Reg. No.:

Name :

VIT

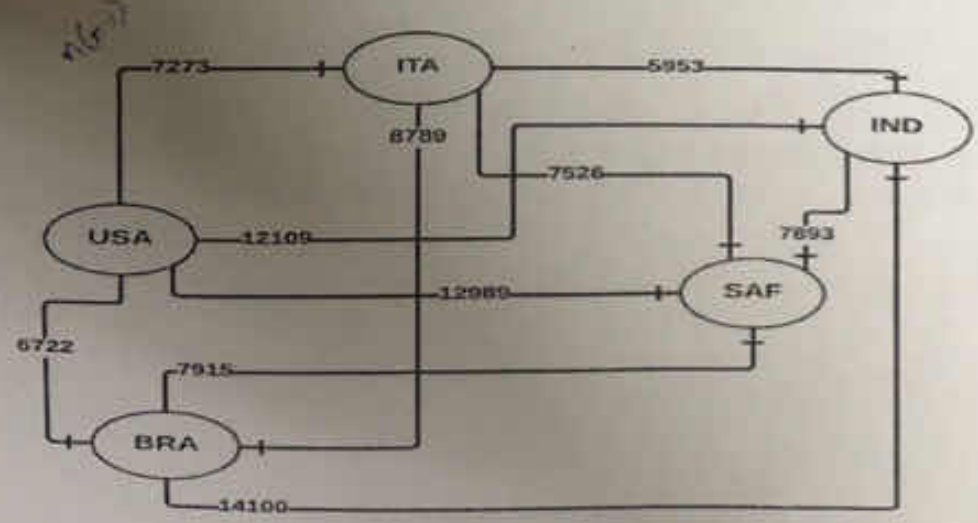
Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

CAT – 2 March- April 2022

Programme	: B.Tech CSE	Semester	:	Winter 21-22
Course Code	: CSE2012	Arrear Class ID	:	CH2021225000708
Course Title	: Design and Analysis of Algorithms			
Faculty(s)	: Dr. Venkatraman S.			
Time	: 90 mins	Max. Marks	:	50

Answer all the Questions (5 X 10 Marks = 50 Marks)

1.		Given a chain <A1, A2, ..., An> of n matrices, where matrix Ai (i = 1, 2, ..., n) has the dimension P_{i-1} X P_i problem is to find the optimal sequence of pairings for multiplication of matrices A1, A2...An in a such way that the number of scalar multiplications required for the product from A1 to An is minimum. Construct an algorithm for matrix chain multiplication problem and illustrate your algorithm for A1*A2*A3*A4 and how it produces parenthesized product sequence in a way that minimizes the number of scalar multiplications. Where dimensions are A1 is 1x2 matrix A2 is 2x3 matrix A3 is 3x4 matrix A4 is 4x5 matrix	10 marks
2.		A travelling salesman plans to visit n cities. He wishes to visit each city only once, and again arriving back to his home city from where he started in such a way that the total travelling distance is minimum. Construct an algorithm for travelling salesman problem. Illustrate how your algorithm works for the below graph that consist of countries and the distances between each pair of countries. Find the shortest possible route that covers each country exactly once, starting from USA and returning back to the origin country?  	10 marks

3. Construct a backtracking algorithm to find all possible ways to place n/2 queens and n/2 Rooks(Elephants) on a n×n chessboard so that no two queens, no two rooks and no queen and rook attack each other.
Thus, a solution requires that

- no two queens share the same row, column, or diagonal,
- no two rooks share the same row or column
- no queen and rook share the same row, column, or diagonal.

Analyze your algorithm with time complexity. **10 marks**

4. Interwoven is a function which takes two strings S1 and S2 as input and generate a string S3 which is obtained by inserting characters of S2 into S1 in order. Few additional characters can be inserted into S1 to obtain S3.
For example, the strings S1= abac and S2= bbc occur interwoven in T = cabcbabcca.

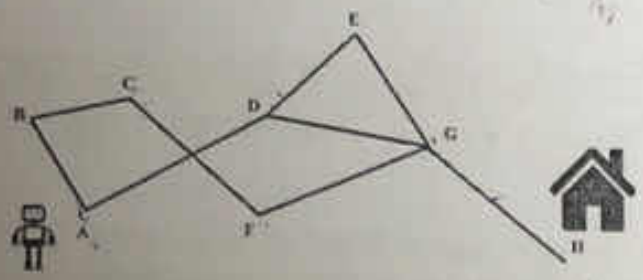
interwoven ("hello", "hai") = "hcedhlalio"

h	c	e	d	h	l	a	l	i	o
S1	R	S1	R	S2	S1	S2	S1	S2	S1

S1 – Character from S1
R – Random character of user choice
S2 – Character from S2

Given two strings S1 and S2 and a text T, Design an algorithm to find whether there is an occurrence of S1 and S2 interwoven in T. **10 marks**

5. Consider a robot navigation problem where a robot is placed in a 2- dimensional environment, which has "n" line segments <L1,L2,L3,... Ln>, some of those lines are connected through end points.The task is to find all possible paths for robot from starting point of the line segment (L1) to end point of the line segment (Ln).



Construct an algorithm for robot navigation problem and illustrate how your algorithm works for the above diagram. (Identify all possible paths for a robot to travel from starting point A to reach the destination point H (House). (Note: Robot can turn left, trun right and move forward) **10 marks**
Example:
Input: AB, AD, BC, CF, DG, FG, DE, EG, GH
One of the possible path output:
Action taken by robot: Turn right and Move forward, Turn right and Move forward,Move forward
Path: AD, DG, GH

⇔⇔⇔