The final exam consists of **six** questions (each worth 25 points).

You **must** answer the **three** Required Questions and any **three** of the Optional Questions. Put all your answers in blue books with your name on each book and indicate on the outside of the blue book which questions are in each book. If you answer more than three of the optional questions, you **must indicate the three you want to be graded.**

Three Required Questions [answer ALL three questions]

Congestion Control for High Bandwidth-Delay Product Networks

1a. Draw and briefly explain the role of the fields in the XCP congestion header.
b. Explain why and how XCP significantly outperforms TCP over RED and CSFQ.
c. Define the role of the Efficiency Controller and the Fairness Controller in XCP.

An Implementation and Experimental Study of the eXplicit Control Protocol (XCP)

1d. What weaknesses in XCP did this paper uncover?

Secure Routing in Wireless Sensor Networks: Attacks and Countermeasures

2a. Explain directed diffusion routing and minimum cost forwarding for a WSN.
b. Discuss in detail a Sybil attack and a Wormhole attack on WSN routing.
c. Describe possible countermeasures for these two attacks.
d. What is the different between a mote-class attack and laptop-class attack with respective to severity of a potential attack and the difficulty in finding appropriate countermeasures?

SCP-MAC: Ultra-Low Duty Cycle MAC with Scheduled Channel Polling

3a. Define duty cycle in WSNs.
b. Explain the SCP-MAC protocol and how it reduces the duty cycle.
c. Explain the concept of two-phase contention in SCP-MAC.
d. What are the important differences between CC2420 and CC1000 radios? How do these differences impact SCP-MAC implementation and performance?

Six Optional Questions [answer ANY three questions]

The War between Mice and Elephants

4a. What factors affect the performance of short TCP flows?
b. Explain the RIO-PS scheme that includes the differences in the role of the edge routers versus the role of core routers.
c. Compare the fairness of Drop tail, RED and RIO-PS queuing with respect to short flows.
d. Discuss the weaknesses of the paper in explaining and justifying the RIO-PS parameters chosen for the simulations presented.

An Analysis of the Skype Peer-to-Peer Internet Telephony Protocol

5a. Explain the difference between the Host Cache and the Buddy List in Skype.
b. Discuss the purpose of Bootstrap Supernodes. How does the Skype client find out about these nodes?
c. Explain the steps taken by the Skype protocol when a three-way conference is established.
d. Explain how media is transferred between users who are behind NATs.

A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols

6a. Explain the differences between Link State and Distance Vector routing.
b. Explain the TORA and DSR ad hoc routing protocols,
c. Define the following three metrics: packet delivery ratio, routing overhead and path optimality.
d. Use these metrics to discuss the performance differences between TORA and DSR demonstrated in the paper.

XORs in The Air: Practical Wireless Network Coding

7a. Define and explain the three main techniques incorporated in the COPE architecture.
b. Explain the pseudo broadcast and the acknowledgement technique used in COPE.
c. Explain the difference between coding gains and coding+MAC gains?
d. Why are hop-by-hop ACKs required in COPE?

Understanding and Mitigating the Impact of RF Interference on 802.11 Networks

8a. Draw a picture that shows all the fields in PLCP header with a long preamble and briefly explain the role of each field within the 802.11 MAC layer protocol.
b. Explain the basic strategy used by an attack that uses header processing interference.
c. Discuss the details of the rapid channel hopping scheme implemented in this paper.
d. Why can rapid channel hopping be effective? When will it be ineffective?

AS-MAC: An Asynchronous Scheduled MAC Protocol for Wireless Sensor Networks

9a. Explain the AS-MAC protocol.
b. Specifically, discuss the role of Hello packets in AS-MAC.
c. Discuss how/why AS-MAC outperforms SCP-MAC in terms of energy consumption.
d. Explain the techniques used to measure energy consumption in the physical AS-MAC experiments conducted.