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Vlth SEMESTER

END SEMESTER EXAMINATION

Roll No………

B.Tech.(MC)

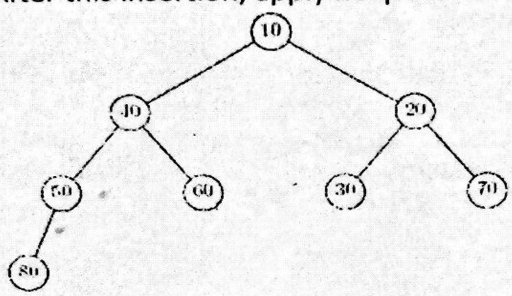
(May/June – 2014)

Paper Code: **MC311** Subject: **Algorithms Design and Analysis**

Time: 3:00 Hours **Max. Marks: 70**

Note:	Answer any five questions. Assume suitable missing data, if any.

1. (a) Suppose we start with the heap below and insert a 35. Show the heap after the insertion. After this insertion, apply heap sort and demonstrate each and every step.



(b) Solve the recurrence T(n) = 2T(n/3) + n using iteration method.

(8+6=14)

2. (a) Using the master method, give tight asymptotic bounds for the following recurrences:

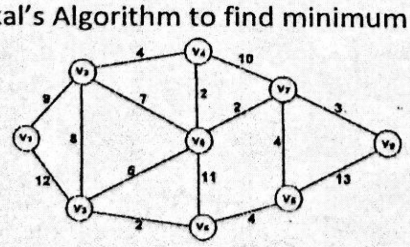
(i) $T(n) = 4T(n/2) + n^3$

(ii) $T(n) = 2T(n/2) + n-1$

(b) Given a weighted, undirected, and connected graph G = (V,E), a maximum spanning tree is a spanning tree of G with the maximum total weight. Design and analyze an algorithm that computes a maximum spanning tree of G.

(8+6=14)

3. (a) Apply Kruskal's Algorithm to find minimum spanning tree on the following graph:



(b) Explain classification of edges for a directed graph using DFS algorithm.

(7+7=14)

4. (a) Write & explain Bellman Ford algorithm to compute the shortest path.

(b) Design a dynamic programming solution for optimal multiplication of the following chain of matrices? Also determine the time complexity of your algorithm.

Matrix	dimension
Al	30x35
A2	35x15

A3	15x5
A4	5x10
A5	10x20
A6	20x25

(6+8=14)

5. (a) Compute Longest Common Subsequence for following two strings using dynamic programming. Also define the structure of optimal solution:
X= "ABRACADABRA" Y="YABBADABBAD"

(b) What is backtracking? Explain how backtracking provides solution space to 4 greens problem. Also write a recursive backtracking algorithm.

(7+7=14)

6. (a) Solve following 0/1 knapsack problem using branch and bound algorithm.
n = 4, profit = 10;10;12;18 weights = 2;4;5;9 m = 15

(b) What do you understand by Polynomial time reducibility? What is the relationship between P, NP and NPC classes?

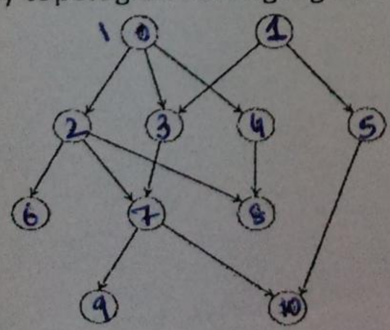
(8+6=14)

7. (a) Given a collection of sorted arrays A1, A2,...,An of size s1, s2,...,sn respectively. It is required to merge all of them into a single sorted array such that total number of elements moved during merge operations is minimum. Design a greedy algorithm which suggests an efficient way of merging arrays. Remember, at a time only two arrays will be merged.

(b) Write merge sort algorithm and explain it using suitable example.

(8+6=14)

8. (a) Apply topological sorting algorithm to find order for following DAG.



(b) List the applications of DFS and BFS algorithms. Write DFS and BFS algorithm in pseudo-code.

(7+7=14)

Total No. of Pages 02

SIXTH SEMESTER B.Tech. [MC]

END SEMESTER EXAMINATION May-2014

MC-312 STOCHASTIC PROCESSES

Time: 3:00 Hours Max. Marks: 70

Note : Answer all questions. By selecting **any two parts** from each question. All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 (a) Explain the Bernoulli process. Give example. When the process is said to be homogeneous? Show that in a Beanoulli process the number of succeeding trials before the next success has geometric distribution.

(b) Discuss the random walk with one absorbing barriers placed at the point $a > 0$. Find the probability of absorption at a. Give an example for the same.

(c) Describe (i) Gaussian process, (ii) Brownian motion, by giving at least one example in each case.

Q.2 (a) Define a Markov Chain. Consider an example of your choice of a Markov Chain with at least three states. Form its transition probability matrix and also its state diagram. What is n-step transion probability matrix of a Markov Chain?

(b) A man drives a car or catches a train to go office each day. He never goes 2 days in a row by a train but if he drives on a day, then the next day he is just as likely to drive again as he is to travel by train. Now suppose that on the first day of the week the man tossed a fair coin and driver to work if head appeared. Write the transition probability matrix and find the probability that he takes a train on the second day. Also find the probability that he drives to work in the long run.

(c) Suppose that the passengers arrive at a train terminal according to a poisson process with rate λ. If the train is dispatched at time t, find the expected sum of the waiting times of all those that enter the train.

Q.3 (a) What is a Poisson process? Give example. Show that it is a Markov process. Prove that sum of two independent Poisson processes is a Poisson process, while difference is not a Poisson process.

(b) People arrive at a bus stop according to a Poisson process with rate λ_1. Buses arrive at the stop according to a Poisson process with rate λ_2. A bus when arrives picks up everybody who is waiting. Find the expected value and the variance of the number of people who got on a bus.

(c) Describe a pure death process. Write its differential difference equation assuming that the system starts with N inventories. Show that its solution is truncated Poisson distribution.

Q.4 (a) What is a renewal process? Give example. How can this be viewed as a generalization of Poisson process? Derive renewal equation.

(b) Suppose $\{N(t), t \geq 0\}$ is a renewal counting process with renewal function $M(t) = \lambda t$. Find the probability distribution of the number of renewals by time T. If $\lambda=5$, what is the probability that there will be exactly 10 renewals in the interval [0, 15]?

(c) A barber shop serves one customer at a time and provides three seats for waiting customers. If the place is full customer go elsewhere. Arrivals occur according to a Poisson distribution with a mean of 4 per hour. The time to get a haircut is exponential with mean 15 minutes. Determine the following:

(i) The steady-state probabilities
(ii) The expected number of customers in the shop
(iii) The probability customer will go elsewhere because the shop is full.

Q.5 (a) Describe M/M/1 queuing model. Give example. Find an expression for the queue length and the waiting time, assuming the queue discipline 'First come First out'.

(b) Describe the following in context with the reliability of a device.
(i) Mean time to failure (MTTF)
(ii) Hazard rate function
(iii) Availability
Find an expression for the hazard rate function of a series system with n components.

(c) Consider a mixed configuration system with five elements components with specific reliabilities of your choice. Find the reliability of the system designed. Can you find the hazard rate function of the system if individual rates are given?

Total No. of Pages: 04 *Roll No:..................*

SIXTH SEMESTER B. Tech.[MC]

END SEMESTER EXAMINATION May, 2014

MC- 313, Matrix Computation

Time: 3.0 Hours Max. Marks: 70

Note: *Attempt Any two parts from each questions. All questions carry equal marks. Assume suitable missing data, if any. Simple calculators are allowed*

1. (a) Let $A(\alpha) = \begin{bmatrix} 0.1\alpha & 0.1\alpha \\ 10 & 15 \end{bmatrix}$. Determine α such that condition number of $A(\alpha)$ is minimized. Use the maximum norm.

   (b) Show if A is a strictly diagonally dominant matrix, then the Gauss-Seidel iteration scheme converges for any initial starting vector.

   (c) Use the Householders method to reduce the given matrix A into the tridiagonal form $\begin{bmatrix} 4 & -1 & -2 & 2 \\ -1 & 4 & -1 & -2 \\ -2 & -1 & 4 & -1 \\ 2 & -2 & -1 & 4 \end{bmatrix}$

2. (a) Determine the condition number of the matrix $A = \begin{bmatrix} 1 & 4 & 9 \\ 4 & 9 & 16 \\ 9 & 16 & 25 \end{bmatrix}$ using (i) $||.||_1$ norm, and (ii) $||.||_\infty$ norm.

(b) Find all the eigenvalues of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 2 \\ 1 & 3 & 2 \end{bmatrix}$ using the Rutishauser method. Iterate till the elements of the lower triangular part are less than 0.05 in magnitude.

(c) Discuss Moore Penrose inverse with example.

3. (a) Estimate the effect of a perturbation $\delta b = [\epsilon_1, \epsilon_2]^t$ on the right hand side of the system of equations $Ax = b$ as given

$$\begin{aligned} x_1 + 2x_2 &= 5 \\ 2x_1 - x_2 &= 0 \end{aligned}$$

on x (i.e. find δx), if $|\epsilon_1|, |\epsilon_2| \leq 10^{-4}$.

(b) Determine the smallest eigenvalue and the corresponding eigenvector of the matrix $\begin{bmatrix} 4 & 1 & 0 \\ 1 & 20 & 1 \\ 0 & 1 & 4 \end{bmatrix}$ correct upto 3 decimal places using the power method.

(c) Find the rate of convergence for the Gauss Jacobi method to solve the following system.

$$3x + 2y = 1$$

$$x + 2y = 2$$

4. (a) Find the eigenvalue nearest to 3 for the matrix $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ using the power method. Perform five iterations. Take the initial approximate vector as $[1, 1, 1]^t$. Also obtain the corresponding eigenvector.

(b) The following system of equations is given

$$\begin{aligned} 3x + 2y &= 4.5 \\ 2x + 3y - z &= 5 \\ -y + 2z &= -0.5. \end{aligned}$$

Set up the SOR iteration scheme for the solution and find the optimal relaxation factor and the rate of convergence.

(c) Find the singular value decomposition of the matrix $\begin{bmatrix} 2 & 4 \\ 1 & 3 \\ 0 & 1 \end{bmatrix}$. 3×2

5. (a) Drive the normal equations for least square quadratic fits and hence find the least square approximation of second degree of the data

x :	-2	-1	0	1	2
$y(x)$:	15	1	1	3	19

(b) Find QR factorization for the matrix

$$\begin{bmatrix} 1 & 1 & 4 \\ 1 & 4 & 2 \\ 1 & 4 & 2 \end{bmatrix}$$

(c) Use the Rayleigh quotient to compute the eigenvalue of A corresponding to the given eigenvector x.

$$A = \begin{bmatrix} 4 & -5 \\ 2 & -3 \end{bmatrix} \text{ and } x = [5, 2]^t.$$

$----TheEnd----$

Total Pages: 9

SIXTH SEMESTER **B.TECH (MC)**

END SEMESTER EXAMINATION **MAY 2014**

MC-314 THEORY OF COMPUTATION

Time: 3 Hours **Maximum Marks: 70**

Note: Answer **ALL** by selecting any **TWO** parts from each question. All questions carry equal marks.

Q1 (a). Define Finite Automaton. Prove by mathematical induction that for any transition function δ and for any two input strings x and y,

$$\delta(q, xy) = \delta(\delta(q, x), y)$$

(b) Consider the finite state machine whose transition function δ is given by the following table

State/Σ	0	1
→ q_0	q_2	q_1
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_1	q_2

Give the entire sequence for the following input strings:

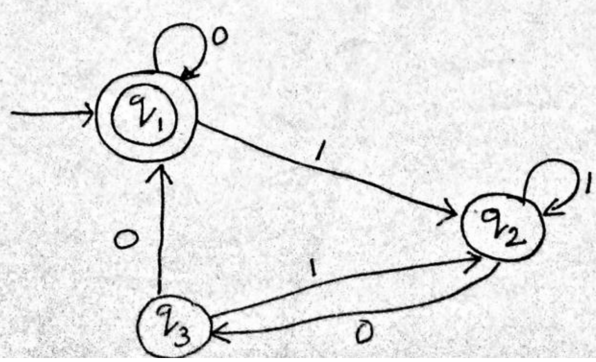
(i) 101101 (ii) 11111 (iii) 110101

Which strings are accepted by the machine?

(c) Let M = (Q,Σ,δ, q_0,F) be a finite automata. Let R be a relation in Q defined by $q_1 R q_2$ iff $\delta(q_1, a) = \delta(q_2, a)\ \forall\ a \in \Sigma$. Is R an equivalence relation? Justify the answer. Also prove that if δ(q, x) = δ(q, y) then δ(q, x z) = δ(q, y z) $\forall\ z \in \Sigma^+$

Q2 (a) State and prove Arden's theorem. Describe the algebraic methods using Arden's theorem to find the regular expression recognized by a transition system.

(b) Construct a regular expression corresponding to the state diagram described below:



(c) Construct a DFA with reduced states equivalent to the regular expression

$10+(0+11)0^*1$

Q3 (a) Define Chomsky Normal Form of a CFG. Reduce the following CFG into CNF

$S \to ASA / bA, \quad A \to B / S, \quad B \to c$

(b) Define Greibach Normal Form (GNF) of a CFG. Convert the grammar $S \to AB$, $A \to BS / b$, $B \to SA / a$ into GNF.

(c) Define ambiguity in CFG. Prove that a regular grammar cannot be ambiguous.

Q4 (a) Let A= ($Q, \Sigma, \Gamma, \delta, q_0, Z_0, F$) be a PDA. Prove that if $(q, x, \alpha) \vdash^* (q', \wedge, \gamma)$ then $\forall \beta \in \Gamma^*, (q, x, \alpha\beta) \vdash^* (q', \wedge, \gamma\beta)$. Show by an example that converse need not be true.

(b) Let A= ($Q, \Sigma, \Gamma, \delta, q_0, Z_0, F$) be a PDA, where

$Q = \{q_0, q_1\}$, $\Sigma = \{a, b\}$, $\Gamma = \{a, Z_0\}$, $F = \emptyset$. Determine N(A). Also construct a PDA 'B' such that T(B)=N(A). δ is defined as

$R_1: \delta(q_0, a, Z_0) = \{(q_0, aZ_0)\}$, $\quad R_4: \delta(q_1, b, a) = \{(q_1, \wedge)\}$

$R_2: \delta(q_0, a, a) = \{(q_0, aa)\}$, $\quad R_5: \delta(q_1, \wedge, Z_0) = \{(q_1, \wedge)\}$

$R_3: \delta(q_0, b, a) = \{(q_1, \wedge)\}$

(c) Prove that if PDA A= ($Q, \Sigma, \Gamma, \delta, q_0, Z_0, F$) accepts L by final state then, we can find a PDA 'B' accepting L by empty store i.e. L=T(A)=N(B).

Q5 (a) Define moves in a Turing Machine. Consider the turing machine given below. Draw the computation of the input string 00b.

Present State	Tape Symbols b	0	1
$\to q_1$	$1Lq_2$	$0Rq_1$	-
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3	-	bRq_4	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
q_5	$0Lq_2$	-	-

(b) Design the Turing Machine for the following languages:

(i) L= $\{a^n : n \geq 1\}$ (ii) L = $\{a^{2n} : n \geq 1\}$ (iii) L = $[(a+b)^*]$ (iv) L = $\{a^n b^n : n \geq 1\}$

(v) L = set of string over {0,1} starting with 00.

(c) Prove that $A_{DFA}=\{(B, w): B \text{ accepts the input string } w\}$

and $A_{CFG} = \{(G, w): \text{the CFG } 'G' \text{ accepts the input string } w\}$ are decidable.

Total No. of Pages 2 *Roll No.*......... 2K11/MC/012

VI-SEMESTER
END SEMESTER EXAMINATION

B.Tech.(MCE)
May– 2014

MC-315 Operating System

Time: 3:00 Hours **Max. Marks: 70**

Note: Answer **all** questions by selecting any **two** parts from each question.
All questions carry equal marks

Q.No. 1

A) What is a process? Explain different states of a process with the help of state diagram. What is an operating system (OS)? List the various services provided by the operating system.

B) Consider the set of processes given in the table with following information

Process	***Arrival Time***	***CPU burst Time***	***Priority***
P1	**0**	**5**	**2**
P2	**1**	**15**	**3**
P3	**2**	**10**	**1**

Assuming 1 to be the highest priority, calculate following

i. Average waiting and turnaround time using FCFS, SJF (Preemptive & no preemptive) and priority (preemptive) scheduling mechanism.
ii. Assume time quantum to be 2 units of time. Calculate average waiting and turnaround time using Round-Robin scheduling.

C) Describe Producer-Consumer problem with its solution. How does Semaphores solve Producer –Consumer problem?

Q.No. 2

A) Describe the Banker's algorithm for safe allocation. Consider a system with three processes and three resource type and at time T_0 the following snapshot of the system has been taken:

Process	Allocated			Maximum			Available		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
P1	2	2	3	3	6	8	7	7	10
P2	2	0	3	4	3	3			
P3	1	2	4	3	4	4			

(i) What is the content of Need matrix?
(ii) Is the current allocation safe state?
(iii) Would the request be granted in the current state? If Process P1 requests (1, 1, 0).

B) What are necessary conditions to hold a deadlock in a system? Explain the resource allocation graph algorithm to deal with deadlock problem. What are the limitations of this approach?

C) What are the approaches that can be used for prevention of deadlock? State and solve readers/writers problem with help of semaphore.

Q.No. 3

A) What is virtual memory? Describe its advantages with respect to user point of view and with respect to system point of view. And also compare contiguous and non contiguous memory allocation.

B) Given references to the following pages by a program

0, 8, 0, 1, 9, 1, 8, 7, 1, 2, 8, 2, 7, 8, 2, 3, 8, 3

How many page faults will occur if the program has three page frames available to it and using : **i.** LRU replacement **ii.** Optimal replacement.

C) Suppose average page fault service time is 20 milliseconds and memory access time is 200 nanoseconds. suppose we wish to have less than 10 % degradation in memory access when a page fault occurs ,what must be the page fault rate less than?

Q.No. 4

A) Explain file access mechanism and file attributes. And also differentiate linked and indexed files.

B) Compare and contrast implementation of Paging and Segmentation with suitable example. How is sharing possible with segmentation?

C) Suppose the head of a moving head disk with 5000 tracks, numbered 0 to 4999, is currently serving a request at track 143 and has just finished a request at track 125. If the queue of requests is kept in the FIFO order as :

86, 1470, 913, 1774, 948, 1022, 1750, 130

What is the total movement to satisfy these requests for the following disk scheduling algorithms?

i) SSTF ii) LOOK iii) C-SCAN

Q.No. 5

A) Explain I/O management system and differentiate between blocking & non-blocking I/O.

B) Explain working of Paged –Segmented system with suitable example.

C) Explain following

i. Critical section Problem and Mutual exclusion.

ii. Process Control Block (PCB) and Multilevel feedback queue scheduling