University of Mumbai			
CLASS: T.E. (Electronics Engineering)		**Semester - VI**	
SUBJECT: Discrete time signals and systems			
Periods per week (each of 60 min.)	Lecture	4	
	Practical	2	
	Tutorial	-	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical examination		
	Oral Examination	-	25
	Term Work	-	25
	Total		150

Objective	This second course in signals and systems aims to introduce the student to the idea of discrete time signal processing as a foundation course for subjects like image processing, speech processing, filter design, adaptive signal processing. It also covers introduction to DSP processors	
Pre-requisite	Basic Continuous signals and systems	
Module	**contents**	**Hours**
1	**Discrete Time (DT) signals & Systems** Signal classification manipulations Signal Periodicity in DT domain Concept of system and System classification System representation as a difference equation Impulse Response Finite Impulse Response (FIR) & Infinite Impulse Response (IIR) systems Convolution and its properties , auto correlation and cross correlation with its properties BIBO stability condition	8
2	**Z Transform** Two-sided Z Transform and Region of Convergence (ROC) Properties of Z Transform and derivations Relationship with Laplace Transform & mapping One-sided Z Transform Inverse Z Transform	6
3	**D.T.System analysis using Z Transform** System Transfer function & Impulse response, pole zero plot BIBO stability and ROC	10

	Solution of a difference equation zero input & zero state responses Frequency response using Analytical & graphical techniques Pole zero plot and filter type for first and second order systems System classification based on phase response as Minimum phase, maximum phase, mixed phase or linear phase systems	
4	**DT Signal Analysis & Computation of Spectra** DTFS definitions from orthogonal complex exponentials CTFS & DTFS and Properties of DTFS Power Density spectrum DTFT and Properties of DTFT Energy Density spectrum Relationship between DTFT & Z transform	6
5	**Discrete Fourier Transform (DFT)** DFT and comparison with other transforms DFT Properties Circular convolution Block convolution using DFT by Overlap-add & Overlap-save methods Fast Fourier Transform (FFT) by radix 2 and radix 3 and radix 4 techniques. Decimation in Time Decimation in frequency with development of flow graphs DFT analysis of Sinusoidal signals Goertzel algorithm Comparison of complex and real, multiplication and additions of DFT and FFT. DFT computation by Divide and conquer approach Limitations of DFT Applications of FFT	10
6	**DSP Processors and application of DSP** Need for Special architecture of DSP processor Difference between DSP processor & microprocessor Fixed point and floating point processors A general DSP processor (TMS320C54XX series), TMS6713, and Da-vinci. Application of DSP to speech, image, biomedical and radar processing.	08

Text- Books:

- Ashok Ambardar, Digital Signal Processing, Cengeg Learning Publication,.
- J.G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and applications, Prentice Hall of India, 1995
- A.V. Oppenheim, Ronald W Schafer, Prentice Hall, 1983.
- E.C.Ifeachor and B.W Jervis,Digital Signal Processing A Practical approach, Pearson Publication.
- B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and TMH, 2004.

Additional Reading:

- S.K. Mitra, Digital Signal Processing, Tata McGraw-Hill Publication, 2001
- B.P.Lathi, linear systems and signals Oxford University Press second Indian Impression, 20007.
- B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and TMH, 2004.

- R.H .Bishop Learning with Lab View 7 Express Pearson education
- Gupta,Virtual Instrumentation using Labview Tata McGraw-Hill Publication,
- Chi-tsong Chen Digital signal processing, Oxford University Press

Suggested list of simulations

Matlab or C/C++ or Labview:

1. Generation and transformations of basic D.T. signals(2 simulations)
2. Discrete periodicity
3. Convolution ,correlation, autocorrelation
4. Z transform of standard signals
5. System impulse response for various inputs
6. Magnitude and phase response using DTF
7. Circular convolution using FFT
8. System realization
9. Application of signal processing operation to practical one dimensional signal e.g. speech signal ,ECG signal, music signal etc.(different signal can be used by different students group as a practical assignment)
10. Real time experiments using DSP processor

T.W. / Oral Examination:

Term Work:

The term work shall consist of at least two numerical assignments and eight MATLAB/ C or Labview simulations covering the whole of syllabus, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments and Journal) : 10 marks.

Test (at least one) : 10 marks.

Attendance (Practical and Theory) : 05 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Theory Examination:

1. Question paper will be comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and will cover all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
6. No question should be asked from pre-requisite module.