

## Academic Course Description

BHARATH UNIVERSITY  
Faculty of Engineering and Technology  
Department of Electronics and Communication Engineering

**BEC505– DIGITAL SIGNAL PROCESSING**  
**Fifth Semester**

### Course (catalog) description

The course considers Digital signal processing and techniques. In this course, we will introduce some of the basic mathematical concepts that will allow us to think in the two “domains” of Signal Processing, the time domain and the frequency domain. The course covers the basic types of digital signals & systems from both a mathematical description and from a block-diagram system approach.

**Compulsory/Elective course** : Compulsory for ECE students

**Credit hours** : 4 Credits

**Course Coordinator** : **Mr.B.Karthik**, Asst. Professor, Department of ECE

Name of the instructor	Class handling	Office location	Office Number	Email (domain: @bharathuniv.ac.in)	Consultation
Mr.B.Karthik	III A	SA 006		Karthik.ece	12.45-1.15 PM
Dr M.Sangeetha	III B	SA 006		Sang_gok@yahoo.c om	12.45-1.15 PM
Ms M.Jasmin	III C	SA 006		jasmine.ece	12.45-1.15 PM

### Relationship to other courses:

Pre –requisites : BEC601 Computer and communication Networks

Assumed knowledge : The students will have a basic knowledge in wireless and Mobile communication system.

Following courses : MAE003 RF System design

### Syllabus Contents

**UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS :****12 HOURS**

Sampling of Analogue signals – aliasing – standard discrete time signals – classification – discrete time systems – Linear time invariant stable casual discrete time systems – classification methods – linear and circular convolution – Overlap add and Save methods-Difference equation representation – DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms.

**UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS:****12 HOURS**

Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – pre warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

**UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS:****12 HOURS**

Symmetric and Antisymmetric FIR filters – Linear phase FIR filters – Design using Frequency sampling technique – Window design using Hamming, Hanning and Blackmann Windows – Concept of optimum equiripple approximation – Realisation of FIR filters – Transversal, Linear phase and Polyphase realization structures.

**UNIT IV FINITE WORD LENGTH EFFECTS:****12 HOURS**

Quantization noise – derivation for quantization noise power – Fixed point and binary floating point number representations – Comparison – Overflow error – truncation error – coefficient quantization error – limit cycle oscillations- signal scaling – analytical model of sample and hold operations.

**UNIT V SPECIAL TOPICS IN DSP:****12 HOURS**

Discrete Random Signals- Mean, Variance, Co-variance and PSD – Periodiogram Computation – Principle of Multi rate DSP – decimation and Interpolation by integer factors – Time and frequency domain descriptions – Single, Multi stage, polyphase structures – QMF filters – Subband Coding

**TOTAL: 60 HOURS****TEXTBOOK:**

- 1 .JohnG.Proakis&DimitrisG.Manolakis,“DigitalSignalProcessing–Principles, Algorithms&Applications”,FourthEdition,PearsonEducation/Prentice Hall,2007.

**REFERENCES:**

1. Sanjit K.Mitra,“Digital Signal Processing–A Computer Based Approach”,Tata McGraw Hill
2. A.V.Oppenheim, R.W. Schafer andJ.R. Buck, “Discrete-Time Signal Processing”, 8th Indian Reprint,Pearson,2004.

**Computer usage:** MATLAB is used to learn Discrete systems and facilitate analysis and design of Digital Filters

**Broad area :** Signal Processing | Communication | Electronics | VLSI | Embedded

## Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts-		0%
Professional subject	-	100%

## Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1 <sup>st</sup> week	Session 1 to 18	2 Periods
2	Cycle Test-2	September 2 <sup>nd</sup> week	Session 19 to 36	2 Periods
3	Model Test	October 2 <sup>nd</sup> week	Session 1 to 60	3 Hrs
5	University Examination	TBA	All sessions / Units	3 Hrs.

## Mapping of Instructional Objectives with Program Outcome

Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve engineering problems:	Correlates to program outcome		
	H	M	L
1. To apply DFT for the analysis of digital signals & systems	a,d,e	-	-
2. To design FIR filters	a,b,c,d,e	i	-
3. To design IIR filters s	a,b,c,d,e	i	-
4. To characterize finite Word length effect on filters	f	b,d,i	-
5. To have a deep understanding on basics of digital signal processing which can be applied to communication systems	-	a,j	-
6. To design the Multirate Filters	c	-	f

H: high correlation, M: medium correlation, L: low correlation

## Draft Lecture Schedule

S.NO	No. of Periods	Topics/ Sub-Topics	Problem Solving (Yes/No)	Reference (Book/Journal) Page No
<b>UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS DSP–John G.Proakis</b>				
1.	1	Sampling of Analogue signals & aliasing	No	T1-21-33
2.	1	Standard discrete time signals & classification	Yes	T1-43-47
3.	1	Linear time invariant stable casual discrete time systems	Yes	T1-85-87
4.	2	linear and circular convolution	Yes	T1-75-84
5.	1	Difference equation representation	No	T1-95-108
6.	1	DFS, DTFT	Yes	T1-247-253
7.	1	DFT using 4-point DIT& DIF algorithms	Yes	T1-399-415
8.	3	FFT computations using DIT& DIF algorithms.	Yes	T1-448-473
9.	1	Time response & Frequency analysis of discrete time systems	No	T1-279-282
<b>UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS DSP–John G.Proakis</b>				
10.	2	Design of analogue Butterworth Filter	Yes	T1-681-683
11.	2	Design of analogue Chebyshev Filter	Yes	T1-683-688
12.	1	Frequency transformation in analogue domain	No	T1, R1
13.	1	Design of IIR digital filters using impulse invariance technique	Yes	T1-671-676
14.	1	Design of digital filters using bilinear transform	Yes	T1-676-680
15.	1	Frequency transformation in digital domain	No	T1-695-698
16.	2	Realization using direct & cascade forms.	Yes	T1-519-521&524-526
17.	2	Realization using Parallel forms	Yes	T1-527-529
<b>UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS DSP–John G.Proakis</b>				
18.	1	Symmetric and Antisymmetric FIR filters	No	T1-620-622
19.	1	Linear phase FIR filters	No	T1-623-625
20.	2	Design using Frequency sampling technique	Yes	T1-630-635
21.	2	Window design using Hamming Window	Yes	T1-625-627

22.	2	Window design using Hanning & Blackman Window	Yes	T1-627-629
23.	2	Concept of optimum equiripple approximation	Yes	T1-638-643
24.	2	Linear phase & polyphase realization structures.	Yes	T1-502-511
<b>UNIT IV INFINITE WORD LENGTH EFFECTS DSP–John G.Proakis</b>				
25.	2	Quantization noise	Yes	T1-569-572
26.	1	Derivation for quantization noise power	Yes	T1-574-578
27.	2	Fixed point and binary floating point number representations	No	T1-557-561
28.	2	Overflow error & truncation error	Yes	T1-562-564
29.	2	coefficient quantization error	Yes	T1-579-581
30.	2	Limit cycle oscillations	Yes	T1-582-584
31.	1	Signal scaling	Yes	T1-584-590
<b>UNIT V SPECIAL TOPICS IN DSP DSP–John G.Proakis</b>				
32.	1	Mean, Variance of Discrete Random Signals	No	T1-783-784
33.	1	Co-variance and PSD of Discrete Random Signals	No	T1-784-785
34.	1	Periodiogram Computation	No	T1-902-904
35.	1	Multi rate DSP	No	T1-782-783
36.	1	Decimation by integer factors	No	T1-784-786
37.	1	Interpolation by integer factors	No	T1-787-789
38.	1	Time and frequency domain descriptions	No	T1-790-791
39.	1	Single, Multi stage, poly phase structures	No	T1-792-800
40.	2	QMF filters	No	T1-833-840
41.	2	Subband Coding	No	T1-831-840

## Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

## Evaluation Strategies

Cycle Test – I	-	10%
Cycle Test – II	-	10%
Model Test	-	25%
Attendance	-	5%
Final exam	-	50%

**Prepared by:**B.Karthik, Assistant Professor, Department of ECE

**Dated :** 23.12.2016

**Addendum****ABET Outcomes expected of graduates of B.Tech / ECE / program by the time that they graduate:**

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Program Educational Objectives****PEO1: PREPARATION:**

To provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Electronics And Communication Engineering.

**PEO2: CORE COMPETENCE:**

To enhance the skills and experience in defining problems in Electronics And Communication Engineering design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

**PEO3: PROFESSIONALISM:**

To enhance their skills and embrace new Electronics And Communication Engineering Technologies through self-directed professional development and post-graduate training or education

**PEO4: SKILL:**

To provide training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

**PEO5: ETHICS:**

Apply the ethical and social aspects of modern communication technologies to the design, development, and usage of electronics engineering.

<b>Course Teacher</b>	<b>Signature</b>
Mr.B.Karthik	
Dr. M.Sangeetha	
Mrs.M.Jasmin	

**Course Coordinator**

(Mr.B.Karthik)

**Academic Coordinator**

( )

**Professor In-Charge**

( )

**HOD/ECE**

(Dr.M.Sundararajan)