KG REDDY College of Engineering & Technology

COURSE FILE CONTENTS

KG REDDY College of Engineering & Technology

Part – 2

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1. Vision, Mission, Program Educational Objectives(PEO'S), Program Outcomes(PO'S) & Program Specific Outcomes(PSO'S)

Vision

To be recognized as a full-fledged centre for learning and research in various fields of Electronics and Communication Engineering through industrial collaboration and provide consultancy for solving the real time problems

Mission

- To inculcate a spirit of research and teach the students about contemporary technologies in Electronics and Communication to meet the growing needs of the industry.
- To enhance the practical knowledge of students by implementing projects based on real time problems through industrial collaboration

Program Educational Objectives

PEO 1: Have strong foundation in mathematical, scientific, engineering fundamentals and communication skills necessary to formulate, understand, analyze and solve technological problems.

PEO 2: Have a technical background to design and develop systems in the main fields of electronics and communication systems.

PEO 3: Practice the ethics of their profession consistent with a sense of social responsibility and develop their engineering design, problem solving skills and aptitude for innovations as they work individually and in multi disciplinary teams.

PEO 4: Be receptive to new technologies and attain professional competence through lifelong learning such as advanced degrees, professional registration, publications and other professional activities.

Program Outcomes

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.

PROGRAMME SPECIFIC OUTCOMES (PSO's)

PSO 1: **Problem Solving Skills** – Graduate will be able to apply latest electronics techniques and communications principles for designing of communications systems.

PSO 2: **Professional Skills** – Graduate will be able to develop efficient and effective Communications systems using modern Electronics and Communications engineering techniques.

PSO 3: **Successful Career** – To produce graduates with a solid foundation in Electronics and Communications engineering who will pursue lifelong learning and professional development including post graduation.

PSO 4: **The Engineer and Society**– Ability to apply the acquired knowledge for the advancement of society and self.

3) Course Objectives, Course Outcomes and Topic Outcomes

a) Course objectives

1. Define the basics of Signals and Systems required for all Electrical Engineering related courses.
2. Discuss concepts of Signals and Systems and its analysis using different transform techniques.
3. Describe the concept of random process which is essential for random signals and systems encountered in Communications and Signal Processing areas.

b) Course Outcomes

At the end of the course student will be able to

CO 1: Recognize the characteristics of linear time invariant systems.

CO 2: Develop any arbitrary analog or Digital time domain signal in frequency domain.

CO 3: Differentiate the Laplace transform and Z-transform

CO 4: Explain the concepts of Random Process and its Characteristics.

CO 5: Illustrate the response of linear time Invariant system for a Random Processes

c) Topic Outcomes

S.No	Topic	**Topic outcome** At the end of the topic the student will be able to
	UNIT-I **Signal Analysis , Signal Transmission through Linear Systems**	
1	Signals and Stochastic Process(SSP)	Define the signals and stochastic process
2	Fundamentals of signals and systems	Define the signal and system
3	Classification of signals and systems	Classify the different signals and systems
4	Operations on signals	Determine the operations on signals
5	**Signal Analysis:** Analogy between Vectors and Signals, Orthogonal Signal Space.	Define signal, system and orthogonal signal space
6	Signal approximation using Orthogonal functions, Mean Square Error.	Approximate the signal using orthogonal function.Define mean square error.
7	Closed or complete set of Orthogonal functions, Orthogonality in Complex functions.	Define the complete set of orthogonal functions and Orthogonality in complex functions

8	Exponential and Sinusoidal signals Concepts of Impulse function, Unit Step function, Signum function.	Define the basic signals in graphical as well as functional representation
9	Classifications of Signals.	Define the different classifications of signals. Compare the energy and power signal.
10	Classifications of Systems .	Define linear system. Define linear time invariant (LTI) t system.
11	Response of Linear Time Variant (LTI) and LTV System, Transfer function of a LTI system.	Define the response of the LTI system. Design the transfer function of LTI system
12	Distortion less transmission through a system, Signal bandwidth, System bandwidth.	sketch the magnitude and phase spectrums distortion less transmission system
13	Filter characteristics of linear system.	Sketch the magnitude response of all the filters
14	Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization.	Sketch the LPF characteristics in the frequency domain. Construct causality of a system by using Paley - Weiner criteria
15	Relationship between Bandwidth and Rise time. Concept of convolution in Time domain and Frequency domain.	Define the relation between bandwidth and rise time Implement the convolution in time domain for continuous time signals
16	Graphical representation of Convolution, Convolution property of Fourier Transform.	Sketch the convolution of two signals.
	Unit-II **Fourier series, Transforms, and Sampling**	
17	**Introduction** **Fourier series:** Representation of Fourier series Continuous time periodic signals.	Define any periodic signal in terms of Fourier series
18	Properties of Fourier Series, Dirichlet's conditions,.	Define the properties of Fourier series
19	Trigonometric Fourier Series Exponential Fourier Series.	Relate any periodic signal in terms of Trigonometric, exponential forms of Fourier Series
20	**Fourier Transforms:** Deriving Fourier Transform from Fourier series.	Derive Fourier transform from Fourier series
21	Fourier Transform of arbitrary signal, Fourier Transform of standard signals.	Determine the Fourier transform of standard signals like impulse function
22	Fourier Transform of Periodic Signals, Properties of Fourier Transform.	Define linearity property

23	Problems on Fourier transform and inverse Fourier transform.	Determine Fourier transform the different signals like triangular signal, sinwt, coswt etc
24	**Sampling:** Sampling theorem – Graphical and analytical proof reconstruction of signals from its samples- aliasing effect.	Convert the continuous time signal to discrete time signal. State and prove the sampling theorem
25	Types of Sampling.	Compare the different types of sampling
26	Problems on sampling theorem.	Sketch the sampled spectrum and determine Nyquist rate for a given signal.
	Unit-III **Laplace Transforms and Z–Transforms**	
27	**Laplace Transforms:** Review of Laplace Transforms (L.T), Region of Convergence (ROC), and Constraints on ROC for various classes of signals.	Determine the Laplace transform and sketch the ROC for a given signal.
28	Properties of Laplace Transform,	Define and prove the properties of Laplace transform.
29	Laplace transform of different signals Relation between L.T and F.T of a signal Inverse Laplace transform	Determine Laplace Transform of different signal and also sketch region of convergence for various signals.
30	Laplace Transform of certain signals using waveform synthesis.	Determine Laplace transform of certain signals by using wave form synthesis
31	**Z–Transforms:** Fundamental difference between Continuous and Discrete time signals.	Determine the Z-transform and inverse Z-transformof a discrete time signal
32	Region of Convergence *ROC* of Z-Transform along with properties	Define and sketch the Region of Convergence (ROC) for discrete time signals
33	Z-Transform of Basic Signals .	Determine the Z-Transform of different discrete time signals
34	Concept of Z Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms.	Compare Laplace and Fourier transform Z.T and DTFT
35	Properties of Z-Transform.	Define and prove the properties of Z-transform
36	Fundamentals of probability	Define the probability
	Unit-IV **Random Processes – Temporal Characteristics**	
37	**:** The Random Process Concept, Classification of Processes.	Define the random process and compare the different random processes
38	Distribution and Density Functions.	Determine the Distribution and density Functions

39	Concept of Stationarity and First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense stationarity.	Define the first, second order stationary process and also WSS process.
40	Statistical properties of Random Processes	Define the statistical properties of the random process like mean, autocorrelation and the cross correlation
41	Time Averages and Ergodicity.	Define time average function and Ergodicity
42	Autocorrelation Function and Its Properties.	State and prove the properties of autocorrelation function
43	Cross-Correlation Function and Its Properties.	State and prove the properties of cross correlation
44	Covariance Functions, Gaussian Random Processes, Poisson Random Process.	Define the covariance function and Gaussian and poison random process.
45	Random Signal, Mean and Mean-squared Value of System Response.	Define the mean for continuous and discrete case.
46	Problems on autocorrelation and cross correlation.	Compare the autocorrelation and cross correlation functions.
47	Problems on autocorrelation and cross correlation. And Summary of the unit four	Determine the autocorrelation from the power spectrum density.
	Unit-V **Random Processes – Spectral Characteristics:**	
48	Relation between power spectrum and auto correlation function.	Define the power spectrum density of a real process. .
49	The Power Spectrum and its Properties.	Define Cross-Power Density Spectrum
50	The Cross-Power Density Spectrum and its properties.	Define Cross-Power Spectrum
51	Relationship between Cross-Power Spectrum and auto-Correlation Function.	Relate the cross power spectrum with cross correlation
52	Relationship between Cross-Power Spectrum and Cross-Correlation Function.	Determine the response of the LTI for deterministic input
53	Spectral Characteristics of System Response Power Density Spectrum of Response.	Determine output power spectral density
54	Cross-Power Density Spectrums of Input and Output.	Solve the problems on the random process
55	Filter design	Design the different types of filters
56	AWG noise characteristics	Explain the AWG noise characteristics

4) COURSE PRE–REQUISITES

1. Basics of signals and systems
2. Classifications of signals and system
3. Operations on signals
4. Introduction to vectors
5. Fundamentals of probability

5) CO'S, PO'S mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1								
CO2	2	3		1	1							
CO3	3	2		2	2							
CO4	2	1		2								
CO5	2	1		2								

Legends: 1 – Low

2 – Medium

3 – High

6. COURSE INFORMATION SHEET

6.a). COURSE DESCRIPTION:

PROGRAMME: B. Tech. (Electronics and Communications Engineering.)	DEGREE: B.TECH
COURSE: **SIGNALS AND STOCHASTIC PROCESS**	YEAR: II SEM: I CREDITS: 4
COURSE CODE: EC304ES REGULATION: R16	COURSE TYPE: CORE
COURSE AREA/DOMAIN: Basics in signal processing	CONTACT HOURS: 3+1 (L+T)) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):EC307ES	LAB COURSE NAME: BS LAB

6.b). SYLLABUS:

Unit	Details	Hours
I	**Signal Analysis:** 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, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function. **Signal Transmission through Linear 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 characteristics of Linear Systems, 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. Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution, Convolution property of Fourier Transforms	13
II	**Fourier series, Transforms, and Sampling: Fourier series:** Representation of Fourier series, Continuous time periodic signals, 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, Fourier Transforms involving Impulse function and Signum function. **Sampling:** Sampling theorem – Graphical and analytical proof for Band Limited Signals, Reconstruction of signal from its samples, Effect of under sampling – Aliasing.	10
III	**Laplace Transforms and Z–Transforms: Laplace Transforms:** Review of Laplace Transforms (L.T), Partial fraction expansion, Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Constraints on ROC for various classes of signals, Properties of L.T, Relation between L.T and F.T of a signal,	9

	Laplace Transform of certain signals using waveform synthesis. **Z–Transforms:** Fundamental difference between Continuous and Discrete time signals, Discrete time signal representation using Complex exponential and Sinusoidal components, Periodicity of Discrete time signal using complex exponential signal, 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.	
IV	**Random Processes – Temporal Characteristics:** The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationary and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationary, (N-Order) and Strict-Sense Stationary, Time Averages and Periodicity, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.	11
V	**Random Processes – Spectral Characteristics:** The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.	7
	Contact classes for syllabus coverage	**50**
	Lectures beyond syllabus	**02**
	Tutorial classes	**12**
	Classes for gaps& Add-on classes	**06**
	Total No. of classes	**70**

6.c). GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

S.NO.	DESCRIPTION	No. Of Classes
1	Fundamentals of signals and systems	2
2	Classifications of signals and systems, operation on signals	2
3	Fundamentals of probability	2

6. d). TOPICS BEYOND SYLLABUS / ADVANCED TOPICS:

S.NO.	DESCRIPTION	No. Of Classes
1	Filter design	1
2	AWG noise characteristics	1

6. e). WEB SOURCE REFERENCES:

Sl. No.	Name of book/ website
a.	nptel.ac.in/courses/112104121/1
b.	http://nptel.ac.in/courses/117101055/14
c.	http://nptel.ac.in/courses/117101055/36

6. f). DELIVERY / INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑ WEB RESOURCES
☑ LCD/SMART BOARDS	☑ STUD. SEMINARS	☐ ADD-ON COURSES

6.g). ASSESSMENT METHODOLOGIES - DIRECT

☑ ASSIGNMENTS	☑ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☑ STUD. LAB PRACTICES	☑ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

6.h). ASSESSMENT METHODOLOGIES - INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

6.i). TEXT / REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
Text Book	Signals, Systems & Communications - B.P. Lathi , 2013, BSP.
Text Book	Signal and systems principles and applications, shaila dinakar Apten, Cambridez university press, 2016.
Text Book	Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, MCGRAW HILL EDUCATION, 4th Edition, 2001
Reference Book	Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, 2 Ed.,
Reference Book	Signals and Signals – Iyer and K. Satya Prasad, Cengage Learning
Reference Book	Signals and sytems- A Nagoor Kani, Mc Graw Hill

7. Micro Lesson Plan

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Topic wise Coverage [Micro Lesson Plan]			
S.No.	**Topic**	**Scheduled date**	**Actual date**
	Unit-I		
1	Introduction to Signals and Stochastic Process(SSP)		
2	Fundamentals of signals		
3	Fundamentals of systems		
4	Classification of signals and systems		
5	Operations on signals		
6	**Signal Analysis:** Analogy between Vectors and Signals,Orthogonal Signal Space.		
7	Signal approximation using Orthogonal functions, Mean Square Error.		
8	Closed or complete set of Orthogonal functions, Orthogonality in Complex functions.		
9	Exponential and Sinusoidal signals Concepts of Impulse function, Unit Step function, Signum function.		
10	Classifications of Signals.		
11	Classifications of Systems .		
12	Response of Linear Time Variant (LTI) and LTV System, Transfer function of a LTI system.		
13	Distortion less transmission through a system, Signal bandwidth, System bandwidth.		
14	Filter characteristics of linear system.		
15	Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization.		
16	Relationship between Bandwidth and Rise time. Concept of convolution in Time domain and Frequency domain.		
17	Graphical representation of Convolution, Convolution property of Fourier Transform.		

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18	Orthogonal signal space		
19	Linear time invariant systems		
20	Graphical representation of convolution		
	Unit-II **Fourier series, Transforms, and Sampling**		
21	**Introduction** **Fourier series:** Representation of Fourier series Continuous time periodic signals.		
22	Properties of Fourier Series, Dirichlet's conditions,.		
23	Trigonometric Fourier Series Exponential Fourier Series.		
24	**Fourier Transforms:** Deriving Fourier Transform from Fourier series.		
25	Fourier Transform of arbitrary signal, Fourier Transform of standard signals.		
26	Fourier Transform of Periodic Signals, Properties of Fourier Transform.		
27	Problems on Fourier transform and inverse Fourier transform.		
28	**Sampling:** Sampling theorem – Graphical and analytical proof reconstruction of signals from its samples- aliasing effect.		
29	Types of Sampling.		
30	Problems on sampling theorem.		
31	Fourier transform of standard signals		
32	Sampling theorem		
	Unit-III **Laplace Transforms and Z–Transforms**		
33	**Laplace Transforms:** Review of Laplace Transforms (L.T), Region of Convergence (ROC), and Constraints on ROC for various classes of signals.		
34	Properties of Laplace Transform,		
35	Laplace transform of different signals Relation between L.T and F.T of a signal Inverse Laplace transform		
36	Laplace Transform of certain signals using waveform synthesis.		

37	**Z–Transforms:** Fundamental difference between Continuous and Discrete time signals.		
38	Region of Convergence *ROC* of Z-Transform along with properties		
39	Z-Transform of Basic Signals .		
40	Concept of Z Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms.		
41	Properties of Z-Transform.		
42	Relation between L.T and F.T of a signal		
43	Properties of Z-transforms		
44	Fundamentals of probability		
45	Fundamentals of probability		
	Unit-IV		
46	**Random Processes – Temporal Characteristics:** The Random Process Concept, Classification of Processes.		
47	Distribution and Density Functions.		
48	Concept of Stationarity and First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense stationarity.		
49	Statistical properties of Random Processes		
50	Time Averages and Ergodicity.		
51	Autocorrelation Function and Its Properties.		
52	Cross-Correlation Function and Its Properties.		
53	Covariance Functions, Gaussian Random Processes, Poisson Random Process.		
54	Random Signal, Mean and Mean-squared Value of System Response.		
55	Problems on autocorrelation and cross correlation.		
56	Problems on autocorrelation and cross correlation. And Summary of the unit four		

57	Distribution and density function		
58	Time averages and ergodicity		
59	Auto correlation function of response		
	Unit-V **Random Processes – Spectral Characteristics:**		
60	Relation between power spectrum and auto correlation function.		
61	The Power Spectrum and its Properties.		
62	The Cross-Power Density Spectrum and its properties.		
63	Relationship between Cross-Power Spectrum and auto-Correlation Function.		
64	Relationship between Cross-Power Spectrum and Cross-Correlation Function.		
65	Spectral Characteristics of System Response Power Density Spectrum of Response.		
66	Cross-Power Density Spectrums of Input and Output.		
67	Relationship between power spectrum and auto correlation function		
68	Power density spectrum of response		
69	Filter design		
70	AWG noise characteristics		

15. Tutorial Topics and Questions

- Orthogonal signal space
- Linear time invariant systems
- Graphical representation of convolution
- Fourier transform of standard signals
- Sampling theorem
- Relation between L.T and F.T of a signal
- Properties of z-transforms
- Distribution and density functions
- Time averages and ergodicity
- Auto correlation function of response
- Relationship between power spectrum and auto correlation function
- Power density spectrum of response

Questions

1. Explain the orthogonal signal space
2. Explain the linear time invariant systems
3. Draw and explain the graphical representation of convolution
4. Determine the Fourier transform of standard signals
5. State and prove the sampling theorem
6. Derive the relation between L.T and F.T of a signal
7. State and prove any four properties of z-transforms
8. Explain distribution and density functions
9. Write short notes on time averages and ergodicity
10. Explain the response of auto correlation function
11. Derive the Relationship between power spectrum and auto correlation function
12. Explain the response of power density spectrum

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