Final Examination

Problem F.1: *internetworking*   (2+2+2+2+2=10 points)

Indicate which of the following statements are correct or incorrect by marking the appropriate boxes. For every correctly marked box, you will earn two points. For every incorrectly marked box, you will loose one point. Statements which are not marked or which are marked as true and false will be ignored. The minimum number of points you can achieve is zero.

true   false

☐   ☐   The IPv6 interface identifier of IPv6 addresses assigned to IEEE 802 interfaces must be constructed from MAC addresses using the EUI-64 algorithm.

☐   ☐   IPv6 uses Neighbor Discovery (ND) to map IPv6 addresses to IEEE 802 MAC addresses.

☐   ☐   IPv6 auto-configuration provides the same services as DHCP for IPv4.

☐   ☐   MTU path discovery is only needed in IPv4 networks.

☐   ☐   Transport protocols such as TCP and UDP compute the header checksum over a pseudo header to exclude fields that are modified by routers.

Problem F.2: *shortest path routing*   (15+2+3=20 points)

Consider the following network topology:
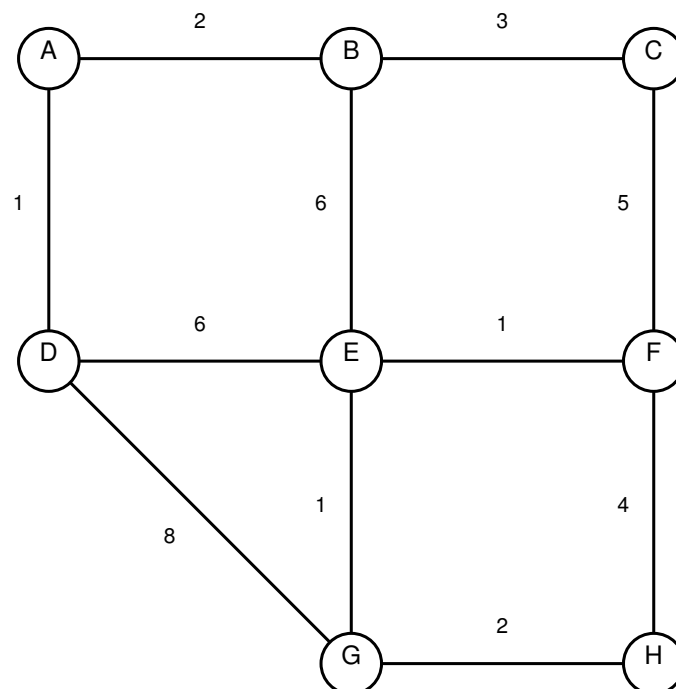
a) Determine the shortest-paths from node A to all destinations using Dijkstra's algorithm. For each step of the algorithm, fill in a row in a table structured as follows:

Step	A	B	C	D	E	F	G	H	Current	Permanent
0	0	∞	∞	∞	∞	∞	∞	∞		
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
...										

b) Which Internet routing protocol is based on Dijkstra's algorithm?

c) Explain the difference between interior and exterior routing protocols. Name interior and exterior routing protocols you are aware of.

Problem F.3: *domain name system* (5+2+3+5=15 points)

a) Explain briefly the purpose of `A`, `AAAA`, `SOA`, `CNAME` and `PTR` resource records.

b) What are recursive queries? Which information must be known by a DNS server to support recursive queries?

c) The DNS protocol can run over UDP and TCP. Explain why both transport protocols are useful. How does a DNS implementation select the transport protocol to use?

d) The `MX` resource record is used to locate email servers providing email services for a given DNS domain. What would be required to generalize the `MX` record so that arbitrary servers providing services in a DNS domain can be found?

Assume that a service is identified by a service name and a transport protocol name (to allow for services utilizing multiple transport protocols) and that you can introduce new resource records but not change the DNS protocol itself.

Problem F.4: *formal notations* (10+10+5=25 points)

Imagine an application protocol for managing rooms in a building. Every room is represented by a room record. Room records must contain a number used to identify the room and the type of the room (office, storage, lab, or other). A room can have an optional name (e.g. *Network Lab*) and an optional contact person (e.g. *J. Schoenwaelder*). Finally, every room record may list zero or more associated user names. All names are ASCII character strings which may include white space characters. Sample textual records might look as follows:

```
room {                                room {
  number = 87,                          number = 86,
  type = office,                        type = lab,
  user = "Juergen Schoenwaelder"        name = "Network Lab",
}                                       contact = "Juergen Schoenwaelder",
                                      }
```

You are welcome to derive from this specific format as long as the requirements spelled out above are satisfied.

a) Write suitable ABNF rules for the representation of room records in a textual format.

b) Write an ASN.1 module for the representation of room records.

c) What are the advantages/disadvantages of the two formalisms? Which one would you prefer for the project outlined above?

Problem F.5: *mail transfer and access protocols*   (5+5+5+5=20 points)

Answer the following questions related to the Internet electronic mail (email) system. Provide concise answers and write clearly.

a) The Internet email system consists of mail delivery agents (MDAs), mail user agents (MUAs), and mail transfer agents (MTAs). Suppose an IUB student is sending an email to another IUB student using the official IUB email addresses. In which sequence will MDAs, MTAs and MUAs be involved in the process? Which protocols play a role in the process?

b) Explain the difference between an envelop address and a header address.

c) Explain the main principle of base64 and quoted-printable encoding. Why are these encodings needed at all?

d) SMTP uses 3-digit structured reply codes and this concept has been carried over to many other application layer protocols. What is the benefit of using SMTP-like 3-digit structured reply codes?

Problem F.6: *remote procedure calls*   (2+2+2+2+2=10 points)

Indicate which of the following statements are correct or incorrect by marking the appropriate boxes. For every correctly marked box, you will earn two points. For every incorrectly marked box, you will loose one point. Statements which are not marked or which are marked as true and false will be ignored. The minimum number of points you can achieve is zero.

true   false

☐   ☐   RPC stub procedures are used to achieve transparency by hiding all communication details.

☐   ☐   At-most-once RPC semantics require that servers maintain state about recently executed RPC calls.

☐   ☐   The ONC RPC system uses a triple (P,V,F) to identify a procedure where P is a program name, V is a version number and F is the procedure name.

☐   ☐   RPC binding can be performed by registering a name identifying a server in the DNS name server.

☐   ☐   Marshalling is the process of transferring data structures used in RPCs from one address space to another and includes data serialization and data representation conversion.

Good luck and have a nice and relaxing christmas break!

/js

ABNF Core Definitions (RFC 2234)

```
ALPHA          =  %x41-5A / %x61-7A    ; A-Z / a-z

BIT            =  "0" / "1"

CHAR           =  %x01-7F
                        ; any 7-bit US-ASCII character,
                          excluding NUL

CR             =  %x0D
                        ; carriage return

CRLF           =  CR LF
                        ; Internet standard newline

CTL            =  %x00-1F / %x7F
                        ; controls

DIGIT          =  %x30-39
                        ; 0-9

DQUOTE         =  %x22
                        ; " (Double Quote)

HEXDIG         =  DIGIT / "A" / "B" / "C" / "D" / "E" / "F"

HTAB           =  %x09
                        ; horizontal tab

LF             =  %x0A
                        ; linefeed

LWSP           =  *(WSP / CRLF WSP)
                        ; linear white space (past newline)

OCTET          =  %x00-FF
                        ; 8 bits of data

SP             =  %x20
                        ; space

VCHAR          =  %x21-7E
                        ; visible (printing) characters

WSP            =  SP / HTAB
                        ; white space
```