L-3/T-2/CSE Date : 09/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 301** (Mathematical Analysis for Computer Science)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Deduce the recurrence relation satisfied by the ultimate survivor J(n). Compute J(54321). **(15)**

   (b) Deduce the formula for maximum number of regions created by n zigs. **(10)**

   (c) Solve the recurrence relation for minimum number of moves required by Tower of Hanoi problem. **(10)**

2. (a) Calculate $\sum_{0\le k<m} k.2^k$ using the method of finite calculus. **(15)**

   (b) Find multiplicity of 96 in 1000! **(10)**

   (c) Give a combinatorial argument to the identity $\sum_{0\le k<m}\binom{k}{r}=\binom{m+1}{r+1}$ for integer $r, n \ge 0$. **(10)**

3. (a) Use inversion formula to calculate number of derangements $n!$ **(15)**

   (b) Prove that $\sum_{k\le n}\binom{n+r}{k}x^k y^{n-k}=\sum_{k\le n}\binom{-r}{k}(-k)^k(x+y)^{n-k}$, where n is an integer. **(10)**

   (c) Deduce and prove recurrence relations satisfied by the stirling numbers of the 1st and 2nd kinds. **(10)**

4. (a) Establish the number of time units required by the worm to reach the other end of the superelastic rubber band. **(15)**

   (b) Establish recurrences satisfied by the Euler number. **(10)**

   (c) Let P_n, N_n, D_n, Q_n and C_n be the number of ways to pay n cents using coins worth at most 1, 5, 10, 25 and 50 cents, respectively. Deduce recurrence relations for these expressions. **(10)**

19

~~18~~

Contd P/2

CSE 301

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

In all cases, use correct symbols and notations.

5. (a) Show that for all random variables X and Y, $E[x] = E[E[X \mid Y]]$. Assume that X and Y are discrete. **(10)**

(b) For a Geometric random variable X with success probability p, show that $P\{X > i\} = (1-p)^i$. **(10)**

(c) (**Best Prize Problem**) Suppose that we are to be presented with n distinct prizes in sequence. After being presented with a prize, we must immediately decide whether to accept it or reject it and consider the next prize. The only information we are given when deciding whether to accept a prize is the relative rank of that prize compared to ones already seen. Let a strategy reject the first l prizes and then accepts the first one that is better than all of those first l. Let $P_l(best)$ denote the probability that the best prize is selected when this strategy is applied. Compute $P_l(best)$. **(15)**

6. (a) Let X be a random variable with probability density **(15)**

$$f(x) = \begin{cases} c(1-x^2), & -1 < x < 1 \\ 0, & otherwise \end{cases}$$

(i) What is the value of c?

(ii) Compute $Vat(X)$.

(b) A dice with six faces got some problem with the paint that has been used to inscribe the dots on its faces. In particular, due to defective material the face containing more dots got heavier and the corresponding face rolls up more likely. To be specific, probability of rolling up face i is proportional to i. If so, compute the following— **(10)**

(i) The probability that face 1 rolls up at least once in three successive rolls.

(ii) The expected number of rolls required to get a six.

(c) What is meant by "conditioning" in computing probability of events? In reference to Question 6(b), suppose two friends, Kamal and Jamal, are playing a game where they both roll the mentioned biased dice. If both the dice roll up the same face, Kamal wins; otherwise Jamal wins. By conditioning, deduce who has the higher chances of winning. **(10)**

7. (a) (**Gambler's Ruin**) Consider a gambler who at each play of the game has probability p of winning one unit and probability $q = 1 - p$ of losing one unit. Assuming that successive plays of the game are independent, what is the probability that, starting with n units, the gambler's fortune will reach N before reaching 0? Show that if $p \leq \frac{1}{2}$, the gambler will, with probability 1, go broke against an infinitely rich adversary. **(15)**

Contd P/3

(b) In sociology, the transitions among various social classes, namely upper, middle and lower, are modeled as a Markov chain assuming that the occupation of a child depends only on its parent's occupation. Let these classes be 0, 1 and 2 respectively. Hence, a state transition probability matrix can be given as follows: **(7+8+5=20)**

$$P = \begin{Vmatrix} 0.45 & 0.48 & 0.07 \\ 0.05 & 0.70 & 0.25 \\ 0.01 & 0.50 & 0.49 \end{Vmatrix}$$

For instance, the underlined value (0.05) denotes the probability that a child of middle class parent takes an upper class occupation. Now, answer the following—

(i) Given that 25 and 65 out of 100 people live in lower and middle class respectively in this generation, how many of them would remain so in the following generation?

(ii) In the long run, what fraction of people belongs to lower class?

(iii) At what rates, people move out of their middle class status (move to upper or lower)?

8. (a) Define Poisson counting process. Suppose you are waiting for a ride in a street. Buses fly at a Poisson rate of 2 per hour whereas taxis show up at a Poisson rate of 5 per hour. Assuming that you catch the first vehicle you get, what is the expected amount of time you need to wait to avail a ride? Suppose you already waited for 20 minutes without any luck. What is the probability that you manage some ride in next 5 minutes? **(15)**

(b) A building has two switches that independently remain either ON or OFF during a day at a *variable* length, both following an exponential distribution with mean $1/\lambda$ (ON) and $1/\mu$ (OFF) respectively. Argue that the scenario can be modeled as a continuous-time Markov chain. Hence, construct a Markov chain with states 0, 1, and 2 where the state denotes the number of switches that are ON in any particular time. Also, compute what fraction of time, in the long run, at least one switch is ON. **(20)**

L-3/T-2/CSE Date : 12/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 313** (Operating System)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Draw the block diagram of the Unix System Kernel. Briefly list all the major subsystems. **(10)**

   (b) Why is buffer cache used in Unix System? What are the benefits of using it? **(7)**

   (c) Explain a scenario where race for free buffer (cache) may occur. What can be a possible solution of such a race condition? **(10)**

   (d) How are the buffers marked as "delayed write" processed while allocating a buffer in the Unix Kernel? **(8)**

2. (a) Explain three scenarios while allocating a buffer (using getblk algorithm) when the buffer cache of free buffers is non-empty. **(12)**

   (b) Give one example of file access times when a file's content has not been changed recently but its permission bits have been changed. **(6)**

   (c) What additional information are used in in-core inodes compared to disk inodes? Why do we need them in in-core inodes? **(7)**

   (d) Considering the Unix System V inode structure, locate the 4,00,000th byte offset in a file. Assume block numbers to explain your answer. **(10)**

3. (a) Write down an algorithm that converts path name to inode. **(10)**

   (b) Draw and explain Unix data structures used to maintain the linked list of free disk blocks. **(10)**

   (c) What is the role of remembered inode in freeing inodes? Give examples to explain your response. **(7)**

   (d) Draw the process state transition diagram for Unix system. **(8)**

4. (a) What happens when the Kernel wakes up a sleeping process? Explain in brief. **(10)**

   (b) Write down an algorithm for duplication of a region. When does such duplication happen in a system? **(10)**

   (c) What happens when open file call is invoked? Explain with respect to file data structures. **(8)**

   (d) Which region's size can be changed using a system call (eg., growreg)? Which cannot be changed? Give examples and justify your answer. **(7)**

Contd P/2

CSE 313

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Suppose you are using paging technique for implementing virtual memory. You have decided to keep the entire page table for each process in main memory. As a result an extra memory lookup is needed for each virtual address generated by the CPU to access the page table. Explain with necessary figures how you can speed up paging. **(13)**

(b) What is inverted page table? Why is it needed? How can you make the search in inverted page table efficient? Give necessary figures. **(5+2+5=12)**

(c) In the aging algorithm, for page replacement, 8 bits are used for maintaining the counter corresponding to each page. Initially all the counters are set to zero. Let there are six page frames in the physical memory numbered from 0 to 5. After the first clock tick the R bits for pages 0 to 5 have the values 101011 (page 0 is 1, page 1 is 0, page 2 is 1, etc.). At subsequent clock ticks the R bit values are 110010, 110101, and 100010. Give the values of the counters after each tick. Which page will be replaced if a replacement is required after the last tick? **(8+2=10)**

6. (a) Define resource deadlock? What are the conditions that must be present for a resource deadlock to occur? **(2+6=8)**

(b) Discuss various ways of recovering from deadlock. **(8)**

(c) Define safe state. What is the difference between unsafe state and deadlock? **(2+2=4)**

(d) Discuss with an example how you can avoid the circular wait condition. **(7)**

(e) A system has four processes and five allocatable resources. The current allocation and maximum needs are as follows: **(8)**

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 3	0 0 x 1 1
Process B	2 0 1 1 0	2 2 2 1 0	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 0	1 1 2 2 1	

Find the smallest value of x for which this is a safe sate.

7. (a) "For real time systems having the right answer but having it too late is often just as bad as not having it all all"— Do you agree with this statement? Justify your position. **(5)**

CSE 313

Contd... Q. No. 7

(b) Write short notes on the following topics **(5+5=10)**

(i) Lottery scheduling

(ii) Convoy effect

(c) Discuss the difference between compute-bound and I/O bound process with figures. **(5)**

(d) Consider the following workload: **(5×3=15)**

Process	Priority (Lowest number has the highest priority	Burst Time (sec)	Arrival Time (sec)
P1	4	40	50
P2	3	70	10
P3	1	50	0
P4	5	100	0
P5	2	50	70

Draw the time scale diagram and calculate the average turnaround for the following scheduling algorithms:

(i) Shortest Job First

(ii) Shortest Remaining Time Next

(iii) Round Robin with quantum 30 sec

8. (a) Which of the following are "per process item", which are "per thread item", and which are neither? **(8)**

Program Counter, Stack, Address Space, Global Variables, Registers, Open Files, Signals, Local Variables

(b) Explain with figures how you can dynamically allocate disk spaces for storing paging in the swap area. **(8)**

(c) Draw the models of main memory presented to the programmer by paging scheme and segmentation scheme. **(2.5+2.5=5)**

(d) Write short notes on the following topics **(5+5=10)**

(i) Semaphore

(ii) Monitor

(e) Explain the use of barriers with necessary figures. **(4)**

L-3/T-2/CSE **Date : 19/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 315** (Microprocessors and Microcontrollers)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain what determines whether a microprocessor is a 16-bit or 32-bit device. **(5)**
   (b) Draw the internal architecture of 8086 and describe all the registers of 8086. **(5+15=20)**
   (c) What are the minimum and maximum modes of operation of a 8086 microprocessor? How can they be selected? **(5)**
   (d) Describe the advantage of queue in 8086 architecture. **(5)**

2. (a) How much physical and virtual memory can 80286 address? Explain how 80286 addresses them. **(5)**
   (b) Discuss the protected mode memory addressing scheme of 80286. **(15)**
   (c) Discuss 80286 protection mechanism. **(15)**

3. (a) Discuss 80386 descriptors. What are the differences they have from 80286 descriptors? **(15)**
   (b) Discuss 80386 virtual mode of operation. **(8)**
   (c) Discuss 80386 paging unit and paging scheme. **(12)**

4. (a) Narrate how 8086 finds the interrupt service routine (ISR) address for an interrupt. **(10)**
   (b) What are the different types of interrupts available in 8086? Briefly describe the interrupts of 8086 pre-defined by INTEL. **(13)**
   (c) Compare the features of 80386 with those of 80286 from the point of view of internal registers. **(12)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Suppose you are to design an automated fire control system for a highly sophisticated room. To detect the fire, a pair of sensors (a smoke(S) sensor and a temperature (T) sensor) are used. The sensors work in this way: the S sensor provides 0 volt if there is not smoke in the room when it detects smoke, it jumps to 5 volt. The T sensor provides analog voltage in the range of 0 to 5 volt in proportional to the temperature between 0^oC to 100^oC.To be sure that the smoke is indeed caused by the fire you have to check the temperature of the room. So, the system continuously listens

Contd P/2

CSE 315

Contd... Q. No. 5(a)

to the S sensor and collects the temperature from the T sensor only after detection of smoke in the room. If the temperature of the room is found to be greater than 60°C after detection of smoke, the system will initiate and alarm to buzz. There will be a switch to stop the alarm. If the alarm is not switched off within one minute of the initiation of buzz, the system will send a start signal to the automated fire fighting system, which is connected to the fire control system. **(8)**

Now, draw the block diagram with appropriate connections of the system along with pin names. You cannot use polling approach to collect data from any of the sensors.

(b) Write necessary steps to program for an external interrupt using ATmega 16. Configure necessary registers to handle INT0. **(10)**

(c) Write short notes on: **(10)**

(i) Interrupt Vector

(ii) Interrupt Service Routine

(d) Briefly explain ADC features of ATmega 16. **(7)**

6. (a) Draw the internal block diagram of 8087 math-coprocessor. **(12)**

(b) Draw the timing diagram for the nonpipelined read cycle of the Pentium processor. **(8)**

(c) Explain the configuration of 8255 if hex 75 is sent to 8255 as a control word. **(5)**

(d) Show the circuit connections between 8255 and 8086 microprocessor, where port addresses of 8255 are: 0580H (PORT-A), 0582H (PORT-B), 0588H (PORT-C), and 058AH (Control Register). Here 8086's address bus is 20 bit and data bus is 16 bit. You need to show the connection of 8255's following pins in your diagram: $\overline{CS}$, $\overline{RD}$, $\overline{WR}$, $\overline{RESET}$, A1, A0, and Data bus. **(10)**

7. (a) What is Paging? What is the difference between paging and Segmentation? **(3+4=7)**

(b) Explain different types of segmentation of Pentium processor with appropriate figure. **(12)**

(c) Write short notes on: **(12)**

(i) Inquire Cycle

(ii) Virtual 8086 Mode

(iii) NMI

(d) Write four applications where micro-controllers are used. **(4)**

8. (a) Explain Real mode and Protected mode architectures of a Pentium processor. **(8)**

(b) Explain the transition of a logical address into a physical address in protected mode of Pentium while paging is enabled. **(20)**

(c) Configure the value of necessary registers for USART communication using ATmega 16 for baud rate of 4800 bps. Assume system clock is configured as 1 MHz. **(7)**

S Rahman 26.05.14

L-3/T-2/CSE **Date : 26/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 317** (Numerical Methods)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Find a positive root of the equation $xe^x = 1$, which lies between 0 and 1. Use the bisection method. Carry out the computation until the approximate relative error is less than 5%. **(12)**

(b) Demonstrate that the approximate relative error is always greater than the true relative error for the bisection method, but not for the false-position method with the help of an illustrative example. **(10)**

(c) Derive the Newton-Raphson formula for finding the roots of equations. Find a root of the equation $x \sin x + \cos x = 0$ using the Newton-Raphson method. Carry out the computation for three iterations, and use four significant figures in your computation. **(13)**

2. (a) What is the rate of convergence of the simple fixed-point iteration method? Provide graphical depiction of convergence and divergence of the simple fixed-point iteration method of finding roots of equations. **(10)**

(b) Explain the difference between the secant method and the false-position method with an illustrative example. Use the secant method to estimate the root of the equation $x^3 - 2x - 5 = 0$. Let the two initial approximations be given by $x_{-1} = 2$ and $x_0 = 3$. Carry out the computation for two iterations. Use three significant figures in your computation. **(12)**

(c) What is the modified secant method? Use the modified secant method to estimate the root of the equation given in 2(b). Use a value of 0.01 for a perturbation fraction. Carry out the computation for two iterations. Use three significant figures in your computation. **(8)**

(d) What is the rate of convergence of the Newton-Raphson method, and the secant method? Which one is faster? **(5)**

Contd P/2

CSE 317

3. (a) Solve the given linear programming problem using the simplex method. **(13)**

maximize $2x_1 + 4x_2 + 3x_3 + 4$

subject to

$$\begin{aligned} 3x_1 + x_2 + x_3 + 4x_4 &\le 12 \\ x_1 - 3x_2 + 3x_3 + 3x_4 &\le 7 \\ 2x_1 + x_2 + 3x_3 - x_4 &\le 10 \\ x_1 \ge 0, x_2 \ge 0, x_3 \ge 0, x_4 &\ge 0 \end{aligned}$$

(b) Solve the given system of linear equations using the Gauss-Seidel method. Carry out three iterations and use three decimal places in your computation. **(12)**

$$\begin{aligned} 10x_1 - 2x_2 - x_3 - x_4 &= 3 \\ -2x_1 + 10x_2 - x_3 - x_4 &= 15 \\ -x_1 - x_2 + 10x_3 - 2x_4 &= 27 \\ -x_1 - x_2 - 2x_3 + 10x_4 &= -9 \end{aligned}$$

(c) What is a diagonally dominant system of linear equations? Is the system of equations given in 3(b) diagonally dominant? How can you improve the convergence of Gauss-Seidel method using relaxation? **(10)**

4. (a) For the given symmetric matrix, find the Cholesky factor matrix. **(10)**

$$\begin{bmatrix} 1.56 & 3.06 & 4.86 \\ 3.06 & 48.91 & 17.72 \\ 4.86 & 17.72 & 26.99 \end{bmatrix}$$

(b) Explain the pivoting strategy, and the effect of scaling on pivoting for solving a system of linear equations with an illustrative example. What is an ill-conditioned system of linear equations? **(11)**

(c) What are the steps of LU decomposition technique of solving linear equations? Solve the following system of equations using LU decomposition with partial pivoting. **(14)**

$$\begin{aligned} 2x_1 + 3x_2 + x_3 &= 9 \\ x_1 + 2x_2 + 3x_3 &= 6 \\ 3x_1 + x_2 + 2x_3 &= 8 \end{aligned}$$

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is the general form of Newton's interpolating polynomial? How can you estimate the error for linear and quadratic interpolation using Newton's interpolating polynomial? **(4+6=10)**

Contd P/3

CSE 317

(b) Derive Newton-Gregory forward formula for interpolation with equally-spaced data. **(10)**

(c) For the given data, fit a Lagrange interpolating polynomial of order four. Use it to estimate the value of the function at $x = 0.65$. **(15)**

x	-1	-0.5	0	0.5	1
$f(x)$	9	0.625	-5	0	-5

6. (a) Distinguish between regression, interpolation and extrapolation with an illustrating example. What is a knot for spline interpolation? **(6+2=8)**

(b) Fit quadratic splines for the given data, and use the results to estimate the value at $x = 5$. **(12)**

x	3.0	4.5	7.0	9.0
$f(x)$	2.5	1.0	2.5	0.5

(c) Use Euler's method to numerically integrate $f(x) = -12x^2 + 4x + 5$ from $x = 0$ to $x = 2$ with a step size of 0.5. The initial condition at $x = 0$ is $y = 5$. Compute the local error and global error for each step. **(15)**

7. (a) Evaluate the following integral correct to three decimal places using the Simpson's $^1/_3$ rule, and the Simpson's $^3/_8$ rule. Also, compute the percent relative error based on the true value. Assume the exact value of the integral is $\log_e 2$. **(10)**

$$I = \int_0^1 \left(\frac{1}{1+x}\right) dx$$

(b) Evaluate the following integral using multi-application trapezoidal rule for two different step sizes, $h = 0.4$ and $h = 0.2$. **(14)**

$$I = \int_0^{0.8} \left(-4x^2 + 3x - 5x + 7\right) dx$$

What is the percent relative error based on the true value for both cases? What is the approximate error term for the multi-application trapezoidal rule? Find out the approximate error in both cases.

(c) Compute a better estimate using the obtained estimates in question 7(b) using Richardson's extrapolation formula. Also, compute the true percent relative error for this third estimate. **(6)**

(d) Distinguish between binding and nonbinding constraints for constrained optimization problems using an illustrative example. **(5)**

Contd P/4

CSE 317

8. (a) Derive the finite divided difference approximation formula for evaluation of the second derivative for forward and backward cases from the Taylor series. How many data points are needed to evaluate third derivative for each of the forward, backward and centered approximation formulas? **(10)**

(b) How can you improve the accuracy of numerical evaluation of derivatives? Derive the high-accuracy formula for the backward approximation of the first derivative. What is the order of the approximation error term of this derived formula? **(11)**

(c) Compute an estimation of the first derivative of $f(x) = -0.1x^4 - 0.25x^3 - 0.5x^2 - 0.15x + 0.9$ at $x = 0.5$ using finite divided difference approximation formula for the forward, backward and centered cases. Use a step size of $h = 0.25$. What is the true percent relative error for each case? Also, compute an estimation of the first derivative using high-accuracy formulas for the forward, backward and centered cases. Find out the true percent relative error for each case. **(14)**

L-3/T-2/CSE **Date : 02/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 321** (Computer Networks)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What are the benefits of Mobile IP over traditional IP system? Briefly describe the following terms in relation to Mobile IP: **($10\frac{2}{3}$)**

   (i) Mobile Node (MN)
   (ii) Home Address (HoA)
   (iii) Care of Address (CoA)
   (iv) Correspondent Node (CN)
   (v) Home Agent (HA)
   (vi) Foreign Agent (FA)

   (b) Describe the process of discovering and registering the CoA. Include necessary diagrams in your description. **(10+10=20)**

   (c) An MN is currently located in a foreign network of a Mobile IP network. A CN is communicating with the MN. Consider the following network conditions, on average. The round trip time (RTT) between a CN and HA is 20 ms; between HA and FA is 30 ms; between FA and CN is 26 ms; and between FA and MN is 4ms. Additionally, you can assume that the one way delay across any link is half the RTT across that link, on average. In this scenario, what will be the average RTT between the MN and CN? **(10)**

   (d) Explain Manchester and Differential Manchester encoding. Which one is more noise resilient? **(6)**

2. (a) Discuss the similarities and differences of OSI and TCP/IP reference models. **(13)**

   (b) Consider the following bit sequence that represents a frame: **(13)**

   1010111010111101111111111011101111110000101101011110111111111000

   What would be the transmitted bit stream, when frame boundaries are identified using

   (i) Flag bytes with byte stuffing.
   (ii) Starting and ending flags, with bit stuffing.

   For byte stuffing, assume the Flag byte is: 10111101; the Escape byte is: 11111111. For bit stuffing, assume the flag is: 01111110.

   (c) What is Hamming distance of a coding system? Show that to correct d bit error, you need a distance $2d+1$ coding system. **(2+8=10)**

   (d) Derive the inequality $(m+r+1) \leq 2^r$; Where, **($10\frac{2}{3}$)**

   m is the number of data bits in a frame

   r is the number of redundant/check bits added to a frame

Contd P/2

CSE 321

3. (a) Take a look at Figure 1. It shows the time line of data communication using RTS/CTS among several wireless devices. From this figure, infer the topology of the network. You can represent the topology as an undirected graph. There is no need to identify the transmission ranges of the nodes. Very briefly state the reasoning behind your inferences. **(20)**

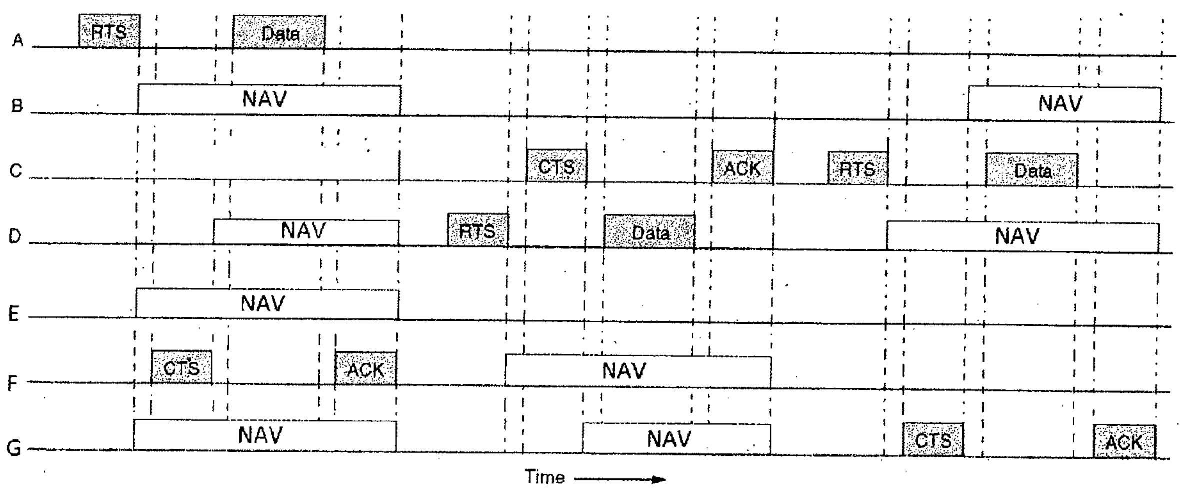

Figure 1: Figure for Question 3 (a)

(b) You need to configure 20 computers into 3 different LANs. LAN #1 will contain 10 computers; LAN #2 and #3 will contain 5 computers each. Following are some additional constraints: **(18)**

* You cannot use shared medium to connect all the computers of a LAN.
* You can only use Layer #2 networking devices. Within Layer #2, if there are many possible device types, you can use any of them as you need. However, note that, all the devices available in the market have exactly 8 ports; and the budget you have only permits you to buy 3 devices.
* You can obviously use necessary connectors to connect the computers to the ports of the device of your choice. You can also use connectors to connect any pair of ports of the same or different devices, if needed.

Can you build the network as asked? Briefly explain your configuration with a diagram.

(c) Why does the frame format of Ethernet include a 'Pad' field? Why is the maximum padding size 46 bytes? **($8\frac{2}{3}$)**

4. (a) "In some scenarios, 1-bit sliding window protocol may result in each data frame being transmitted twice" – Explain with an example. **(8)**

(b) Show with examples that the maximum number of outstanding frames in sliding window protocol using "Go back N" and "Selective Repeat" cannot be more than MAX_SEQ and (MAX_SEQ+1)/2 respectively. (Here, MAX_SEQ is the maximum possible sequence number of a frame). **(8+8=16)**

CSE 321

Contd... Q. No. 4

(c) Analyze the channel efficiency of Basic Bit-map Protocol at low and high load. How does Binary Countdown Protocol improve on it? **(10)**

(d) In Adaptive Tree Walk Protocol, show that the optimal level to being searching the tree is $\log_2(q)$, where q is the number of ready stations. **(6⅔)**

(e) Briefly describe how keyboard and mouse can communicate with a desktop computer through Bluetooth. **(6)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Alice is owner of a software company. Trudy is an employee in the company. After each month, Alice pays Trudy through an on-line balance transfer request that is sent to Alice's banker Bob. [All names follow traditional cryptography] Now, before placing each transfer request Alice wants to authenticate Bob using a shared key. Alice has no idea how she can do it. Therefore, Alice hires Falsdy [this name does not follow traditional cryptography!]. Falsdy first comes up with a naive two-day authentication protocol, and then shortened it. **(23⅔+23=46⅔)**

   After getting the two-say authentication protocols, Alice becomes very happy. She becomes happier thinking that she has two different versions of the same protocol. She starts using both the protocols with Bob.

   After a couple of months, Alice wants to change her shared secret key with Bob. Now, she realizes that she needs to manually communicate with Bob each time she wants to change the key. However, she does not like to do so, as, after all, she lives in a digital era! Therefore, she again hires Falsdy for designing an algorithm for establishing a shared key. Falsdy, this time, goes to Diffie and Hellman (these names get back to traditional cryptography), and gets such an algorithm. The tragic end of this story is that Trudy, being an intruder in Alice's company, breaks the authentication protocols and intervenes in the key sharing algorithm.

   Now, you need to do the following:

   (i) Depict the basic and shortened two-way authentication protocols using a shared key. In addition, show how Trudy breaks both of the protocols.

   (ii) Depict the algorithm for establishing a shared key. In addition, show how Trudy intervenes in the operations of the algorithm.

6. In an unknown planet, its aliens somehow invent computing machines and get very excited. They want to establish reliable data communication among the machines. Two aliens, named Sallien and Rallien (fractious names), are given the job to establish the reliable communication. Sallien decides to work on the sender's side and Rallien decides to work in the receiver's side. Now, the first mechanism they agree upon is that Sallien transmits one chunk of data, Rallien receives it and sends an acknowledgement to Sallien, Sallien transmits the next chunk of data only after getting the acknowledgement and the whole process continues. The mechanism works for reliable communication and they become happy! **(11+11+12⅔+12=46⅔)**

Contd P/4

CSE 321

Contd... Q. No. 6

All of a sudden, both of them discover that the communication speed exhibits poor performance with this mechanism. Therefore they decide that Sallien can transmit a fixed number of multiple chunks before getting an acknowledgement. This mechanism improves the speed, and they become happier!

After a few days, they discover a new problem. When either Sallien or Rallien remains slow, for example only a small volume of data is sent by Sallien in an interactive manner or a small volume of data is received at a time by Rallien's application, their mechanism performs poorly. They want to solve these problems, but, get screwed. Therefore, they come down to earth and contact to famous researchers named Nagle and Clark. These two researchers give solutions to the above-mentioned problems. After all, they are human!

This is not the end of story. When Sallien and Rallien happily decide to get back to their planet with the solutions, they fortunately meet another researcher named Tahoe. Tahoe tells them they will face another problem when they would try to pump data in their communication networks exceeding their network capacities. Both Sallien and Rallien can forecast the problem and look screwed again. Tahoe helps them with a solution to get rid from this problem. Another researcher, name Reno, smiles seeing the solution Tahoe gives to the aliens, as he knows a better solution than Tahoe.

Now, you need to briefly depict all the solutions Sallien and Rallien get from Nagle, Clark, and Tahoe. Also, you need to briefly depict the solution of Reno.

7. In a city, its citizens want to establish a network among computing devices. The citizens form a team for building the network. The team forms a subteam for deciding how data will be routed over the computing devices. **($10+15+6+15\frac{2}{3}=46\frac{2}{3}$)**

The subteam comes up with a solution where each computing device exchanges its distance to all other devices with only its neighbor devices. The solution primarily works.

However, after a few days the subteam discover a problem called "count-to-infinity problem". They solve this problem using "split horizon" and "forced update" rules.

Subsequently, a researcher arrives in the city. He says that even with both the solutions, the problem may still persist. He gives them a solution combining OSPF and BGP. The city survives a long period of time with this solution.

Now, you need to do the following:

(i) Draw an example scenario of happening "count-to-infinity" problem.
(ii) Briefly present the two solutions for preventing the problem.
(iii) State why the problem may still persist even with the solutions.
(iv) State how OSPF and BGP may work in combination.

8. Write short notes on: **($11+11+12+12\frac{2}{3}=46\frac{2}{3}$)**

(i) Random Early Detection, (ii) Jacobson's RTT estimation mechanism,
(iii) Network Address Translation (NAT), (iv) Leaky bucket algorithm.

L-3/T-2/ME **Date : 02/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **ME 343** (Machine Design II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Machine deign handbook II may be used.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) A certain bearing is to carry a radial load of 4 kN and an axial trust of 1.8 kN. The service life of the bearing should be at least 5 years, for 8 hr/day at 2500 rpm with 95% reliability. The outer ring of the bearing contact bearing is stationary. Find the following: **(20)**

   (i) Select an angular contact bearing for these applications.

   (ii) What is the median life of the selected bearing?

   (iii) What is the probability of survival of the selected bearing for the design life?

   (b) A certain bearing is to carry a radial load of 45 kN at speed of 10 rpm for 20% of the time. This load changes to 35 kN at 50 rpm for 50% of the time and 20 kN at 100 rpm for 30% of the time. With a desired life of 3000 hours, find the cubic mean load and select a straight roller bearing appropriate for the specified load. **(15)**

2. (a) A Journal bearing is 400 mm in diameter and 40 mm in length and has a journal speed of 1200 rpm. The redial clearance ratio is 1000. The bearing is lubricated with SAE 40 oil at an inlet temperature of 40°C. The applied radial load on the bearing is 3.0 kN. The bearing is medium construction (A = 12.5 dl) ring oiled, operating is still air. Determine the following: **(15)**

   (i) Minimum film thickness.

   (ii) Friction loss on the bearing.

   (iii) Heat dissipated to the surrounding.

   (b) A pair of helical gears, subjected to heavy shock loading is to transmit 25 kW at 1200 rpm of the pinion, with velocity ratio of 4.0 and helix angle 45°, and minimum D_P of 120 mm. The gears are made of hardened steel with BHN 350 and teeth are carefully cut, with normal pressure angle of 20° FD. Select the appropriate gear sizes. **(20)**

3. (a) A pair of 4 : 1 reduction gears is designed for a 20 kW motor whose full load speed is 1000 rpm with intermittent service. The gears are to be 20° FD with a phosphor bronze (SAE 65) pinion and a cast iron (class 35) gear. Make an estimate of the size of spur gear required. Considering average mounting conditions and light shock in driven machinery. **(20)**

   (b) A 40 kW motor running at 1750 rpm is to deliver power to a worm gear reducer with velocity ratio of 20. Worm is made of steel with minimum BHN 250, and the gear is made of phosphor bronze. Decide upon the appropriate gear set and compute the efficiency of the gear drive. **(15)**

Contd P/2

ME 343

4. The break shown in Figure 4 is 300 mm in diameter and is actuated by a mechanism that exerts the same force F on each shoe. The shoes are identical and have a face width of 32 mm. The lining is molded asbestos having a coefficient of friction 0.32 and a pressure limitation of 1000 kPa. Estimate the following: **(35)**

   (a) Maximum allowable actuating force F.

   (b) Idntify the location of the maximum pressure.

   (c) Braking capacity.

   The following relations are given:

   Moment of normal forces: $M_f = \dfrac{fp_a br}{\sin\theta_a}\left[\left(-r\cos\theta\right)_0^{\theta_2} - a\left(\dfrac{1}{2}\sin^2\theta\right)_0^{\theta_2}\right]$

   Moment of friction forces: $M_N = \dfrac{p_a bra}{\sin\theta_a}\left(\dfrac{\theta}{2} - \dfrac{1}{4}\sin 2\theta\right)_0^{\theta_2}$

   Torque applied to drum: $T = \dfrac{fp_a br^2\left(\cos\theta_1 - \cos\theta_2\right)}{\sin\theta_a}$

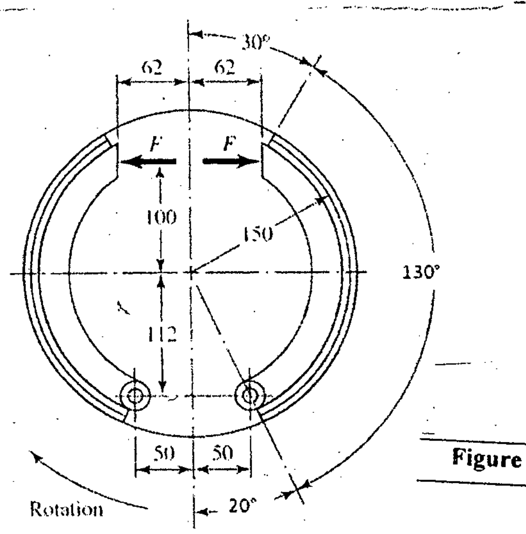

Figure for Q. 4

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE.**

Symbols have their usual meaning.

5. A BS-5216 Grade 4 compression spring is to be used for the front side of an automobile. The spring has an index of 6, a free length of 105 mm, 21 active coils, and squared and ground ends. The spring is to be assembled with a preload of 45 N and will operate to a maximum load of 225 N during use. **(35)**

   (a) Decide upon the outside and wire diameter of the spring for a design factor of 1.5 based on Goodman Criteria.

   (b) What would be the design factor for the spring obtained in (a) guarding against a fatigue failure based on a life of 50,000 cycles and 99% reliability?

Contd P/3

ME 343

6. An 8 mm thick leather belt connects two flat pulleys to transmit a power of 3 kW. The pulley diameters are 300 mm and 450 mm and the corresponding angles of lap are 160° and 210°. The smaller pulley runs at 200 rpm. The coefficient of friction between the belt and pulley is 0.25. The safe working stress in the belt material is 1.6 MPa. (Muss of belt per unit length = 2 kg/m) **(35)**

   (a) Design the belt cross-section for 2% slip at the pulley and 20% overhead capacity.

   (b) It is proposed to increase the power transmission capacity of the drive by increasing the coefficient of friction by 10%. Verify the effectiveness of the proposal.

7. (a) List the relative advantages of using wire ropes over other flexible power transmission elements. **(10)**

   (b) A skip for a mine shaft weighs 900 kg and is to lift a maximum load of 1350 kg from a depth of 300 m. The maximum speed of 6 m/sec is attained in 5 sec. **(25)**

   (i) Design a 6 × 19 Improved Plow Steel rope based on static design consideration.

   (ii) What is the elongation of the rope found if 1350 kg load is added while the hoist hangs freely at the bottom?

   (iii) How is the wear life of a rope is assured? Is the extent of wear associated with the above rope within the acceptable limit?

8. A circular shaft (machine finished) transmits 188.5 kW at 180 rpm by a pulley. A maximum bending moment of 2500 N-m (completely reversed) is applied to the shaft. The shaft material is B830 M31, hardened and tempered. For suddenly applied load with minor shock, determine the shaft diameter using **(35)**

   (a) Static load approach

   (b) ASME design code

   (c) Soderberg approach

   (d) Goodman approach

   Consider fatigue stress concentration factor of 2.0 for profile keyway. Choose factor of safety of 3.0 for (a) and (b), and 1.3 for (c) and (d).
