ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**Signals and Stochastic Process**			
Academic Year	**2018-19**			
Course Code	**EC304ES**			
Regulation	**R16**			
Year & Sem	**II Year & I Sem**			
Course structure	Lectures	Tutorial	Practicals	Credits
	3	**1**	**0**	**3**
Course Faculty	**Mrs. ASIYA SULTHANA**			

I. OVERVIEW

Signals and Systems encounter extensively in our day-to-day lives, from making a phone call, listening to a song, editing photos, manipulating audio files, using speech recognition software's like Siri and Google now, to taking EEGs, ECGs and X-Ray images. Each of these involves gathering, storing, transmitting and processing information from the physical world. This course will equip to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems. Here we will explore the various properties of signals and systems, characterization of Linear Time Invariant Systems/ Time variant systems, convolution and Fourier Series and Transform, and also deal with the Sampling theorem, Z-Transform, Correlation and Laplace transform. Ideas introduced in this course will be useful in understanding further Electronic/Electrical Engineering courses which deal with control systems, communication systems, digital signal processing, statistical signal analysis and digital message transmission. Further concepts such as signal sampling and aliasing are introduced. The theory is exemplified with processing of signals in MATLAB.

The course addresses the concepts, principles and techniques of sets and probability and random variable and random process. The course teaches the fundamentals of probability applying the concepts of mean and variance and development techniques. This course forms the basis for the study of advanced subjects like signals and systems. Students will learn probability concepts and difference between random variable and random process and estimation of power spectral density.

II. PREREQUISITE(S)

Engineering Mathematics, Basics of Vector theory,Mathematics I,Mathematics II

III. MARKS DISTRIBUTION

For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of one **objective paper, one descriptive paper and one assignment.** The objective paper and the descriptive paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for descriptive paper). The objective paper is set with 20 bits of multiple choice, fill-in the blanks and matching type of questions for a total of 10 marks. The descriptive paper shall contain 4 full questions out of which, the student has to answer 2 questions, each carrying 5 marks. While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus. Five marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid examination, and the second assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each student in internals/sectionals. If any student is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the university. The details of the question paper pattern are as follows.

The end semester examinations will be conducted for 75 marks consisting of two parts viz. i) Part-A for 25 marks, ii) Part - B for 50 marks.

Part-A is compulsory question which consists of ten sub-questions. The first five sub-questions are from each unit and carry 2 marks each. The next five subquestions are one from each unit and carry 3 marks each.

Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

IV. EVALUATION SCHEME

S. No	COMPONENT		DURATION	MARKS
1	Mid –I Examination	Theory	One Hour	10
		Quiz	20 Minutes	10
		Assignment - 1	--	05
2	Mid –II Examination	Theory	One Hour	10
		Quiz	20 Minutes	10
		Assignment - 2	--	05
3	Semester End Examination	--	3 Hours	75

V. COURSE OBJECTIVES

- This gives the basics of Signals and Systems required for all Electrical Engineering related courses.
- This gives concepts of Signals and Systems and its analysis using different transform techniques.
- This gives basic understanding of random process which is essential for random signals and systems encountered in Communications and Signal Processing areas.

VI. COURSE OUTCOMES

By the end of this course, Students should be able to:

1. **Analyze Construct** arbitrary signal in terms of complete sets of orthogonal functions.
2. **Determine** the response of an LTI system to arbitrary input signals.
3. **Analyze** various signals and systems, its operations in time domain and frequency domain and **Interpret** Sample and Reconstruction of Signals.
4. **Evaluate** the statistical parameters of Random Processes and LTI system in temporal domain.
5. **Estimate** various spectral characteristics of random processes and LTI system.

VII. HOW PROGRAM OUTCOMES (POs) ARE ASSESSED

PROGRAM OUTCOMES		LEVEL	ASSESSED BY
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**H**	**Lectures, Assignments, Exercises**
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.	**H**	**Assignments, Hands on Practice**
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.	**N**	**-**
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.	**H**	**Lab Sessions, Hands on Practice**
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.	**N**	**-**
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.	**N**	**-**

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.	**N**	**-**
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**N**	**-**
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	**N**	**-**
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.	**N**	**-**
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.	**N**	**-**
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.	**H**	**Exercises**

VIII. **HOW PROGRAM SPECIFIC OUTCOMES (PSOs) ARE ASSESSED**

PROGRAM OUTCOMES		**LEVEL**	**ASSESSED BY**
PSO1	Students shall have knowledge on **specific problems in Industrial and Domestic automation** and ability to provide prototype solutions Using (i) Advanced Micro	**N**	**-**

	Controllers/Processors & DSP processor, (ii) Software Tools.		
PSO2	Developing student's ability to **Design and Simulate Architectures** in VLSI domain using Xilinx and FPGA, thereby, evaluating and analyzing the performance of them by EDA Tools.	**N**	**-**

N- None **S- Supportive** **H- Highly Related**

IX. SYLLABUS

EC304ES: Signals and Stochastic Process

B.Tech. II Year I Sem. **L T P C**
3 1 0 3

UNIT – I

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signala pproximation using Orthogonal functions, Mean Square Error, Closed or complete set ofOrthogonal functions, Orthogonality in Complex functions, Exponential and Sinusoidalsignals, Concepts of Impulse function, Unit Step function, Signum function. **Signal Transmission through Linear Systems:** Linear System, Impulse response, Responseof 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 lesstransmission 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

UNIT – 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.

UNIT – 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, 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.

UNIT – IV

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution an Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and ItsProperties, Cross-Correlation Function and Its Properties, Covariance Functions, GaussianRandom Processes, Poisson Random Process. Random Signal, Mean and Mean-squaredValue of System Response, autocorrelation Function of Response, Cross-CorrelationFunctions of Input and Output.

UNIT- 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 Spectrumof Response, Cross-Power Density Spectrums of Input and Output.

X. **COURSE PLAN**

Lecture No.	Name of the Unit / Topic	Topic Covered Date
1	**UNIT - I :Signal Analysis** 1.1 Analogy between Vectors and Signals	
2	1.2 Orthogonal Signal Space	
3	1.3Signal approximation using Orthogonal functions	
4	1.4 Mean Square Error	
5	1.5Closed or complete set of Orthogonal functions	
6	1.6 Orthogonality in Complex functions	
7	1.7 Exponential and Sinusoidal signals, Concepts of Impulse function	
8	1.8Unit Step function	
9	1.9 Signum function	
	1.10 Signal Transmission through Linear Systems: Linear System,	
10	1.11 Impulse response	
11	1.12 Response of a Linear System	
12	1.13Linear Time Invariant (LTI) System	
13	1.14 Linear Time Variant (LTV) System	
14	1.15 Transfer function of a LTI system	
15	1.16 Filter characteristics of Linear Systems,	
16	1.17 Distortion less transmission through a system	
17	1.18 Signal bandwidth	
18	1.19 System bandwidth	
19	1.20.Ideal LPF, HPF and BPF characteristics	
20	1.21 Causality and Paley-Wiener criterion for physical realization	
21	1.22 Relationship between Bandwidth and Rise time	
22	1.23 Concept of convolution in Time domain and Frequency domain	
23	1.24 Graphical representation of Convolution, Convolution property of Fourier Transforms	
	UNIT - II : Fourier series, Transforms, and Sampling: Fourier series: 2.1Representation of Fourier series,	
24	2.2 Continuous time periodic signals	
25	2.3Properties of Fourier Series, Dirichlet's conditions,	
26	2.4 Trigonometric Fourier Series and Exponential Fourier Series	
27	2.5 Complex Fourier spectrum.	

28	2.6 Fourier Transforms: Deriving Fourier Transform from Fourier series,	
29	2.7 Fourier Transform of arbitrary signal	
30	2.8 Fourier Transform of standard signals,	
31	2.9 Fourier Transform of Periodic Signals	
32	2.10 Properties of Fourier Transform	
33	2.11 Fourier Transforms involving Impulse function and Signum function.	
34	2.12 Sampling: Sampling theorem	
35	2.13 Graphical and analytical proof for Band Limited Signals	
36	2.14 Reconstruction of signal from its samples	
37	2.15 Effect of under sampling – Aliasing	
	UNIT - III : Laplace Transforms and Z–Transforms **3.1Review of Laplace Transforms (L.T),**	
38	3.2 Partial fraction expansion, Inverse Laplace Transform	
39	3.3Concept of Region of Convergence (ROC) for Laplace Transforms	
40	3.4 Constraints on ROC for various classes of signals, Properties of L.T, Relation between L.T and F.T of a signal,	
41	3.5 Laplace Transform of certain signals using waveform synthesis	
42	3.6 Z–Transforms: Fundamental difference between Continuous and Discrete time signals,	
43	3.7 Discrete time signal representation using Complex exponential and Sinusoidal components	
44	3.8 Periodicity of Discrete time signal using complex exponential signal,	
45	3.9 Concept of Ztransform of a Discrete Sequence	
46	3.10 Distinction between Laplace, Fourier and Z Transforms,	
47	3.11 Region of Convergence in Z-Transform	
48	3.12 Constraints on ROC for various classes of signals	
49	3.13Inverse Z-transform, Properties of Z-transforms	
	UNIT - IV :Random Processes – Temporal Characteristics 4.1The Random Process Concept, Classification of Processes	
50	4.2 Deterministic and Nondeterministic Processes	
51	4.3 Distribution and Density Functions,	
52	4.4 concept of Stationarity and Statistical Independence.	
53	4.5 First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity	

54	4.6 (N-Order) and Strict-Sense Stationarity	
55	4.7 Time Averages and Ergodicity,	
56	4.8 Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions,	
57	4.9 Gaussian Random Processes, Poisson Random Process. Random Signal,	
58	4.10 Mean and Mean-squared Value of System Response,	
59	4.11 autocorrelation Function of Response	
60	4.12 Cross-Correlation Functions of Input and Output	
61	**Topics beyond syllabus**	
62	**PROBABILITY** : Probability introduced through Sets and Relative Frequency	
63	Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms,	
64	**THE RANDOM VARIABLE** : Introduction, Random Variable Concept, Distribution Function, Density Function, Properties, The Gaussian Random Variable	
65	**MULTIPLE RANDOM VARIABLES** : Multiple Random Variables : Vector Random Variables, Joint Distribution and density functions, Properties, Marginal Distribution Functions ,Conditional Distribution and Density, Statistical Independence, Distribution and density of a sum of random variables, Central Limit Theorem	
66	**Noise Analysis** :Noise classification: uncorrelated noise (external nose :atmospheric noise, extra terrestrial noise, manmade noise. internal noise: shot noise, transit-time nose, thermal noise)	

XI. MAPPING OF COURSE OUTCOMES WITH POs AND PSOs

Course Outcome	**Program Outcomes(POs)**												**Program Specific Outcome (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO**

CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	2	-	-
Avg.	2.6	2.4	-	2.25	-	-	-	-	-	-	-	2	-	-