Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (INFORMATION TECHNOLOGY/COMPUTER AND COMMUNICATION ENGINEERING) END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: PROGRAM ELECTIVE I – SOCIAL NETWORK ANALYTICS [ICT 4021]

REVISED CREDIT SYSTEM
(27/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** questions.
- Write the detailed steps for all the problems/algorithms.
- Missing data, if any, may be suitably assumed.

1A. Compute the eigen vector centrality for the graph given in Fig.Q.1A

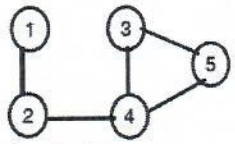

Fig.Q.1A

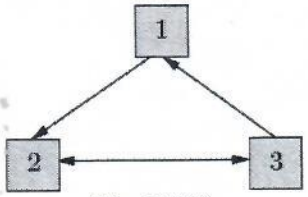

Fig.Q.1B

1B. Represent the adjacency matrix of the graph in Fig.Q.1B. Write paths of length 3 from node 3 to node 2. Is this graph connected or strongly connected? Justify your answer. 5 3

1C. The number of bookings taken per hour at an airport office follows a Poisson distribution. Past record indicate that the hourly number of bookings has a mean of 10 and a standard deviation of 10. Analyze the suitability of the Poisson distribution for this example. 2

2A. Consider a Web graph with three nodes 1, 2, and 3. The links are as follows: 1->3, 3->2, 3->1, 2->3. Compute the page ranks of 1, 2 and 3 pages for at least 3 iterations by finding the transition probability matrices P for the surfer's walk with teleporting probability α=0.5. 5

2B. Differentiate between random network and scale free model. 3

2C. Find the eigenvalues and eigenvectors of the matrix A.

$$A=\begin{bmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{bmatrix}$$ 2

3A. Use the Girvan-Newman method to detect two communities for the graph given in Fig.Q.3A. Show the detailed steps. 5

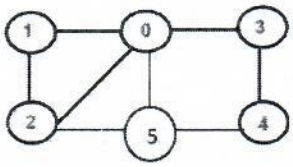

Fig.Q.3A

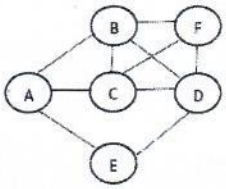

Fig.Q.3B

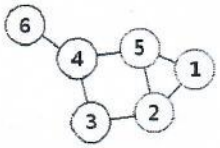

Fig.Q.3C

3B. Determine possible maximal cliques using Born and Kerbosch algorithm in the graph given in Fig.Q.3B. 3

3C. Find the Laplacian Matrix for the graph given in Fig.Q.3C. 2

4A. Consider the scores of five teams in four tournaments as given in Table.Q.4A. Predict the scores obtained by the team "T4" in 2nd tournament "A2" by using the user based collaborative filtering method. Assume neighborhood size=2

Table.Q.4A

Team name	A1	A2	A3	A4
T1	3	0	3	3
T2	5	4	0	2
T3	1	2	4	2
T4	3	?	1	0
T5	2	2	0	1

5

4B. Explain Watts-Strogatz model of small world networks. 3

4C. Determine the normalized cut for the graph given in Fig.Q.4C, if the cut consists of the edges (4,5), (4,6) and (2,6)

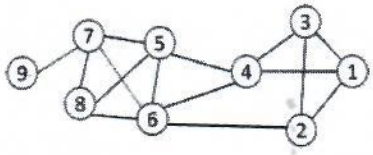

Fig.Q.4C

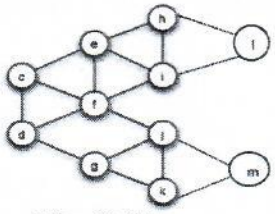

Fig. Q.5A

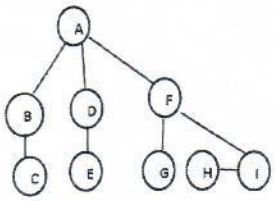

Fig. Q.5C 2

5A. Consider the network depicted in Fig.Q.5A. Assume each node starts with the behavior 'B', and each node has a threshold of q=2/5 for switching to behavior 'A'.
(i) The nodes, 'c' and 'd' form a two-node set S of initial adopters of behavior A. If other nodes follow the threshold rule for choosing behaviors, which nodes will eventually switch to 'A'? Explain.
(ii) Find a cluster of density greater than (1-q) in the part of the graph outside S that blocks behavior A from spreading to all nodes, starting from S, at threshold q. Give explanation for the answer. 5

5B. The web usage pattern is as given in the Table Q.5B. Find the communities by enumerating the bipartite sub graphs with support 2. Determine the possible number of communities based on the web usage pattern.

Table Q.5B

Users	Websites visited
U1	W1,W2,W3,W9
U2	W1,W6,W7
U3	W2,W5,W8
U4	W2,W5
U5	W1,W6
U6	W4

3

5C. Find the normalized degree centrality of the graph given in Fig.Q.5C 2