	6

1) Calculate the Need matrix.

2) Is the current state safe? If yes, give a safe sequence.

c) Justify - Cycle is necessary as well as sufficient condition for the occurrence of a deadlock. 4

**Q. 5. a)** Discuss the address translation mechanism in paging with the help of suitable diagram. 8

b) A process refers five pages, 1,2,3,4 and 5 in the following order: 2,3,2,1,5,2,4,5,3,2,5,2  
Starting with an empty main memory with 3 frames, find the number of page faults when FIFO and OPT page replacement policies are used.

c) A 1-Mbyte block of memory is allocated using the buddy system. Show the results of the following sequence through an appropriate diagram after every request : P1 Request 100K;  
P2 Request 35K ;P3 Request 70K; Return P1;P4 Request 80 K; Return P2; Return P4; Return P3. 4

**Q. 6. a)** What are typical operations that may be performed on a directory? Explain the Tree-Structured directory with the help of suitable diagram. 8

b) Find the average seek length for the following sequence of disk track requests: 17, 30, 24, 37, 15, 27, 11, 75, 20, 5 for the following strategies. Assume that the disk drive has 80 tracks and the head is initially positioned at track 28 and is moving in the direction of decreasing track number. 6

1) SSTF

2) ECF

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(27)

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Year: TY

Examination: ESE

Subject: Design and Analysis of Algorithms

Branch: Computer Engineering

Max. Marks: 100

Subject Code: CS3002

Day &amp; Date: 8 May 2019

Total Pages of Question Paper: 3

Time: 10 AM- 1 PM

**Instructions to Candidate**

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

**Marks**

<b>Q1 a</b>	Attempt any ONE of the following.	6
i)	Prove that time complexity of any comparison based sorting algorithm to sort array of size $n$ is at-least $\Omega(n \log n)$ .	CO 3
ii)	State the Master's theorem for the solution of recurrence relations. Use recursion tree method or the Master's theorem to give tight asymptotic bounds for the following recurrences: 1. $f(n) = 3f(n/2) + O(n)$ 2. $f(n) = f(2n/3) + 1$	CO 3
<b>Q1 b</b>	Attempt the following.  Let $G$ is simple directed graph. We say $G$ has a universal sink node if there exist a node $v$ in $G$ , such that there is an edge from every other node of $G$ to $v$ . Suppose $G$ has a universal sink and you are given adjacency matrix of $G$ as input. Design an efficient algorithm to find the universal sink node. For full credit your algorithm should run in time $O(n)$ or better where $n$ is number of vertices of $G$ .	6 CO 1,2,6
<b>Q2 a</b>	Attempt any ONE of the following.	6
i)	Let $G$ be a weighted directed graph. Explain Floyd-Warshall algorithm to compute shortest paths between all pairs of vertices of $G$ . Analyze the time complexity of the algorithm. Compare and Contrast this algorithm with Dijkstra's shorted path algorithm.	CO 1,2,3
ii)	Consider the problem of computing $n$ -th Fibonacci number. (Fibonacci numbers are defined by recurrence $F_n = F_{n-1} + F_{n-2}$ , with $F_0 = 0$ and $F_1 = 1$ ). (1) What is time complexity of naive recursive algorithm which uses above recurrence as it is, prove your claimed bound. (2) Give an efficient dynamic programming based algorithm for the problem, clearly describe the memoization used, time and space complexity of your algorithm. Qualitatively compare divide and conquer and dynamic programming techniques, usually when is the divide-conquer approach more efficient.	CO 1,2,3
<b>Q2 b</b>	Attempt any ONE of the following.	6
i)	Given set of $n$ integers each in the range 0 to $K$ . Partition these integers into two subsets such that you minimize $ S_1 - S_2 $ , where $S_1$ and $S_2$ denote the sums of the elements in each of the two subsets.	CO 1,2,6
ii)	Consider a $2^n \times 2^n$ chessboard with one (arbitrarily chosen) square removed.	CO

(a) Prove that any such chessboard can be tiled without gaps or overlaps by L-shaped pieces, each composed of 3 squares. (b) Describe and analyze an algorithm to compute such a tiling, given the integer  $n$  and two  $n$ -bit integers representing the row and column of the missing square. The output is a list of the positions and orientations of  $4^n - 1$  tiles. Your algorithm should run in  $O(4^n)$  time.

- Q3 a** Attempt any **ONE** of the following.
- i) Given an array of  $n$  integers  $A[1], A[2], \dots, A[n]$  design an efficient algorithm to determine a contiguous sub-array  $A[i], A[i+1], \dots, A[j]$  for which the sum of elements in it is maximized. For example, if the array  $A[1-7] = \{-6, 12, -7, 0, 14, 7, 5\}$  then the contiguous sub-array with largest sum is  $A[2-5]$  with sum =  $19 = 12 - 7 + 0 + 14$ .

Prove the correctness of your algorithm and analyze time complexity. Full credit will be given to an algorithm which has time complexity  $O(n)$  or better.

- ii) Consider a text over alphabet  $\{a, b, c, d, e, f, g, h\}$  relative frequencies of the characters are 5, 15, 16, 10, 8, 2, 20, 24 respectively. Find Huffman encoding for each of the six characters. Suppose original text contains total 10,00,000 characters what will be size of the text in bits after encoding.

- Q3 b** Attempt the following.
- i) For a graph  $G(V, E)$ , subset  $S$  of vertices is called independent set if for any pair of vertices  $i, j$  in  $S$ , edge  $(i, j)$  is not present in  $E$ . Let  $G$  be a rooted tree, design an efficient algorithm to compute size of largest independent set of  $G$ . Give proper pseudocode for your algorithm and analyze its time complexity. (a rooted tree is a tree in which one specific vertex is designated as root of the tree)

- Q4 a** Attempt any **TWO** of the following
- i) Define complexity classes P, NP, coNP. Give a decision problem characterizing each class.
- Give an example of a decision problem which is NP-hard but not NP-complete. Prove that If  $P = NP$  then  $NP = coNP$
- ii) Define polytime many one reductions among the design problems. Explain with suitable example. Prove that Polynomial time many one reductions are transitive.
- iii) State the graph **k-COLORING** problem. Design an algorithm to solve graph k-COLORING based on back-tracking strategy. Give proper pseudocode of your algorithm.

- Q4 b** Attempt the following.
- Clearly state the decision problems **Circuit-SAT** and **3-CNF-SAT**. Give a polynomial time many-one reduction from **Circuit-SAT** to **3-CNF-SAT**.

- Q5 a** Attempt any **TWO** of the following
- i) Clearly state VERTEX-COVER and CLIQUE decision problems. Give a polynomial time many one reduction from CLIQUE to VERTEX-COVER. Prove correctness of your reduction.
- ii) Prove that if there is a polynomial-time efficient approximation algorithm for TSP it would imply  $P=NP$
- iii) Give a polynomial time many-one reduction from **CLIQUE** to **Vertex-Cover**.

- Q5 b** Attempt the following
- Give an efficient approximation algorithm for metric version of TSP (by metric version we mean triangle inequality applies to distances involved). What is approximation ratio of your algorithm? Prove correctness and approximation guarantee of your algorithm.

- Q6 a** Attempt any **TWO** of the following.
- i) State Integer Linear Programming (ILP) problems. Formulate Vertex cover problem as an instance of an integer linear program.
- ii) Give recurrence relation for computing binomial coefficient  $nCr$ , using it design an efficient algorithm to compute its value. Give proper pseudocode of your algorithm.

- iii) Suppose you are given a hypothetical subroutine P which on input a Boolean formula G outputs 1 if G is satisfiable and 0 otherwise. Assume that P is extremely efficient and it produces the output in  $O(1)$  time. You are given a satisfiable formula F. Design an efficient algorithm to find a satisfying assignment of F. You are allowed to query the subroutine P for any formulae of your choice.

CO  
1.2.3

28

- Q6 b) Attempt the following.

8

CO 6

Given two sorted arrays A[1..n] and B[1..n], design  $O(\log n)$  time algorithm to compute median of union of A and B. Give proper pseudo-code for the algorithm. Briefly explain how will you generalize your algorithm if we want to find kth smallest element in union of  $t \geq 2$  many sorted arrays each of size n.

