Department of Electronics and Communication Engineering

COURSE FILE

Sub: Signals and Systems **A.Y.2022-2023**

Year: 2nd Year B.Tech I Semester

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CMR ENGINEERING COLLEGE

UGC AUTONOMOUS

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision of the Institute:

To be recognized as a premiere institution in offering value based and futuristic quality technical education to meet the technological needs of the society.

Mission of the Institute:

1. To impart value based quality technical education through innovative teaching and learning methods.
2. To continuously produce employable technical graduates with advanced technical skills to meet the current and future technological needs of the society.
3. To prepare the graduates for higher learning with emphasis on academic and industrial research.

VISION OF THE DEPARTMENT

To promote excellence in technical education and scientific research in electronics and communication engineering for the benefit of society.

MISSION OF THE DEPARTMENT

M1: To impart excellent technical education with state of art facilities inculcating values and lifelong learning attitude.

M2: To develop core competence in our students imbibing professional ethics and team spirit.

M3: To encourage research benefiting society through higher learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Establish themselves as successful professionals in their career and higher education in the field of Electronics & Communication Engineering and allied domains through rigorous quality education.

PEO 2: Develop Professionalism, Ethical values, Excellent Leadership qualities, Communication Skills and teamwork in their Professional front and adapt to current trends by engaging in lifelong learning

PEO 3: Apply the acquired knowledge & skills to develop novel technology and products for solving real life problems those are economically feasible and socially relevant

PEO 4: To prepare the graduates for developing administrative acumen, to adapt diversified and multidisciplinary platforms to compete globally

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Ability to apply concepts of Electronics & Communication Engineering to associated research areas of electronics, communication, signal processing, VLSI, embedded systems, IoT and allied technologies.

PSO2: Ability to design, analyze and simulate a variety of Electronics & Communication functional elements using hardware and software tools along with analytic skills.

Program Outcomes (POs) :

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3:Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4:Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5:Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6:The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7:Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10:Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11:Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12:Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3.Mapping of course out comes with POs

Course Name: Signals and Systems (EC303PC):

Course Name: Signals and Systems :

Course Code.CO No.	Course Outcomes (CO's)
At the end of the course student will be able to	
CO.1	Represent any arbitrary signals in terms of complete sets of orthogonal Functions and understands the principles of impulse functions, step function and signum function
CO.2	Express periodic and non periodic signals in terms of Fourier Series/Transform
CO.3	Understand the principle of linear system, filter characteristics of a system and its bandwidth. .
CO.4	Discover the continuous and discrete time system response and obtain system stability by using Laplace transform and z-Transform respectively and know the relation between F.T., L.T. & Z.T.
CO.5	Interpret the concept of convolution and correlation of signals & know the concept of sampling.

Course Outcome (CO)-Program Outcome (PO) Matrix:

CO's/ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C214.1	3	3	2	2	3	-	-	-	-	-	2	3
C214.2	3	3	2	2	3	-	-	-	-	2	2	3
C214.3	3	3	3	2	3	-	-	-	-	2	3	3
C214.4	3	3	3	2	3	-	-	-	-	2	3	3
C214.5	3	3	3	2	3	-	-	-	-	-	2	3

Course Outcome (CO)-Program Specific Outcome (PSO) Matrix:

CO's/ PSO's	PSO1	PSO2
C214.1	3	2
C214.2	3	2
C214.3	3	2
C214.4	3	2
C214.5	3	2

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4.Syllabus Copy and Suggested/Reference Books

CMR ENGINEERING COLLEGE (UGC AUTONOMOUS)

II Year B.Tech. I Sem.	**L**	**T/P/D**	**C**
	3	**-/-/-**	**3**

(EC303PC) SIGNALS AND SYSTEMS

Pre-requisite: Nil

Course Objectives:

- This gives the basics of Signals and Systems required for all Electrical Engineering related courses.
- To understand the behavior of signal in time and frequency domain
- To understand the characteristics of LTI systems
- This gives concepts of Signals and Systems and its analysis using different transform techniques.

Course Outcomes: Upon completing this course, the student will be able to

- Differentiate various signal functions.
- Represent any arbitrary signal in time and frequency domain.
- Understand the characteristics of linear time invariant systems.
- Analyze the signals with different transform technique

UNIT - I

Signal Analysis: Basic elementary signals, Classification of signals, Operations on Signals, Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions.

UNIT – II

Fourier series: Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform and Introduction to Hilbert Transform.

UNIT - III

Signal Transmission through Linear Systems: Classification of systems, Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and their properties.

UNIT – IV

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform and Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

UNIT - V

Sampling theorem: Sampling theorem –Types of Sampling - Impulse Sampling, Natural and Flat top Sampling, Aliasing**,** and introduction to Band Pass Sampling.

Correlation of Signals: Correlation of signals, Cross Correlation and auto correlation of functions, properties of correlation functions, relation between convolution and correlation.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.

REFERENCE BOOKS:

1. Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,
2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH
3. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.
4. Signals, Systems and Transforms - C. L. Philips, J.M.Parr and Eve A.Riskin, 3 Ed., 2004, PE.
5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

5.INDIVIDUAL TIME TABLE

II -I time table w.e.f 31.10.22.rar

6.SESSION PLAN

S.No	JNTU Syllabus	Sub-Topic	ESTIMATED PERIODS	Sugested Textbooks	Remarks
		UNIT-1			
1	Signal Analysis	What is signal and what is system?,signal types,elementry signals,representation of signals, Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error	8	T1,T2,T3	
2		Closed or complete set of orthogonal functions ,Orthogonality in complex functions	3	T1,T2,T3	
3		Exponential and sinusoidal signals, concepts of Impulse function, Unit step function ,Signum function	2	T1,T2,T3	
		UNIT-1 TOTAL	13		

		UNIT-2			
4		Representation of Fourier series,	2	T1,T2,T3	
5		Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series	3	T1,T2,T3	
6	Fourier series & Fourier Transforms	Exponential Fourier Series, Complex Fourier spectrum.	3	T1,T2,T3	
7		Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals,	3	T1,T2,T3	
8		Fourier Transform of Periodic Signals, Properties of Fourier Transform,	4	T1,T2,T3	
9		Fourier Transforms involving Impulse function and Signum function. Introduction to Hilbert Transform.	3	T1,T2,T3	
		UNIT-II TOTAL	18		
	Signal Transmission through Linear Systems	**UNIT-3**			
10		Linear System, Impulse response, Response of a Linear System, Linear Time Invariant (LTI) System, Linear Time Variant (LTV) System,	3	T1,T2,T3	
11		Transfer function of a LTI system, Filter characteristics of Linear Systems, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics,	3	T1,T2,T3	
12		Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and Rise time.	3	T1,T2,T3	
13		Concept of convolution in Time domain and Frequency domain,	2	T1,T2,T3	

14		Graphical representation of Convolution, Convolution property of Fourier Transforms	3	T1,T2,T3	
		UNIT-III TOTAL	14	T1,T2,T3	
	Laplace Transforms & Z– Transforms	**UNIT-4**			
15		Laplace Transforms (L.T), Inverse Laplace Transform,	2	T1,T2,T3	
16		Concept of Region of Convergence (ROC) for Laplace Transforms, Constraints on ROC for various classes of signals,	2	T1,T2,T3	
17		Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.	3	T1,T2,T3	
18		Fundamental difference between Continuous and Discrete time signals, Discrete time signal representation using Complex exponential and Sinusoidal components,	2	T1,T2,T3	
19		Periodicity of Discrete time signal using complex exponential signal, Concept of Z-Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms,	3	T1,T2,T3	
20		Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms,INVERSE Z-TRANSFORM	3	T1,T2,T3	
		UNIT-IV TOTAL	15		
	Sampling theorem & Correlation	**UNIT-5**			
21		Sampling theorem	2	T1,T2,T3	
22		Graphical and analytical proof for Band Limited Signals,	2	T1,T2,T3	

23		Reconstruction of signal from its samples, Effect of under sampling Aliasing.	1	T1,T2,T3	
24		Introduction to Band Pass Sampling.	1	T1,T2,T3	
25		cross correlation and auto correlation of functions	2	T1,T2,T3	
26		properties of correlation functions	2	T1,T2,T3	
27		energy density spectrum ,power density spectrum	2	T1,T2,T3	
28		parseval's theorem relation between auto correlation function and energy/power spectral density function relation between convolution and correlation	2	T1,T2,T3	
29		detection of periodic signals in the presence of noise by correlation extraction of signal from noise by filtering	2	T1,T2,T3	
		UNIT-V TOTAL	14		
		GRAND TOTAL PERIODS REQUIRED	74		

7.Detailed Lecture Plan

ACADEMIC YEAR 2022-2023

ACADEMIC SCHEDULE FOR SIGNALS AND SYSTEMS (II B.TECH I-SEM)

S.No	Day	Date	Topic	Total Classes	Remarks
1	Monday	10-Oct-22	UNIT:1 Signal Analysis:What is signal and what is system?	1	
2	Tuesday	11-Oct-22	Signal types,Elementary signals and problems	3	
3	Wednesday	12-Oct-22	T&P		
4	Thursday	13-Oct-22	Representation of signals,operation on signals and problems	4	
5	Saturday	15-Oct-22	Analogy between vectors and signals and problems	5	
6	Sunday	16-Oct-22	SUNDAY		
7	Monday	17-Oct-22	Orthogonal signal space and problems	6	
8	Tuesday	18-Oct-22	Signal approximation using Orthogonal functions and problems	8	
9	Wednesday	19-Oct-22	T&P		
10	Thursday	20-Oct-22	Mean square error and problems	9	
11	Saturday	22-Oct-22	Problems on orthogonality	10	
12	Sunday	23-Oct-22	SUNDAY		
13	Monday	24-Oct-22	DEWALI		
14	Tuesday	25-Oct-22	Closed or complete set of orthogonal functions , Orthogonality in complex functions	12	
15	Wednesday	26-Oct-22	T&P		
16	Thursday	27-Oct-22	Exponential and sinusoidal signals	12	
17	Saturday	29-Oct-22	concepts of Impulse function	14	
18	Sunday	30-Oct-22	SUNDAY		
19	Monday	31-Oct-22	Unit step function , Signum function	15	
20	Tuesday	1-Nov-22	Unit-II:Fourier series & Fourier Transforms:Representation of Fourier series for Continuous time periodic signals,Dirichlet's conditions,	17	
21	Wednesday	2-Nov-22	T&P		
22	Thursday	3-Nov-22	Trigonometric Fourier Series	18	
23	Saturday	5-Nov-22	Exponential Fourier Series	19	
24	Sunday	6-Nov-22	SUNDAY		
25	Monday	7-Nov-22	Complex Fourier spectrum	20	

26	Tuesday	8-Nov-22	Dirichlet's conditions, Trigonometric Fourier Series	**22**	
27	Wednesday	9-Nov-22	T&P		
28	Thursday	10-Nov-22	Problems on Trigonometric fourier series	**23**	
29	Saturday	12-Nov-22	Problems on Exponential Fourier series	**23**	
30	Sunday	13-Nov-22	SUNDAY		
31	Monday	14-Nov-22	Complex Fourier spectrum	**25**	
32	Tuesday	15-Nov-22	Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal,	**27**	
33	Wednesday	16-Nov-22	T&P		
34	Thursday	17-Nov-22	Fourier Transform of standard signals	**28**	
35	Saturday	19-Nov-22	Fourier Transform of standard signals	**29**	
36	Sunday	20-Nov-22	SUNDAY		
37	Monday	21-Nov-22	Fourier Transform of Periodic Signals,Problems	**31**	
38	Tuesday	22-Nov-22	Properties of Fourier Transform	**33**	
39	Wednesday	23-Nov-22	T&P		
40	Thursday	24-Nov-22	Introduction to Hilbert Transform.	**34**	
41	Saturday	26-Nov-22	Problems	**35**	
42	Sunday	27-Nov-22	SUNDAY		
43	Monday	28-Nov-22	Unit :3 Signal Transmission through Linear Systems:Linear System, Impulse response	**36**	
44	Tuesday	29-Nov-22	Linear Time Variant (LTV) System,Problems	**38**	
45	Wednesday	30-Nov-22	T&P		
46	Thursday	1-Dec-22	Transfer function of a LTI system,Problems	**38**	
47	Saturday	3-Dec-22	Assignment questions discussion	**39**	
48	Sunday	4-Dec-22	SUNDAY		
49	Monday	5-Dec-22	Mid Exams		
50	Tuesday	6-Dec-22	Mid Exams		

51	Wednesday	7-Dec-22	Mid Exams		
52	Thursday	8-Dec-22	Mid Exams		
53	Friday	9-Dec-22	Mid Exams		
54	Saturday	10-Dec-22	Mid Exams		
55	Sunday	11-Dec-22	SUNDAY		
56	Monday	12-Dec-22	Filter characteristics of Linear Systems,	**40**	
57	Tuesday	13-Dec-22	Distortion less transmission through a system, Signal bandwidth, System bandwidth, Problems	**42**	
58	Wednesday	14-Dec-22	T&P		
59	Thursday	15-Dec-22	Ideal LPF, HPF and BPF characteristics	**43**	
60	Saturday	17-Dec-22	Causality and Paley-Wiener criterion for physical realization,	**44**	
61	Sunday	18-Dec-22	SUNDAY		
62	Monday	19-Dec-22	Relationship between Bandwidth and Rise time	**45**	
63	Tuesday	20-Dec-22	Problems	**46**	
64	Wednesday	21-Dec-22	T&P		
65	Thursday	22-Dec-22	Unit-IV:Laplace Transforms & Z–Transforms:Laplace Transforms (L.T)	**47**	
66	Saturday	24-Dec-22	Inverse Laplace Transform,Problems	**48**	
67	Sunday	25-Dec-22	SUNDAY		
68	Monday	26-Dec-22	Concept of Region of Convergence (ROC) for Laplace Transforms,	**49**	
69	Tuesday	27-Dec-22	Constraints on ROC for various classes of signals,Relation between L.T and F.T of a signal, Problems	**51**	
70	Wednesday	28-Dec-22	T&P		
71	Thursday	29-Dec-22	Properties of L.T	**52**	
72	Saturday	31-Dec-22	Laplace Transform of certain signals using waveform synthesis,Problems	**53**	
73	Sunday	1-Jan-23	SUNDAY		
74	Monday	2-Jan-23	Concept of Z- Transform of a Discrete Sequence,	**54**	
75	Tuesday	3-Jan-23	Distinction between Laplace, Fourier and Z-Transforms, Region of Convergence in Z-Transform,Problems	**56**	
76	Wednesday	4-Jan-23	T&P		
77	Thursday	5-Jan-23	Constraints on ROC for various classes of signals,	**57**	

78	Saturday	7-Jan-23	Properties of Z-transforms,	**58**	
79	Sunday	8-Jan-23	SUNDAY		
80	Monday	9-Jan-23	Inverse Z-transform,	**59**	
81	Tuesday	10-Jan-23	Problems on Laplace and z-transforms	**62**	
82	Wednesday	11-Jan-23	T&P		
83	Thursday	12-Jan-23	Unit-V:Sampling theorem & Correlation:Types of sampling	**63**	
84	Saturday	14-Jan-23	Sampling theorem,	**64**	
85	Sunday	15-Jan-23	SUNDAY		
86	Monday	16-Jan-23	Impulse Sampling, Natural and Flat top Sampling,	**64**	
87	Tuesday	17-Jan-23	Aliasing, Introduction to Band Pass Sampling,Problems	**66**	
88	Wednesday	18-Jan-23	T&P		
89	Thursday	19-Jan-23	Correlation of signals	**67**	
90	Saturday	21-Jan-23	Cross Correlation and Auto Correlation of Functions	**68**	
91	Sunday	22-Jan-23	SUNDAY		
92	Monday	23-Jan-23	Properties of Correlation Functions	**69**	
93	Tuesday	24-Jan-23	Problems	**72**	
94	Wednesday	25-Jan-23	T&P		
95	Thursday	26-Jan-23	Problems	**72**	
96	Saturday	28-Jan-23	Relation between Convolution and Correlation.	**73**	
97	Sunday	29-Jan-23	SUNDAY		
98	Monday	30-Jan-23	Revision	**74**	
99	Tuesday	31-Jan-23	Revision	**76**	
100	Wednesday	1-Feb-23	T&P		
101	Thursday	2-Feb-23	Revision	**77**	
102	Saturday	4-Feb-23	Revision	**78**	
103	Sunday	5-Feb-23	SUNDAY		
104	Monday	6-Feb-23	Mid Exams		
105	Tuesday	7-Feb-23	Mid Exams		
106	Wednesday	8-Feb-23	Mid Exams		
107	Thursday	9-Feb-23	Mid Exams		
108	Saturday	11-Feb-23	Mid Exams		
109	Sunday	12-Feb-23	SUNDAY		

8.Session Execution Log:

S.no	Syllabus	Scheduled	Completed date	Remarks
1	I-UNIT			completed
2	I1-UNIT			completed
3	I11-UNIT			completed
4	IV-UNIT			completed
5	V-UNIT			completed

9.Assignment Questions

SIGNALS AND SYSTEMS

Ist-Mid-ASSIGNMENT A.Y:2022-23

1. A) Examine whether the following signals are energy signals or power signals and calculate their energy or power

I. $x(t)=\sin^2 w_0 t$ II. $x(t)= t\,u(t)$ CO.1[BTL-4]

B) Define, Formulate and Sketch all the elementary signals ? CO.1[BTL-1]

C) Solve whether the following signals are periodic or not? If periodic determine the fundamental period. CO.1,CO.2 [BTL-3]

I. $x(t) = 3\sin 200\,\pi t + 4\cos 100t$ II. $x(t) = 6e^{j(4t+\frac{\pi}{3})} + 8e^{j(3\pi t+\frac{\pi}{4})}$

2. A) State Dirichlet's Conditions for the existence of Fourier Transform? CO.2[BTL-1]

B) Show that the following signals are orthogonal over an interval **[0,1]** CO.1[BTL-3]

$x_1(t)=2$ and $x_2(t)=\sqrt{3}(1-2t)$

C) Evaluate Mean square error for N-dimensional orthogonal functions? CO.1[BTL-5]

3. A) A rectangular function ***x(t)*** is defined by

$$x(t)=\begin{cases} 1 \text{ for } 0 < t < \pi \\ -1 \text{ for } \pi < t < 2\pi \end{cases}$$

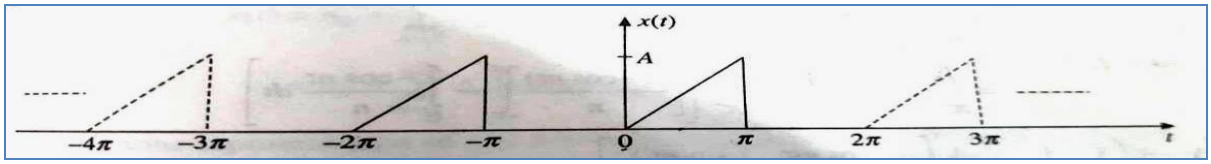
approximate the above rectangular function by a single sinusoid ***sint*** over the interval ***[0,2π]*** such that the mean square error is minimum. CO.1[BTL-2]

B) List out the basic signal operations and explain with an example? CO.1[BTL-1]

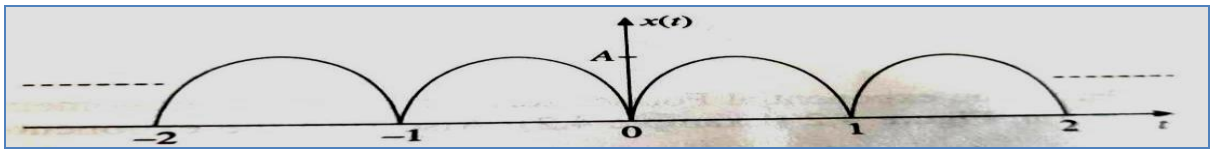
C) Sketch the following signals CO.1[BTL-3]

I. $x(t) = u(t) + u(t-4)$ II. $x(t) = \sin wt\,u(t-2)\,u(8-t)$

4. A)Obtain the Trigonometric Fourier series for the waveform shown in figure CO.2[BTL-4]



B)Illustrate the exponential Fourier series for the rectified sine wave shown in figure CO.2[BTL-3]



C) Justify the following with respect to Fourier series CO.2[BTL-3]

i) Odd functions have only sine terms

ii) Even functions have only cosine terms.

5. A)State and Prove following five properties of Fourier Transform CO.2[BTL-1,BTL-6]

I. Convolution II. Time scaling III. Multiplication IV. Time Integration V. Linearity

B) Solve the following Standard signals using Fourier Transform CO.2[BTL-3]

I. $sgn(t)$ II. Constant amplitude **(1)** III. Unit step function IV. $e^{|t|}$ V. $\Delta\left(\frac{t}{\tau}\right)$

C) Derive the Fourier transform pair equation of non-periodic signal from CO.2[BTL-1]

a periodic signal?

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ASSIGNMNET –II
Signals and Systems (EC303PC)

1. a) Check whether the following system

i. Static or dynamic

ii. Linear or non-linear

iii. Causal or non-causal

$$\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y^2(t) = x(t+1)$$ CO.3 [BTL-4]

b) Derive the relation between bandwidth and rise time of a low-pass filter

with neat sketches. CO.3 [BTL-2]

2. a) Draw the ideal filter characteristics for LPF, HPF, BPF and BRF. CO.3 [BTL-1]

b) Consider a stable LTI system that is characterized by the differential equation. CO.3 [BTL-4]

$\frac{d^2y(t)}{dt^2}+4\frac{dy(t)}{dt}+3y(t)=\frac{dx(t)}{dt}+2\,x(t)$. Find its response for input $x(t) = e^{-t}u(t)$.

3. a) State and prove initial and final value theorem for Laplace Transform. CO.4[BTL-1]

b) Find the inverse Laplace transform of the following CO.4 [BTL-3]

$X(s) = \frac{s^2+2s+5}{(s+3)(s+5)^2}$ For $(i) Re(s) < -5$ $(ii) Re(s) > -3$ $(iii)\ -5 < Re(s) < -3$

c) A system is described by the differential equation CO.4 [BTL-3&5]

$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8\,y(t) = \frac{dx(t)}{dt} + x(t)$; $\frac{dy(0)}{dt} = 3,\ y(0) = 1,\ x(t) = u(t)$, find the transfer function of the system and output signal y(t) ?

4. a) Write the properties of ROC of X(z). CO.4 [BTL-1]

b) Prove that the sequences CO.4 [BTL-3]

$(i)\, x(n) = a^n\, u(n)$ $(ii)\, x(n) = -a^n u(-n-1)$ have the same $X(z)$ and differ only in ROC. Also plot their ROCs.

c) Find the inverse Z-Transform of CO.4 [BTL-3]

$$X(z) = \frac{3z^{-1}}{(1-z^{-1})(1-2z^{-1})}$$

$(i) if\ ROC; |z| > 2$ $(ii)\ if\ ROC\ ; |z| < 1$ $(iii) if\ ROC\ ; 1 < |z| < 2$

5. a) When does aliasing occur how can it be avoided? CO.5 [BTL-1]

b) State and prove sampling theorem for band limited signals? CO.5 [BTL-2]

c) Define auto-correlation and cross-correlation of a function and state their properties? CO.5 [BTL-1]

10.Sample assignment script

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11.Unit-wise course material

ss-notes.rar

12.Mid question papers

II.B.TECH- I-SEM -I MID EXAMINATIONS, ***Date: 07-12-2022*** **Time*: 10:00 AM TO 11:30 AM***

Subject: Signals and Systems **Branch: ECE** **Marks: 25 M**

Note: Question paper contains two parts, Part - A and Part - B.

Part-A is compulsory which carries 10 marks. Answer all questions in part-A.

Part-B consists of (2 1/2) units. Answer any one full question from each unit. Each question carries 5 marks and may have a,b,c sub questions.

PART A **5 x2=10**

1. Solve whether the following signals are periodic or not? If periodic determine the fundamental period. CO.1,CO.2 [BTL-4]

I. $x(t) = 3\sin 200\,\pi t + 4\cos 100t$ II. $x(t) = 6e^{j(4t+\frac{\pi}{8})} + 8e^{j(3\pi t+\frac{\pi}{4})}$

2. Define, Formulate and Sketch any four of the Elementary signals? CO.1[BTL-1]
3. State Dirichlet's Conditions for the existence of Fourier Transform? CO.2[BTL-1]
4. Show that the following signals are orthogonal over an interval [0,1] CO.1[BTL-3]

$x_1(t) = 2\ and\ x_2(t) = \sqrt{3}(1-2t)$

5. Sketch the following signals CO.1[BTL-3]

I. $x(t) = u(t) + u(t-4)$ II. $x(t) = \sin wt\, u(t-2)\, u(8-t)$

PART B **3 x5=15**

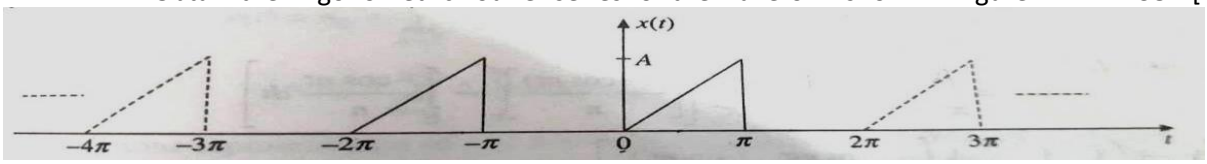
6. A rectangular function *x(t)* is defined by

$$x(t)=\begin{cases} 1\ for\ 0 < t < \pi \\ -1\ for\ \pi < t < 2\pi \end{cases}$$

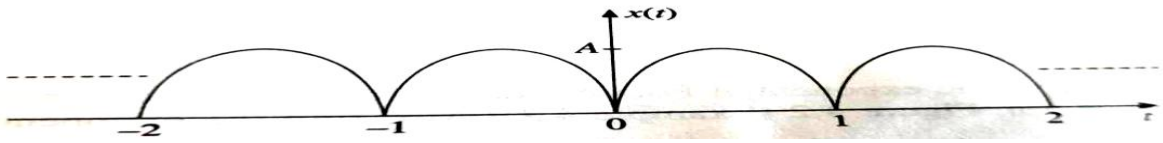
Approximate the above rectangular function by a single sinusoid *sin t* over the interval *[0,2π]* such that the mean square error is minimum. CO.1 [BTL-2]

(OR)

7. Obtain the Trigonometric Fourier series for the waveform shown in figure CO.2[BTL-3]



8. Find the Exponential Fourier series for the rectified sine wave shown in figure and plot frequency and phase spectrum. CO.2[BTL-3]



(OR)

9. Prove following properties of Fourier Transform CO.2[BTL-1,BTL-6]

II. Convolution b) Time Integration c) Parseval's Theorem

10. Fourier Transform of following Standard signals CO.2[BTL-3]

a) *sgn(t)* b) $e^{-a|t|}$ c). $\Delta\left(\frac{t}{\tau}\right)$

(OR)

11. Derive the Fourier transform pair equation of non-periodic signal from a periodic signal? CO.2[BTL-1]

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II.B.TECH- I-SEM -II MID EXAMINATIONS, Date: 08-02-2023 Time: 10:00 AM TO 11:30 AM

Subject: Signals and Systems Branch: ECE Marks: 25 M

Note: Question paper contains two parts, Part - A and Part - B.

Part-A is compulsory which carries 10 marks. Answer all questions in part-A.

Part-B consists of (21/2) units. Answer any one full question from each unit. Each question carries 5 marks and may have a, b, c sub questions.

PART A **5 x2=10**

1. Check whether the following system

i. Static or dynamic

ii. Linear or non-linear

$$\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 3y^2(t) = x(t+1)$$ **CO.3 [BTL-4]**

2. Draw the ideal filter characteristics for LPF, HPF, BPF and BRF? **CO.3 [BTL-2]**
3. Find the z-Transform of the following sequence $x(n) = -a^n u(-n-1)$ and draw its ROC? **CO.4 [BTL-3]**
4. Write the properties of ROC of X(z) ? **CO.4 [BTL-1]**
5. When does aliasing occur how can it be avoided? **CO.5 [BTL-2]**

PART B **3 x5=15**

6. Derive the relation between bandwidth and rise time of a low-pass filter with neat sketches? **CO.3 [BTL-2]**

(OR)

7. Consider a stable LTI system that is characterized by the differential equation. **CO.3 [BTL-4]**

$\frac{d^2y(t)}{dt^2}+4\frac{dy(t)}{dt}+3y(t)=\frac{dx(t)}{dt}+2\,x(t)$. Find its response for an input $x(t)=e^{-t}u(t)$?

8. Find the inverse Laplace transform of the following **CO.4 [BTL-3]**

$X(s)=\frac{s^2+2s+5}{(s+3)(s+5)^2}$ For $(i)Re(s)<-5\ \ (ii)Re(s)>-3\ \ (iii)\ -5<Re(s)<-3$

(OR)

9. Find the inverse Z-Transform of **CO.4 [BTL-3]**

$X(z)=\frac{3z^{-1}}{(1-z^{-1})(1-2z^{-1})}$ For $(i)if\ ROC;|z|>2\ \ (ii)\ if\ ROC\ ;|z|<1\ \ (iii)if\ ROC\ ;1<|z|<2$

10. State and prove sampling theorem for band limited signals? **CO.5 [BTL-2]**

(OR)

11. Define auto-correlation and cross-correlation of a function and state their properties? **CO.5 [BTL-1]**

SCHEME OF EVALUATION

Branch:ECE **Subject: SS**
Year: II-I-II-Mid **Date: 08-02-2023**
Total marks: 25 **Time: 10 A.M To 11:30 A.M**

Scheme of Evaluation

S.NO	THEORY	MARKS	TOTAL
PART-A			
1	Proving static or dynamic	1	2 Marks
	Proving linear or non-linear	1	
2	For drawing any two characteristics give 1 mark, For drawing all characterist then give 2 marks	2	2 Marks
3	Writing Z transform equation	1	2 Marks
	Applying z-transform for second given discrete function and draw it's ROC	1	
4	Writing at least 4 ROC properties of z-transform give 1 mark, if Writing all ROC properties of z-transform then give 2 marks	2	2 Marks
5	Formula for Nyquist rate	1	2 Marks
	About Aliasing effect theory	1	
	PART-B		
6	Writing low pass filter characteristics	2	5 Marks
	Derivation for rise time and bandwidth	3	
7	Applying laplace transform for given differential equation to find out H(S)	2	5 Marks
	Applying laplace transform for given x(t) to find out X(S)	1	
	Finding Y(S)	1	

	Applying inverse laplace transform for Y(S) to find y(t)	1	
8	Finding poles and to do partial fractions for given X(S)	2	5 Marks
	Applying inverse laplace transform for X(S) to find x(t) for each Region .	3	
9	Finding poles and to do partial fractions for given X(z)	2	5 Marks
	Applying inverse z transform for X(z) to find x(n) for each Region .	3	
10	Writing Nyquist rate	1	5 Marks
	Drawing magnitude graph for converting C.T signal to D.T signal	1	
	For Sampling derivation	3	
11	Definition of Auto and Cross Correlation functions	1	5 Marks
	Properties statement of of Auto Correlation	2	
	Properties statement of of Cross Correlation	2	

12. Sample mid answer script

mid I & ii.rar

13. Material collected from Internet/Websites

SS.rar

14. Power point presentations

Signals and Systems-Total-PPT.rar

15. Previous question papers

pre assignment.rar

16. References (Text books/websites/Journals)

WEBSITES:

I. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course%20Objective.htm

II. http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/index.htm

III. www.iitd.ernet.in

IV. http://books.google.co.in/books?id=VgUtRFHXQicC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

V. http://www.nptel.iitm.ac.in/courses/117104074

VI. http://users.ece.gatech.edu/~bonnie/book/worked_problems.html

VII. http://engineeringppt.blogspot.in/2010/01/signals-and-systems.html

EXPERT DETAILS

The Expert Details which have been mentioned below are only a few of the eminent ones known Internationally, Nationally and Locally. There are a few others known as well.

INTERNATIONAL

1 Prof.Yulin Wang-International School of Software, Wuhan University, China
2 Prof. George Constantine Giakos, The University of Akron, USA

NATIONAL

1. Dr.MaheshChandra, DepartmentofElectronicsandCommunicationEngineeringBITMesra, Ranchi, India
2. P.Ramesh babu,Assitant professor at saranathan college of engineering, trichy-12, Tamil nadu ,India

REGIONAL

1. Prof. N.S. Murthy, Dept. of ECE, NIT, Warangal.
2. P. Sri hari-Professor & Head of the Dept., Dept.of Electronics and Instrumentation Engg. GITAM University, Hyderabad .

JOURNAL:

INTERNATIONAL

1. *IEEE Transactions on Signal Processing,*, pp. 4811-4823, September 2010.
2. *IEEE Transactions on Audio, Speech, and Language Processing* , Vol. 21, No. 6, June 2013
3. *IEEE Transactions on Automatic Control*. vol. 58, no. 3, March 2013
4. Circuits, systems and signal processing (USA)

NATIONAL

1. Signal, Image and speech processing
2. Circuits and Systems
3. Pattern Recognition