 1 of 2

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2020

Course No.: EE-283
Course Title: Electrical Drives and Instrumentation
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) Describe the principle of a simple loop generator. What is the function of commutator? 13

Q.1(b) State four conditions for buildup of shunt DC generator. 08

Q.1(c) A short-shunt compound generator delivers a load current of 30A at 220V and has armature, series field and shunt field resistances of 0.05 ohm, 0.30 ohm, and 200 ohm, respectively. Calculate the induced e.m.f and the armature current. Allow 1.0V per brush for contact drop. 07

23''

Q.1(d) A long shunt compound generator delivers a load current of 50 at 550V and has armature, series field, and shunt field resistances of 0.05 ohm, 0.03 ohm, and 250 ohm, respectively. Calculate the generated voltage and the armature current. Allow 1v per brush for contact drop. 07

Q.2(a) Draw and explain the OCC curve of a self-exited DC shunt generator and from the curve define critical resistance. 09

Q.2(b) Compare over-compounded, under-compounded, and flat compounded DC generator. 06

Q.2(c) Explain the physical phenomenon of eddy current loss and hysteresis loss in DC generator. How can these losses be minimized? 10

Q.2(d) State two applications of each of the following machines: DC series motor, DC shunt motor, induction motor, Dynamo and stepper motor. 10

Q.3(a) How back emf in DC motor is produced? 08

Q.3(b) Show that it is dangerous to start DC series motor without mechanical load. 07

Q.3(c) Derive and draw the equivalent circuit of a single phase transformer. 10

Q.3(d) Describe the speed control methods of DC shunt motor. 10

Q.4(a) What is slip? Specify the physical significance of slip in induction motor. 08

Q.4(b) Define starting torque. Derive the equation of the starting torque of a 12 induction motor and show the condition that achieves the maximum starting torque.

Q.4(c) What is synchronous speed? Why it is impossible for an induction motor to operate at synchronous speed? 10

Q.4(d) When and how an induction motor operates as a generator? 05

Section-B

Q.5(a) What are the benefits of PWM control of inverter? Delineate the circuit diagram and waveform of single phase half bridge inverter. 10

Q.5(b) Define voltage transformation ratio. Transformer used in power transmission and distribution system reduces the system loss. Justify the statement. 08

Q.5(c) What is controlled rectifier? Explain the principle of on-off control of a single phase full wave AC voltage controller. 10

Q.5(d) Make a comparative analysis between full step and half step operation of stepper motor. 07

Q.6(a) *Derive the emf equation of a single phase transformer.* 08

Q.6(b) *Define all day efficiency of a transformer.* 04

Q.6(c) State the conditions of synchronization of an alternator to connect in parallel with infinite bus-bar. 07

Q.6(d) Prove that the maximum power developed by a synchronous motor is $(P_m)_{max} = E_b V/X_s$, where symbols have their usual meaning. 16

Q.7(a) Define piezo-electric effect. Explain the operation of piezoelectric transducer. 10

Q.7(b) What is LDVT? How does linear motion can be converted into electrical signal in LDVT? Explain with necessary diagram. 10

Q.7(c) Differentiate between colored noise and white noise in electronic circuit. 07

Q.7(d) Write short notes on the following: (i) photovoltaic cell (ii)BCD to decimal diode matrix. 08

Q.8(a) Draw and explain the circuit diagram of digital frequency meter. 13

Q.8(b) Draw and explain the circuit diagram of a ramp type digital voltmeter. 10

Q.8(c) Describe the operation of a spectrum analyzer. 09

Q.8(d) Write short note on the recording devices in modern technological works. 03

$P_m = E_b I \cos\psi$

-The End-

MATH-243 1

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2020

Course No.: Math-243
Course Title: Fourier Analysis and Laplace Transformations
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) Define Fourier series and write down the applications of Fourier series. 10

Q.1(b) Find the fourier series by determining the function f(x) from figure 1, which is assumed to have the period $2\prod$ 25

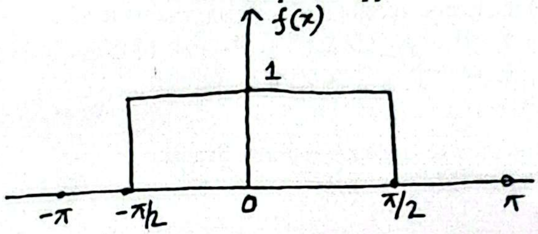

Figure 1

Q.2(a) Define Fourier sine and cosine integral. Find the fourier integral for 20

$$F(x)=\begin{cases} 1-x^2 ; & |x| \leq 1 \\ 0 ; & |x| > 1 \end{cases}$$

15

Q.2(b) Prove that $\frac{\prod^4}{90}=1+1/2^4+1/3^4+\ldots\ldots$

From $f(x)=x^2(-\prod<x<\prod)$ by using parseval's identity.

Q.3(a) Define finite fourier sine transform and its inverse. 05

Q.3(b) Find the fourier transform of f(x) defined by 10

$$f(x)=\begin{cases} 1 ; & |x| < a \\ 0 ; & |x| > a \end{cases}$$

Hence, evaluate $\int_{-\alpha}^{\alpha} \frac{\sin ua \cos ua}{u} du$

Q.3(c) Using finite fourier sine transform solve the boundary value problem 20

$$\frac{\partial^2 u}{\partial t^2} = 9\frac{\partial^2 u}{\partial x^2}$$

Subject to the conditions u(0,t)=0, u(2,t)=0, u(x,0)=0.05x^2(2-x), u_t(x,o)=0 where 0<x<2, t>0.

$e^{at} = \frac{1}{w-a}$ $\sin at = \frac{a}{w^2+a^2}$

$t^n = \frac{\lfloor n}{w^{n+1}}$ $\frac{1}{1-e^{-pT}}\int_0^T e^{-wt} f(t)$

Q.4(a) Find the transverse displacement y(x,t) by considering an infinite string, Which is initially at rest and initial displacement y(x,0)=f(x), -infinity<x<infinity $(-\alpha < x < \alpha)$. 17

Q.4(b) An infinite string is initially at rest and the initial displacement is f(x), (-infinity<x<infinity). Use the method of fourier transform to determine the displacement y(x,t) of the string. Also show that the solution can be Put in the form ½(f(x+ct)+f(x-ct)). 18

Section B

Q.5(a) Define laplace transform of the F(t) and write the applications of laplace transform? Find the laplace transform of the following functions 15

$$f(t)=\begin{cases}\cos(t-2\pi/3) & ; \quad t>2\pi/3\\ 0 & ; \quad t<2\pi/3\end{cases}$$

Q.5(b) If f(t) is a periodic function with period T. then determine the formula for $\alpha(f(t))$. 20

Find the lplace transform of the triangular wave of period 2a. given by

$$f(t)=\begin{cases} t & ; \quad 0<t<a\\ 2a-t & ; \quad a<t<2a\end{cases}.$$

Q.6(a) Define inverse laplace transform. Evaluate 15

(i)$L^{-1}\{(s+2)/(s^2+4s+5)^2\}$

(ii)$L^{-1}\{\ln(1+(1/s^2))\}$

Q.6(b) Use convolution theorem to evaluate 20

(i) $\mathcal{L}^{-1}\left\{\frac{s}{(s+2)(s^2+9)}\right\}$,

(ii) $\mathcal{L}^{-1}\left\{\frac{1}{(s^2+a^2)^2}\right\}$

$e^{ax}\cos bx$

Q.7(a) Solve $d^2y/dt^2+2(dy/dt)-3y=\sin t$, $y=dy/dt=0$ when $t=0$ using the transform method. 15

$\frac{e^{ax}}{a^2+b^2}(a\cos bx+b\sin bx)$

Q.7(b) A particle p of mass 2 grams moves on the x axis and is attached toward origin 0 with a force numerically equal to 8X. If it is initially at rest at x=0, find its positions at any subsequest time assuming a damping force numerically equal to 8 times the instantaneous velocity acts. 20

Q.8(a) An impulsive voltage $E\delta(t)$ is applied to a circuit consisting of L, R, C in series with zero initial conditions. If i be the current at any subsequent time t, find the limit of I as $t\to 0$. 15

Q.8(b) The currents I_1 and I_2 in mesh are given by

$\frac{1}{2a^3}(\sin at - at\cos at)$

$di_1/dt-wi_2=a\cos pt$,

$di_2/dt+wi_1=a\sin pt$

Find I_1 and i_2 by laplace transform if $I_1=I_2=0$ at $t=0$

$e^{at}=\frac{1}{s-a}$

$t^n f(t)=(-1)^n\cdot\frac{d^n}{ds^n}f(s)$

$\frac{1}{t}f(t)=\int_s^\infty f(s)$

$\int_0^t f(t)=\frac{1}{s}f(s)$

-The End-

$\int_0^t f(t)\cdot g(t-u)\,du$

Ans → hand ...

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-4, Self Study, Exam. 2020

Course No.: CSE-465
Course Title: Digital Signal Processing
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) Define signals, systems and signal processing. Distinguish between Digital and Analog signal processing. 08

Q.1(b) With appropriate examples and figures briefly explain: Multidimensional signal, Continuous-time continuous-valued signal, Discrete-time continuous-valued signal, Continuous-time discrete-valued signal, Discrete-time discrete-valued signal. 12

Q.1(c) Write down the properties that characterize Continuous-time and Discrete-time Sinusoidal Signals. Prove that a discrete-time sinusoid is periodic only if its frequency f is a rational number. 15

Q.2(a) While sampling analog signals, what happens for the signals having frequencies above $\frac{F_S}{2}$ (where F_S is the sampling frequency)? Explain with appropriate example. 12

Q.2(b) What are the three different ways of representing the discrete-time signals? Represent the signal of Fig. 2(b) using these three techniques. 11

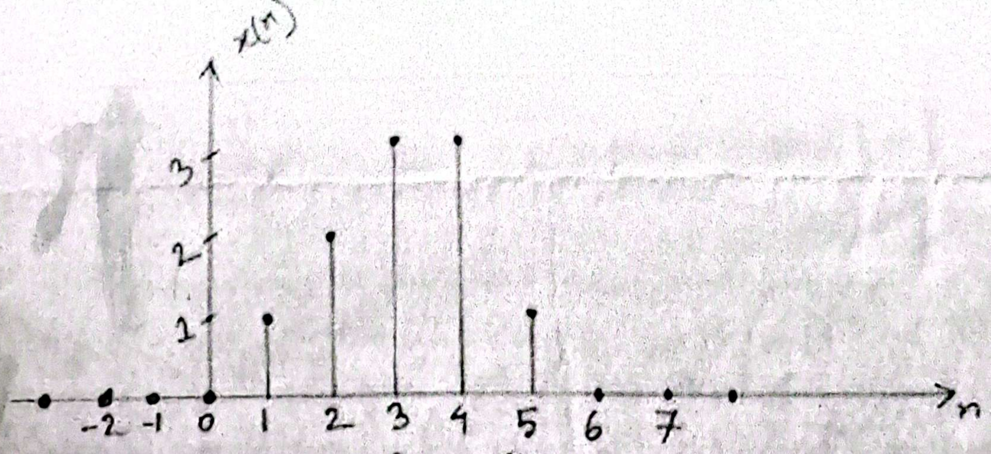

Fig. 2(b)

Q.2(c) Determine the response of the following systems to the input signal, 12

$$x(n) = \begin{cases} |n|, & -3 \le n < 3 \\ 0, & otherwise \end{cases}$$

i. $y(n) = x(n-1)$
ii. $y(n) = x(n+2)$
iii. $y(n) = \frac{1}{3}[x(n+1) + x(n) + x(n-1)]$
iv. $y(n) = max\{x(n+1), x(n), x(n-1)\}$
v. $y(n) = x(n) + x(n-1) + x(n-2) + \cdots$

CSE-465

Q.3(a) Consider a finite duration sequence $x(n) = \{2,4,0,3\}$. Resolve the sequence $x(n)$ into sum of weighted impulse sequences. 10

Q.3(b) Determine the frequency response, magnitude and phase response of the system given by 10

$$y(n) = x(n) - x(n-1) + x(n-2)$$

Q.3(c) Compute and draw the 8 point FFT butterfly structure 15

Q.4(a) Determine the Z-transform of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$. 10

Q.4(b) What is inverse Z-transform? Derive an expression for inverse Z-transform. 12

Q.4(c) What do you know about the linearity property of Z-transform? Determine the Z-transform and the ROC of the signal, 13

$$x(n) = [3(2^n) - 4(3^n)]u(n)$$

Section-B

Q.5(a) Write down the set of conditions that guarantee the existence of the Fourier transform of a signal. Derive the Parseval's relation for power signal. 11

Q.5(b) Determine the power density spectrum of the rectangular pulse train signal given in Fig. 5(b). 12

Slide

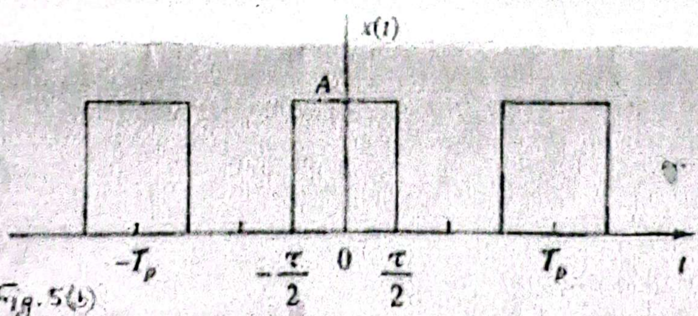

Fig. 5(b)

Q.5(c) Determine the output sequence of the system with impulse response 12

Slide

$$h(n) = \left(\frac{1}{2}\right)^n u(n).$$

When the input signal is $x(n) = Ae^{j\pi n/2}, -\infty < n < \infty$.

Filters

Q.6(a) Briefly explain each of the five classes of ideal filters, with necessary diagram. 15

Q.6(b) Distinguish between symmetric and antisymmetric FIR filters. 10

Q.6(c) Summarize the window functions for FIR filter design. 10

Q.7(a) Determine the cross correlation sequence $r_{xy}(l)$ of the sequences 15

$$x(n) = \{\cdots, 0, 0, 2, -1, 3, \underset{\uparrow}{7}, 1, 2, -3, 0, 0, \cdots\}$$

$$y(n) = \{\cdots, 0, 0, 1, -1, 2, -2, \underset{\uparrow}{4}, 1, -2, 5, 0, 0, \cdots\}$$

CSE-465

Q.7(b) Explain the sound quality and data rate in digital audio processing technique. 10

Q.7(c) What does it mean by aliasing? How can it be avoided? 10

Q.8(a) The frequency domain representation of a signal (after DFT) is shown below: 15

↓ DFT

Frequency Domain

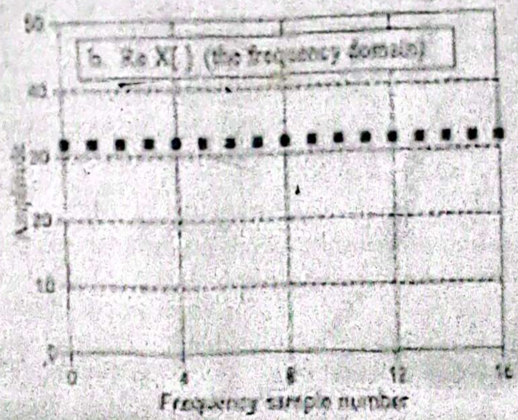

figure 8(a)

It shows the real part of the frequency domain where all the samples hold the constant value of 32. The imaginary part (not shown) is composed of all zeros. Find the time domain signal by using the concept of inverse DFT. Show necessary calculations and figures.

Q.8(b) With necessary figures, explain each of the three steps of FFT operation. Also show the flow diagram of FFT operation that converts time domain data to frequency domain data. 20

↓ FFT

-The End-

$F_s \geq 2F$

$2F_{max} \leq F_s$

$F_{max} \leq \frac{F_s}{2}$

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2020

Course No.: CSE-243
Course Title: Algorithms Design and Analysis
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) What is the closet pair problem? Write an algorithm to solve the problem using divide and conquer paradigm. 10

Q.1(b) Define time-space tradeoff. Analyze the best case, worst case, and average case complexities of sequential search in an array of n integers. 08

Q.1(c) Define Big 'O', omega, and theta asymptotic notation. Let, $T(n)=1/2(n^2)+3n$. Which of the following statements are true? (i)$T(n)=O(n)$, (ii)$T(n)=\Omega(n)$, (iii)$T(n)=\theta(n^2)$, (iv)$T(n)=O(n^3)$. 10

Q.1(d) Why does study of algorithms so important? Enumerate the factors to keep in consideration while analyzing the algorithm. Why asymptotic analysis is mandatory? 07

Q.2(a) Describe the three cases of master method with an example of each case Demonstrate that master theorem is variation of recursion tree method with appropriate example. 12

Q.2(b) Obtain a swap tree of the following Fig. 2(b) binary tree. Also perform preorder, in-order, and post-order traversal of the obtained swap tree. 10

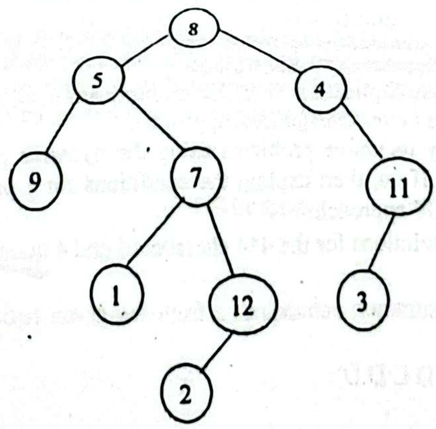

Fig. 2(b)

Q.2(c) Calculate average and best cases complexity of quick sort using recursion method. 5

Q.2(d) Write an algorithm to delete an element x from a binary search tree t. What is the time complexity of this algorithm? 8

Q.3(a) A sorting method is said to be stable if at the end of the method, identical elements occur in the same order as in the original unsorted set. Is merge sort a stable sorting method. 08

Q.3(b) Let S be a sequence (not necessarily sorted) of n keys. A key k in S is said to be an approximate median of S if $|\{k^i \epsilon S:k^i<k\}|\geq n/4$ and $|\{k^i \epsilon S:k^i>k\}|\geq n/4$. Devise an O(n) time algorithm to find the approximate medians of S. 10

Q.3(c) How do non-comparison sorts provide linear asymptotic run time? 07

Explain with appropriate example or diagram.

Q.3(d) Justify the statement 'Ternary search is much better than linear and binary search'. What is backtracking algorithm? Write down the general backtracking algorithm with optimizing techniques. 10

Q.4(a) Define the terms i. feasible solution, ii. Optimal solution, iii. Greedy choice property. 08

Q.4(b) Assume there are N children standing in a line. Each child is assigned a rating value. You are giving candies to these children subjected to the following requirements.

i. Each child must have at least one candy.
ii. Children with a higher rating get more candies than their neighbors. What is the minimum candy you must give? Propose a greedy algorithm to solve the above scenario. 10

For your convenient, 2 input-output sets are provided below:
Here, input denotes the rating of the children and output is minimum candies to be given.

Input	Output
A=[1,2]	3
B=[1,5,2,1]	7

Q.4(c) How does the choice of pivot element impact in average run-time of quick sort algorithm? Explain. Define parallel and approximation algorithms. Write down the parallel version of merge sort. 07

Q.4(d) Consider three items along with their respective weights and values as 10

$I=<I_1,I_2,I_3>$

$w=<5,4,3>$

$V=<6,5,4>$

The knapsack has the maximum weight capacity w=7. We have to fill the knapsack according to greedy strategy such that it can have maximum profit. Write pseudo-code of the algorithm and demonstrate the steps of solution using above specifications.

Section-B

Q.5(a) Using karatsuva multiplication find the multiplication of X=5678 and Y=1234. Why it is better than general approach. 09

Q.5(b) Can we solve any recursive problems using the dynamic programming (DP) techniques? If no, then explain the conditions for a problem to be solved using the DP approach. 10

Q.5(c) Find all possible solutions for the 4*4 chessboard and 4 queue problems. 7

Q.5(d) Find the longest common subsequence from the given two sequence of characters: 9

P=<A B C D B C D C D D>

Q=< B C D C D>

Also write the pseudo code of longest common subsequence algorithm.

Q.6(a) Differentiate between Dijkstra's and Bellmanford single source shortest path algorithms. What are their runtime complexities. 08

Q.6(b) How many approaches are there to represent a graph? Describe them with associated pros and cons. Why do stack and queue data structures appropriate for DFS and BFS respectively? Why time complexity for BFS is O(V+E) instead of O(V*E)? 12

Q.6(c) Apply rod cutting algorithm to compute the maximum obtainable value for the rod of length 2,4, and 6 from the following table. 8

BCDCD

Length	1	2	3	4	5	6	7	8
price	3	5	8	9	10	17	17	20

Q.6(d) Define the following terms: Degree of a graph, complete graph, Bipartite graph, Euler path, and Hamiltonian cycle. 7

Q.7(a) What are the invariants of Red-Black tree? Proof that every red-black tree with n nodes has height $\leq \log_2(n+1)$. **8**

Q.7(b) Run either kruskal or prims MST algorithm on the graph shown in Fig. 7(b) and draw the resulting graph. If the algorithm you use needs a starting vertex, start it on vertex A. Write down the pseudo code of your selected algorithm. Also, mark the edges you selected according to algorithm with 1,2,3,.. so on. **9**

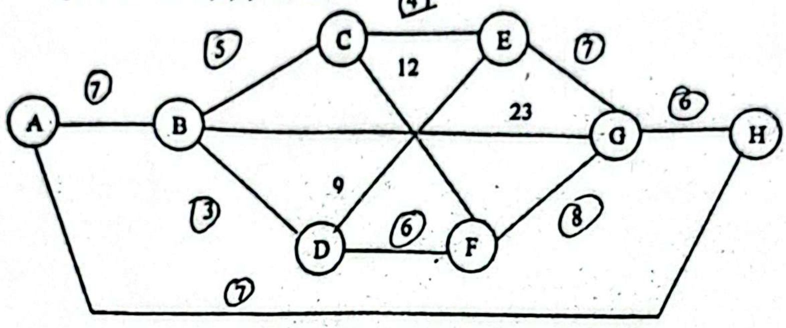

Fig.7(b)

Q.7(c) Write down the algorithm for finding m coloring of a graph. Draw the state space tree for m coloring where m=3 and n=3. **10**

Q.7(d) What is amortized cost? Show three different ways of computing amovtized cost. What is negative cycle in case of digraph. **8**

Q.8(a) What is bloom filter and its supported operations? Give a heuristic analysis to show that the false positive error probability in bloom filter can be kept minimum. **8**

Q.8(b) Write short notes on i. Load factor, ii. Uniform hashing, iii. Double hashing **8**

Q.8(c) *Prove that P=NP. Explain and prove looks theorem.* **9**

Q.8(d) *Define topological sort. How it can be implemented by DFS? Show that the running time of such implementation is O(m+n), where m is the number of edges and n is the number of nodes.* **10**

-The End-