- **READ THESE INSTRUCTIONS CAREFULLY.**
- Before you begin, **write your USC ID**.
- The exam is closed book and closed notes, all ELECTRONICS should be put away
- Answer the questions *only* in the spaces provided on the question sheets. If you run out of room for an answer, your answer is probably incorrect.
- Your answers do not need to be complete, grammatically correct sentences.
- For some multiple-choice questions, **more than one choice may be correct**. You will receive credit for partial answers.
- An incorrect answer to a multiple-choice question will result in a deduction of 50% of the points allotted to that question. So, for example, if a multiple-choice question worth 1 point has 2 correct answers and one of your answers is wrong, you will get 0.5 for the correct answer and -0.25 for the incorrect answer, resulting in a total of 0.25.

USC ID: _____

1. True or False, explain

   (a) (3 points) Media access protocols, such as token ring, eliminate collisions.

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   Solution: True (one point)
   (two points) Each sender waits for its turn to get the token, and sends only when it has a token. Hence there are no collisions.

   (b) (3 points) Forwarding is the process of building forwarding tables.

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   Solution: False (one point)
   (two points) Forwarding is the process of directing a data packet to an outgoing link or port
   (two points) Routing is the process of building forwarding tables

   (c) (3 points) The 802.3 Ethernet protocol is connectionless.

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   Solution: True (one point)
   (two points) There is no handshaking between the sending and receiving adapter

   (d) (3 points) Go Back N algorithms are ideal for wireless links

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   Solution: False (one point)
   (two points) only one or two packets would get errors due to bit corruptions.
   (or two points) selective repeat is a better strategy
   (or two points) Go back N is better for buffer overflows where several packets can be lost at once.

   (e) (3 points) The Link State protocol requires global information to compute routes.

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Solution: True (one point)
(two points) It needs to know the full network topology to compute routes

(f) (3 points) In a wireless environment, information about the status of the channel can be known simply by sensing the medium/carrier.

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Solution: False, (one point)
(two points) CSMA is hard in wireless as two nodes could be communicating leading to the hidden terminal and exposed terminal problems.

2. Fill in the blanks

(a) (2 points) The lack of _____ and _____ are necessary and sufficient for valid routing state in a network.

Solution: deadends and loops

(b) (2 points) The acronym CSMA expands to _____

Solution: Carrier sense multiple access

(c) (2 points) A _____ is used to combine two or more collision domains and it can automatically configure itself.

Solution: self learning switches

(d) (2 points) Virtual local area networks are used to create non-proximity based independent networks on the campus based on requirements such as

_____ and _____

Solution: security and load/bandwidth/delay.

3. Short Answers:

(a) (3 points) Name three metrics that can be used to compute the link costs for routing.

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Solution: length of link or propagation delay
bandwidth
load/congestion

(b) (3 points) Expand the acronym PoP. What is the goal of the PoPs at Facebook?

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Solution: PoP: Points of presence The goal of the PoP is too: bring content closer to the user add a layer of security between the user and the Facebook data centers. Users do not talk with the datacenter directly. (either one of the above reasons gets full points)

(c) (3 points) During the Facebook talk, Dr Sinha showed samples of fibre that they deploy across ocean floors. He specifically pointed out the copper sheeting around fiber optical cables. Explain two purposes of the copper sheeting.

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Solution: protection
the copper sheeting carries electricity to the repeaters to amplify the optical signal.

(d) (3 points) Explain briefly how CSMA works?

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Solution: CSMA: listen before transmit
If channel sensed idle: transmit entire frame
If channel sensed busy, defer transmission

(e) (2 points) What is the main difference between 802.3 and 802.11 protocol specification.

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Solution: 802.3: wired ethernet networks
802.11: wifi/ wireless networks

(f) (2 points) Why do collisions occur in CSMA?

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Solution: Because of nonzero propagation delay A sender could be sending a frame and another sender may not sense, due to propagation delay, and start sending too.

(g) (2 points) Consider a configuration where three wireless stations A, B, and C are positioned in a straight line and are equidistant from each other. Station A can hear B but not C. Station C can hear station B but not A and by symmetry, station B can hear both A and C. Illustrate below the hidden terminal problem.

Solution: A —B —-C
A is sending to B
C is the hidden terminal as it cannot hear A

4. (10 points) (a) (10 points) Please complete the following Dijkstra's Algorithm for Link State routing Assume the following notation:
   - D(v): total cost of the current least cost path from source to destination v
   - p(v): vs predecessor along path from source to v
   - S: set of nodes whose least cost path definitively known
   - c(i,j): link cost from node i to j; cost is infinite if not direct neighbors;

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Initialization:
  S = {A};
   for all nodes v
    if v adjacent to A
     then ..............................
    else ..............................

Loop
  find w not in S such that ..............................;
  add ........................
  update ................. for all v adjacent to w and not in S:
  if  ..........................................
   then ..........................................
until all nodes in S;
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Solution: Please refer to slides in Lecture 9

(b) (6 points) Can link state routing algorithms be used for inter-domain routing? Give the two reasons to support you claim.

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Solution: No they cannot be used (two points)

Reasons: scale large number of nodes, complexity of the algorithm is $O(N^2)$ or optimized to O(NlogN) (2 points)

security, inter-domain is across domain and LS requires knowing full topology. Different ASes do not want their topology to be known to others for competitive and security reasons. (2 points)

other answers: Flooding of message create lot of traffic. (2 points)

large region, hence convergence is a big problem (2 points)