CROSS RIVER UNIVERSITY OF TECHNOLOGY, CALABAR
DEPARTMENT OF COMPUTER SCIENCE
SECOND SEMESTER EXAMINATIONS 2018/2019 SESSION

COURSE CODE: 4201
COURSE TITLE: QUEUING THEORY **TIME: 2HRS**
INSTRUCTION: ANSWER ANY FOUR QUESTIONS

QUESTION 1

a. **Figure 1** shows a queuing network system and their routing probabilities. The number besides each service centre is the service time for that service centre. Write the traffic equations for this queuing network.

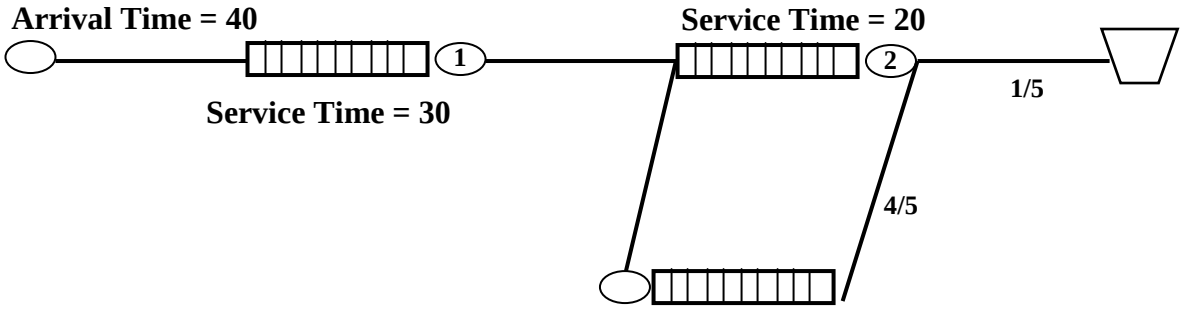

Figure 1

b. Explain what queuing theory means to you.
c. Differentiate between preemptive and non-preemptive priority scheme of the queuing discipline.

QUESTION 2

a. A Processor sends 20 disks I/O per second (which are exponentially distributed). Average disk service time is 40 microseconds.
1. On average, how utilized is the disk? 2. What is the average time spent in the queue? 3. What is the average response time for a disk request (including queuing time and disk service time?
b. Answer the following multiple choice questions:
i. Times between two successive requests arriving is called the: (a) Interarrival time (b) Arrival time (c) Poisson distribution (d) Average residual service time
ii. An I/O system with a single disk gets on average 50 I/O requests per second and average time for a disk to service an I/O request is 10ms, utilization of I/O system would be: (a) 0.2 (b) 0.5 (c) 0.75 (d) 1.5
iii. Area where tasks accumulate, waiting to be serviced is called: (a) Queue (b) Waiting line (c) DIMM (d) Both a and b

QUESTION 3

a. Show that the number of customers N in the queue at a time, t, given by:

$$\boldsymbol{N(t)} = \begin{bmatrix} t \\ 1 \\ \tau \end{bmatrix} - \left[\frac{1\ t--}{\frac{\tau}{1}} \right] = [\tau t] - \left[\mu t - \frac{\mu}{\tau} \right]$$ where t = throughput

b. In a queue, the throughput is 80secs. If customers arrive at the constants rate of 6secs and the service is at the constant rate of 4.5secs, find the numbers of customers on the queue.

c. When:
i. Does the queue length grow without bound?
ii. May the queue length be always zero,
iii. Will the queue length fluctuate between 0 and 1

QUESTION 4

Consider a single-server queue with infinite buffer space

a. Consider the situation
- The inter-arrival time is a constant and is given by 1 sec.
- The service time required by each customer is always 0.5 sec.

What is the mean waiting time per customer?

b. Consider the situation
- The inter-arrival time is exponentially distributed with mean 1 sec.
- The service time required by each customer is exponentially distributed with mean 0.5 sec.

What is the mean waiting time per customer?

c. Compare the answers of (a) and (b), what conclusions can you draw?

QUESTION 5

In an IT Consortium, jobs arrive at a printer on average rate of 20 per hour. The average service time by the printer on average is 2 seconds. Calculate the average number of jobs the printer needs to print in the system, the average number of jobs on the queue the printer will print, the average waiting time the job will have to wait in order to be served in the system, the average waiting time the job will have to wait in order to be served in the queue, the probability of zero jobs in the system and the percentage of the time the printer will be idle.

QUESTION 6

a. **Figure 2** is an Acyclic (feed forward) Network of M/M/m Queue showing the External arrivals jobs with τ_1 and τ_2 from Poisson process (probabilistic) routing with the routing probabilistic routing for all the queues in this Acyclic queue network. Find the individual state probability distribution for each of the queues shown the figure.

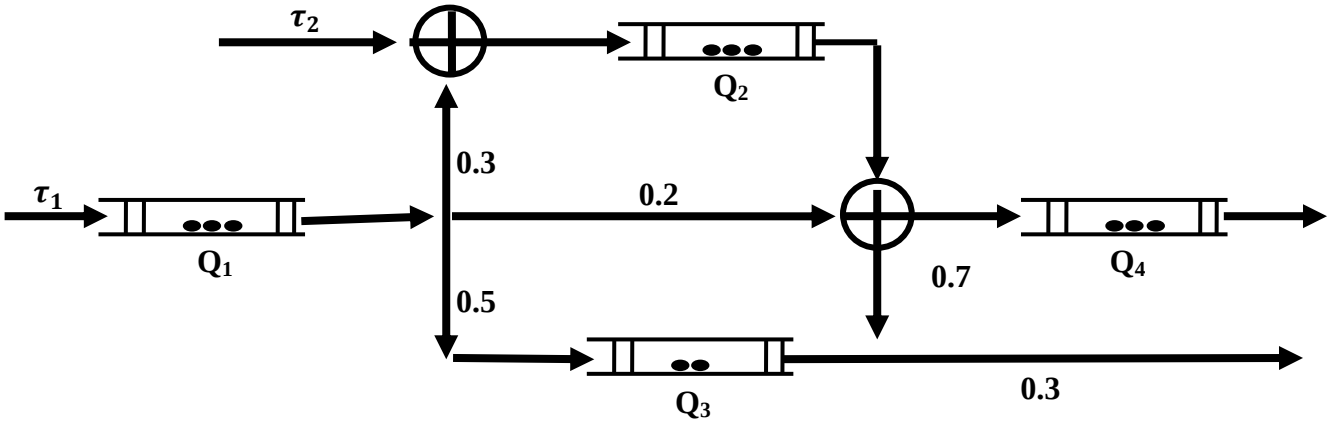

Figure 2: An Acyclic (Feed forward) Network of M/M/m Queues