Department of Computer Science and Engineering
Introduction to Internet (IT30037)
Class Test – 1

Date: 1-9-2017 Time: 8-9 am Marks: 20

1. Briefly discuss the principles involved in circuit switching and store-and-forward switching. (2M)

2. Name the layers that are present in OSI model, and not exist in TCP/IP model. (1M)

3. Computer A sends a message to computer D via LAN1, router R1 and LAN2 as shown in the figure. Show the contents of the packets and frames at network and data link layers for each hop interface. (2M)

4. For the given periodic square wave (shown in figure), plot the spectrum and mark the appropriate values to frequency components. (1M)

5. A telephone line has a bandwidth of 4 KHz. What is the maximum data rate supported by this telephone line, when the signal and noise amplitudes are 20 V and 2 mV, respectively. (2M)

6. What is the total delay (latency) for a frame of size 10 million bits that is being sent through a sequence of links connected through 5 routers each having a queuing and processing delays of 2 and 1 micro secs, respectively. The total length of the links is 5000 Km. The speech of the light inside the link is 2 Lakh Km/sec. The bandwidth of each link is 5 Mbps. Which component of total delay is dominant? Which one is negligible? (5M)

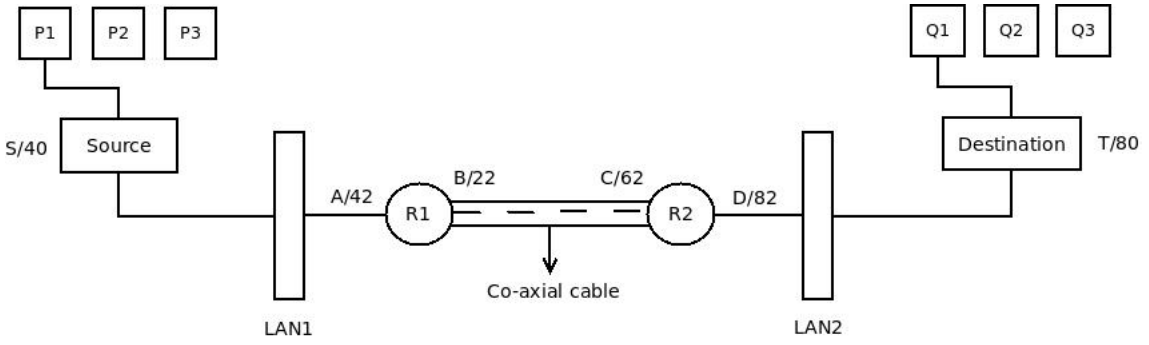
7. Discuss why the following issues are important in view digital transmission? In view of each coding scheme discussed in the class, comment on each of the issues mentioned below: (7M)
   (a) Baseline wandering
   (b) DC components
   (c) Self-synchronization
   (d) Built-in-error detection
   (e) Immunity to noise and interference
   (f) Complexity
   (g) Bandwidth (Signal Rate)

Indian Institute of Technology Kharagpur
Department of Computer Science and Engineering
IT 30037: Introduction to Internet

Date: 10-10-2017 (3-5 pm) Mid-sem examination Marks: 60 Time: 2 hrs

Note: All parts of the question (a,b,c,d) should be answered at a stretch.

1. The source and destination hosts are connected through LANs and routers as shown in the figure. An application from source host is sending a file of size 100 KB (kilo bytes) to an application at the destination host. Assume that the network has been configured with OSI reference model, and each layer introduces a delay of 1 ms. The routers are connected through a coaxial cable of length 2000 km. The signal speed inside the cable is about 2,00,000 km/sec and it supports the data rate of 1000 kbps. Determine the time required to reach the file from source application process to destination application process. Show the contents of messages, packets and frames at the transport, network and data link layers of each hop interface. **(10M)**



2. Suppose, the data sequence 100110 is transmitted using (i) NRZ-I, (ii) RZ, (iii) AMI, (iv) Manchester, (v) 2B1Q digital transmission schemes. Draw the signal waveforms for each of the transmission schemes mentioned above and comment on the transmission schemes w.r.t (i) DC component, (ii) synchronization, (iii) bandwidth, (iv) error detection and (v) complexity. **(10M)**

3. (a) The synchronous TDM system combines 10 voice channels. Each voice channel is sampled at 8 kHz and each sample is encoded with 5 bits. Each output slot carries 10 bits from each digital source, one extra bit is added to each frame for synchronization.
   i. What is the size of the output frame in bits?
   ii. What is the output frame rate?
   iii. What is output data rate?
   iv. What is the effective utilization (in %) of the channel?

(b) With suitable diagrams, explain the principle of frequency hopped spread spectrum, and how it is used for multiplexing various sources of information. **(6+4=10M)**

4. (a) The following code vectors (1001011, 0101101 and 0011110) are generated from a (7,3) parity check code. Assume the pattern of the code vector is ($C_i = m_2m_1m_0p_3p_2p_1p_0$). Find the rule for generating each of the parity checks. Determine all valid code vectors. What is the minimum distance of this code? What is the error detection and correction capability of this code? When the errors will be missed out, and illustrate the same by taking the example code vectors from the above coding scheme.

   (b) Briefly discuss the principle of ADSL. How the bandwidth is shared between voice and data transmission? With appropriate diagrams show how voice and data transmission will takes place simultaneously. **(7+3=10M)**

5. Mention TRUE or FALSE for statements givenbelow:

   (a) The network layer in OSI model consisting of only two peer processes.

   (b) A square wave contains all odd harmonics of its fundamental frequencies.

   (c) Digital transmission requires band-pass channel for its data transmission.

   (d) For better utilization of resources baud/signal rate should be less than the data rate.

   (e) Time division multiplexing is involved in transmission of AM and FM radio transmissions.

   (f) Graded index fiber offers higher distortion compared to step index fiber.

   (g) LEDs are used as optical sources in case of single mode fibers.

   (h) Sky propagation is used in case of satellite transmission.

   (i) Radio waves are unidirectional, where as microwaves are omnidirectional.

   (j) In optical fiber core has lesser refractive index than cladding. **(5M)**

6. (a) Determine the number of physical links required for 100 nodes to be connected in mesh and star topologies.**(2M)**

   (b) What is the role of Reverse Address Resolution Protocol (RARP) ? **(1M)**

   (c) Determine the SNR required for transmission of 150 Kbps through a channel of 5 KHz bandwidth. **(2M)**

   (d) The number of invalid code vectors in 8B/10B coding scheme is ———- **(1M)**

   (e) What is the role of scrambling in digital transmission? **(1M)**

   (f) Draw the signal waveforms for the data sequence 10110 in case of BASK, BFSK and BPSK. **(3M)**

   (g) The bandwidth of QPSK is ———— times that of the bandwidth of BPSK and the data rate supported by QPSK is ————- times that of BPSK. **(1M)**

   (h) Why the wires in twisted-pair are twisted? **(1M)**

   (i) Name the devices used for multiplex/de-multiplex the optical signals in WDM. **(1M)**

   (j) What is error detection, burst error detection and error correction capability for (i) single and (ii) horizontal and vertical (2-dimensional) parity check codes? **(2M)**

Department of Computer Science and Engineering
Introduction to Internet (IT30037)
Class Test – 2

Date: 3-11-2017 Time: 8-9 am Marks: 20

1. **(5M+2M)**

   (a) If each packet carries 1000 bits of data, how long does it take to send 1 million (1,000,000) bits of data using (i) stop and wait ARQ, (ii) go-back-n ARQ and (iii) selective repeat ARQ. Assume that all three ARQs are using 3 bits for representing sequence numbers. The distance between sender and receiver is 5000 Km and the propagation speed is 2×10^8 m. Ignore transmission, waiting and processing delays. Assume no data or control frame is lost or damaged.

   (b) For the above problem, to achieve the minimum delay for the transmission of 1 million bits using (i) go-back-n ARQ and (ii) selective repeat ARQ, what will be the optimal size of sender and receiver windows and what will be the optimal number of bits required for go-back-n and selective repeat ARQs to incorporate sequence (SN) and request (RN) numbers.

2. What is meant by bit-stuffing in the context of framing at DLC layer. For the given data (N/W layer packet + header + trailer), prepare the frame, mark the flags (frame boundaries) and mark the locations where bit-stuffing has been incorporated.
   Data: 0 0 0 1 1 1 1 1 1 1 0 0 1 1 1 1 1 0 1 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1 1 1 **(3M)**

3. One thousand stations on a pure ALOHA network share a 10-Mbps channel. If frames are 2000 bits long and each station is sending 5 frames per second (assume frame arrivals follow Poisson distribution). Find the (i) frame transmission time, (ii) average number of frames transmitted over a frame transmission time (iii) probability of no traffic (zero frames) during vulnerable period and (iv) throughput. **(4M)**

4. With neat diagrams clearly explain the problems encountered in wireless LANs by using simple CSMA protocols for channel allocation. Discuss how those problems are alleviated by using CSMA/CA protocol. Consider the scenario (placement of stations in the figure) such a way that at least one station experiences each problem independently and one station experiences all problems. **(6M)**

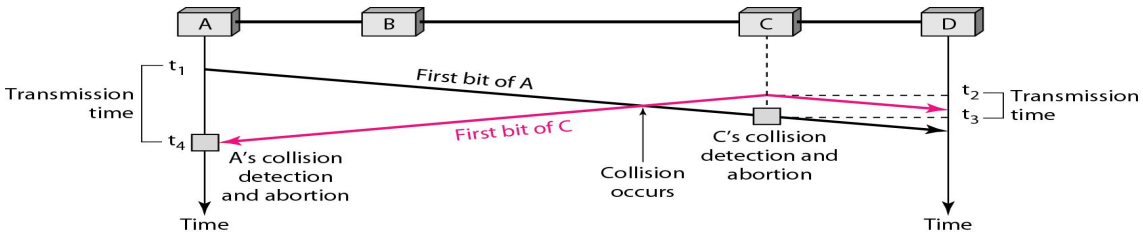
Indian Institute of Technology, Kharagpur
End-Autumn Semester 2017-18

Date of Examination: 22-11-2017 Session: FN (9-12 am) Duration: 3 hrs
Subject No.: IT30037 Subject: INTRODUCTION TO INTERNET
Department/Center/School: Computer Science and Engineering
Specific charts, graph paper, log book etc., required: NO Total Marks : 50
Special instructions (if any): ANSWER ANY FIVE (5) QUESTIONS.
Note: All parts of the question (a,b,c,d) should be answered at a stretch.

1. (a) Frames of 1000 bits are sent over a 100 Kbps channel between 2 nodes, where the propagation time from one node to other node is 250 ms. Assume that headers are short and acknowledgements are sent soon after receiving the frame. What is the maximum achievable channel utilization using stop-and-wait, Go-back-N and selective-repeat protocols with 5-bit sequence numbers? For achieving 100% channel utilization, what will be the size of sequence numbers in case of Go-back-N and selective-repeat protocols. **(5 + 5 = 10M)**

   (b) In below figure, the data rate is 10 Mbps, the distance between station A and C is 2500 meters, and the propagation speed is 2×10^8 meters/sec. Station A starts sending a long frame at time $t_1 = 0$; station C starts sending a long frame at time $t_2 = 3$ micro sec. The size of the frame is long enough to guarantee the detection of collission by both stations. Find

   i. The distance between collission point and station A.
   ii. The distance between collission point and station C.
   iii. The time when staion C hears the colission after the start of its transmission (t_3).
   iv. The time when staion A hears the colission after the start of its transmission (t_4).
   v. The number of bits station A has sent before detecting the collission.
   vi. The number of bits station C has sent before detecting the collission.



2. (a) Name the various connecting devices that we encounter in Internet. For each device, clearly specify in which layer it operates and its functionality. **(3 + 3 + 4 = 10M)**

   (b) Sixteen stations numbered 17-32, are contending for the use of a shared channel by using Tree-splitting algorithm. If all the stations whose addresses are prime numbers suddenly become ready at once, how many slots are needed to resolve the contention? Indicate the result (which station is successfully transmitted or which have received collision) of each of the slots in sequence (i.e., 1,2,3, .). Also draw the tree diagram.

(c) Assume the stations A, B, C, D, E and F use CSMA for their data transmission in wireless LAN. The position and the range of each station are shown below. List the hidden and exposed stations for the following transmissions: (i) F → A, (ii) A → B, (iii) B → C, and (iv) C → D.

F A B C D

E

Transmitting Station	Range of Transmission (Stations receive the transmission)
F	A
A	F, B
B	A, C, E
E	B, C
C	B, E, D
D	C

3. (a) For eah of the following IP addresses (i) determine the class, (ii) address range of the class in dotted decimal notation, (iii) network mask (iv) indicate the network and host ids in dotted decimal form. **(4 + 1 + 5 = 10M)**
(1) 11000110001011010100100011100111,
(2) 11100011010100110011100000101010,
(3) 10111000010000100101110010000101 and
(4) 11011111101001111100000000010111.

   (b) Derive the complete IPv6 address from the following abbreviated form: C::B0F:0:FF

   (c) A large number of consecutive IP addresses are available starting at 54.128.128.0. Suppose that five organizations, A, B, C, D and E, request 1000, 3000, 500, 16000 and 8000 addresses, respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation.

4. (a) Assume that a packet with 2000 byte data (packet id: 10) has to pass through two networks whose MTUs are 600 (1st network) and 400 (2nd network) bytes respectively, to reach destination. Specify the IP fields related to fragmentation for the packet/fragments (i) at the source, (ii) while passing through the network whose MTU is 600 (iii) while passing through the network whose MTU is 400 and (iv) at the destination. How the destination IP combine these fragments and regenerate the original packet? **(5 + 3 + 1 + 1 = 10M)**

   (b) With neat IPv6 datagram figure provide all control fields in the header, and explain the functionality of each field.

   (c) Name the various extension headers supported by IPv6.

   (d) Mention the strategies for transition from IPv4 to IPv6.

5. (a) Give the format of ARP packet and list the sequence of steps used by ARP to carry out its service. **(2 + 2 + 4 + 2 = 10M)**

(b) Briefly discuss how DHCP provides logical address for the given host. What are the distinct variations between BOOTP and DHCP.

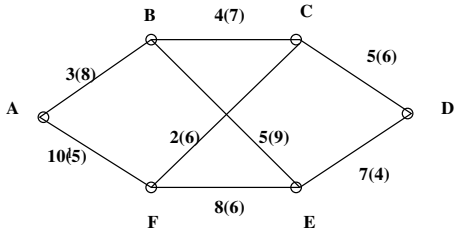
(c) What is the role of ICMP in Network layer? Mention various error reporting messages generated by ICMP and briefly discuss about each of them. Indicate the format (contents) of ICMP packet in case of error reporting.

(d) Discuss how the trace-route application use ICMP services (with appropriate figure) for determining the route to the destination host.

6. (a) Show the forwarding process of the following packets at the router R1 with the following destination addresses: (a) 112.59.163.200 (b) 112.59.198.49 (c) 155.79.128.197 and (d) 155.74.234.45 **(4 + 4 + 2 = 10M)**

Router Table of R1			
Mask	Network Address	Next Hop	Interface
255.255.192.0	112.59.192.0	——-	m0
255.255.0.0	112.59.128.0	———	m1
255.254.0.0	155.72.0.0	———	m2
255.248.0.0	155.76.0.0	———	m3
Any	Any	189.72.146.55	m1

(b) Consider the subnet shown in figure. The link delays at time t1 are marked on the figure (outside the brackets). The link delays at time t2 (t2 > t1) are marked on the figure (within the brackets). Using distance vector routing determine the following: (i) Delay vectors sent to Node C by the neighbouring nodes at time t1 (ii) Node C's routing table at time t1 (iii) Delay vectors sent to Node C by the neighbouring nodes at time t2 (iv) Node C's routing table at time t2.



(c) Discuss the broad steps involved in Link-State routing approach. Provide the format of a link-state packet generated by node (router) E of the above subnet shown in figure.

7. (a) What are socket addresses? **(1 + 1 + 1 + 1 + 6 = 10M)**

(b) What are the differences in well-known vs registered vs dynamic port addresses?

(c) Specify the control fields present in UDP.

(d) Mention the specific applications that exclusively use UDP.

(e) With appropriate figure mark all control fields correspond to TCP header. Discuss the use of each control field. Explain clearly (with appropriate sketches) how TCP provide (i) virtual connection establishment, (ii) data transmission through connection, (iii) releasing connection and (iv) flow control