Dr. Mahalingam College of Engineering & Technology
Pollachi – 642 003
(An Autonomous Institution affiliated to Anna University)

16EET44
Networks and Signals

Tutorial Book

Name : ----------

Roll No : ----------

Department & Section : ----------

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Course Code & Title: 16EET44 – Networks and Signals Date:

RUBRICS TO BE FOLLOWED FOR TUTORIAL

Criteria	Level of Performance			
	Excellent	**Good**	**Satisfactory**	**Needs Improvement**
	5 Points	**4 Points**	**3 Points**	**2 Points**
Computation & Execution	All aspects of the students solution were completely accurate	The students computations were essentially accurate	The student made minor computational error	The student made errors in computation serious enough to flaw the solution
Completion & Neatness	All problems are completed. the work is presented in a clear and organized manner	80% problems are completed. the work is presented in a clear manner to understand	70% problems are completed. the work is presented clearly	Only 50% problems are completed. the work is presented in a clear but difficult to read.

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Course Code & Title: 16EET44 – Networks and Signals Date:

Unit IV

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Tutorial No	Date	Tutorial Topic	Marks	Sign
CO4: Classify the type of signals & system and Perform operation on signals				
19		**Classification of Signals**		
20		**Classification of Signals**		
21		**System Classification**		
22		**System Classification**		
23		**Correlation and Linear Convolution**		
24		**Circular Convolution and De-convolution**		
Average				

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Useful Finite Summation Identities ($a \neq 1$)

$$\sum_{k=0}^{n} a^k = \frac{1-a^{n+1}}{1-a}$$

$$\sum_{k=0}^{n} ka^k = \frac{a}{(1-a)^2}[1-(n+1)a^n+na^{n+1}]$$

$$\sum_{k=0}^{n} k^2a^k = \frac{a}{(1-a)^3}[(1+a)-(n+1)^2a^n+(2n^2+2n-1)a^{n+1}-n^2a^{n+2}]$$

$$\sum_{k=0}^{n} k = \frac{n(n+1)}{2}$$

$$\sum_{k=0}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$$

$$\sum_{k=0}^{n} k^3 = \frac{n^2(n+1)^2}{4}$$

$$\sum_{k=0}^{n} k^4 = \frac{n}{30}(n+1)(2n+1)(3n^2+3n-1)$$

Useful Infinite Summation Identities ($|a| < 1$)

$$\sum_{k=0}^{\infty} a^k = \frac{1}{1-a}$$

$$\sum_{k=0}^{\infty} ka^k = \frac{a}{(1-a)^2}$$

$$\sum_{k=0}^{\infty} k^2a^k = \frac{a^2+a}{(1-a)^3}$$

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Course Code & Title: 16EET44 – Networks and Signals Date:

Tutorial No:19 – Signal Classification – Periodic/Aperiodic

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Compute and sketch the signals $x_1(n-3)$, $x_1(n)x_1(n-3)$, $x_1(n)x_1(n+2)$, if$x_1(n)=\{1,5,7,11,13,15\}$.

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2. Check the following signals are periodic or not and if periodic find the fundamental period.

i) $\sin(0.02\pi n)$

ii) $\cos(4n)$

iii) $\sin(2\pi n/3)+\cos(2\pi n/3)$

iv) $\cos(n/6)\cos(n\pi/6)$

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Course Code & Title: 16EET44 – Networks and Signals Date:

Tutorial No:20 – Signal Classification – Even/Odd, Energy/Power

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Find even and odd components for the given signal. X1(n)={2,1,3,-2,4}

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2. Check the following signal is energy or power signal.
   i) $x(n) = (1/3)^n u(n)$
   ii) $x(n) = \text{Sin}(\pi n/4)$
   iii) $x(n) = e^{2n} u(n)$

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Tutorial No:21 – System Classification – static or dynamic, causal or non-causal, linear or non-linear

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Check whether the following systems are static or dynamic.

a. $y(n)=x(n-3)$ b. $y(n) = x(n+1)$ c. $y(n)= x^2(n)$ d. $y(n)=ax(n)$

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2. Check whether the following systems are causal or non-causal.

a. $y(n)=x(n)+x(n-1)$ b. $y(n) =x(n)+x(n+1)$

c.$y(n)=x(2n)$ d.$y(n)=x(n^2)$

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3. Check whether the following systems are linear or non-linear.

a. $y(n) = nx(n)$ b. $y(n) = 10x(n)+12$ c. $y(n)=[x(n)]^2$ d. $y(n)=n^2x(n)$

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Course Code & Title: 16EET44 – Networks and Signals Date:

Tutorial No: 22 – System Classification – time variant or time invariant,stable or unstable,recursive or non-recursive

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Check whether the following systems are time variant or time invariant.

a. $y(n) = x(-n)$ b. $y(n) =$

c. $y(n)= x^2(n)$ d. $y(n)=x(n^2)$

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2. Check whether the following systems are stable or unstable system.
   a. $y(n) = ax^2(n)$ b. $y(n) = ax(n-1)+bx(n+1)$
   c. $y(n)= 2^n u(n-4)$ d. $y(n)= e^{n/4} u(n-4)$

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3. Check whether the following systems are recursive or non-recursive system.
   a. $y(n) = y(n-1)+y(n-2)+x(n)+x(n-1)$ b. $y(n) = x(n)+x(n-1)$

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Course Code & Title: 16EET44 – Networks and Signals Date:

Tutorial No:23 – Operation on signals – Correlation and Linear convolution

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Find the correlation of the two signals. x(n)={4,-3,-2,1} y(n) ={1,1,0,1}

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2. Find $\gamma_{xx}(n)$, $\gamma_{yy}(n)$, $\gamma_{xy}(n)$, $\gamma_{yx}(n)$ for the following sequence.
   x(n)={-2,3,-2,4,2,3} y(n)={-2,3,1,2,3,4}

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3.Obtain linear convolution for the following signal by graphical method

$x(n)=\{1,2,3,4\}$ and $h(n)=\{1,4,2,1\}$

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Course Code & Title: 16EET44 – Networks and Signals Date:

Tutorial No:24 – Operation on signals – Circular convolution and Deconvolution

CO4: Classify the type of signals & systems and perform operation on signals (Understand)

1. Obtain Circular convolution forthe followingsignal.
   x(n)={1,-1,-2,3,-1} h(n) ={1,2,3}

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2. Using Circular convolution find y(n) for the given x(n)={1,2,3}& h(n)={1,1,1,1}and compare the result withLinear convolution.

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3. Find the input x(n) that will generate an output sequence y(n) = {1,5,10,11,8,4,1} for a system with impulse response h(n) = {1,2,1}

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Unit V

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CO5: Analyze Discrete Time Signal				
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27		**DTFT**		
28		**DTFT**		
29		**Solution of Difference Equation**		
Average				

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Discrete Time Fourier Series (DTFS)

The periodic sequence can be represented by DTFS as,

$$x(n) = \sum_{k=<N>} X(k)\, e^{jk\Omega_0 n} \quad \text{(Synthesis equation)}$$

$$X(k) = \frac{1}{N} \sum_{n=<N>} x(n)\, e^{-jk\Omega_0 n} \quad \text{(Analysis equation)}$$

Here 'N' is the period of $x(n)$.

$\Omega_0 = \frac{2\pi}{N}$ is the frequency in radians.

$\sum_{k=<N>}$ means summation over the range of 'N' for difference values of k.

Properties of DTFS:

Sr. No.	Name of the property	Property
1	Linearity	$a\,x(n) + b\,x(n) \xleftrightarrow{DTFS} a\,X(k) + b\,Y(k)$
2	Time shift	$x(n-n_0) \xleftrightarrow{DTFS} e^{-jk\Omega_0 n_0} X(k)$
3	Frequency shift	$e^{jk_0\Omega_0 n}\,x(n) \xleftrightarrow{DTFS} X(k-k_0)$
4	Scaling	$x(an) \xleftrightarrow{DTFS} a\,X(k)$
5	Convolution	$x(n) \bullet y(n) \xleftrightarrow{DTFS} N\,X(k)\,Y(k)$
6	Modulation	$x(n)\,y(n) \xleftrightarrow{DTFS} X(k) \bullet Y(k)$
7	Symmetry	If $x(n)$ is real, then $X^*(k) = X(-k)$ If $x(n)$ is imaginary, then $X^*(k) = -X(-k)$ If $x(n)$ is real and even, then $Im\{X(k)\} = 0$ If $x(n)$ is real and odd, then $Re\{X(k)\} = 0$
8	Parsevals relation	$\frac{1}{N} \sum_{n=<N>} \lvert x(n)\rvert^2 = \sum_{k=<N>} \lvert X(k)\rvert^2$

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Tutorial No:25

CO5: Analyze Discrete Time Signal

1. Determine the DTFS coefficients to evaluate DTFS representation of following x(n)

x(n)=cos$\left[\frac{6\pi}{13}n+\frac{\pi}{6}\right]$

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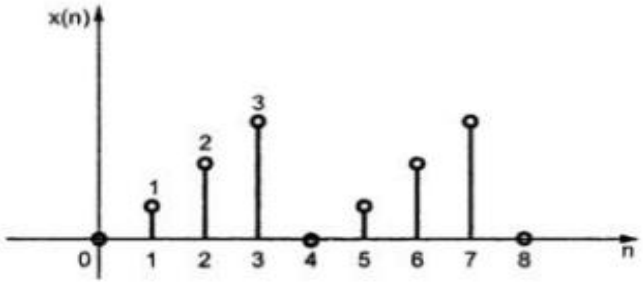
2. Find the DTFS coefficients of the following figure shown:



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Tutorial No:26

CO5: Analyze Discrete Time Signal

1. Determine DTFS representation of the signal x(n)= $\cos\left(\frac{n\pi}{3}\right)$. Plot the spectrum of x(n).

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Tutorial No:27

CO5: Analyze Discrete Time Signal

1. Determine the DTFT of the sequence

$x(n)=\alpha^n u(n),\ |\alpha|<1$

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2.Find the DTFT of the two sided sequence x(n)=$x(n) = \left(\frac{1}{4}\right)^{|n|}$

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Tutorial No:28

CO5: Analyze Discrete Time Signal

1. If the frequency response is $H\left(e^{jw}\right) = \frac{1-\frac{1}{4}e^{-jw}}{1+\frac{1}{42}e^{-jw}}$, Find the unit sample response

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2. Solve $y(n) - 0.25y(n-1) = x(n) - x(n-2)$ for $x(n)=\delta(n)$,assuming zero initial conditions.

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Tutorial No:29

CO5: Analyze Discrete Time Signal

1. If $x(n)=2\delta(n+2)- \delta(n+1)+ 3\delta(n)- \delta(n-1) - \delta(n-2)$ Evaluate
   a) $X(e^{jw})|_{w=0}$
   b) $X(e^{jw})|_{w=\pi}$

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2. Find the frequency response of a LSI system whose input and output satisfy the difference equation $y(n) – 0.5y(n-1) = x(n) + 2\ x(n-1) + x(\ n-2)$