Academic Course Description

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

BEC505– DIGITAL SIGNAL PROCESSING

Fifth Semester (2017-2018), Odd 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 & Contact hours **:** 4 & 60

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

Name of the instructor	Class handling	Office location	Office Number	Email (domain: @bharathuniv.ac.in)	Consultation
Mr.B.Karthik	III YEAR	SA BLOCK		Karthik.ece	12.45-1.15 PM
Ms M.Jasmin	III YEAR	SA BLOCK		jasmine.ece	12.45-1.15 PM

Relationship to other courses:

Pre –requisites Signals and Systems

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

Following courses : -

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,

2. 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 1st week	Session 1 to 18	2 Periods
2	Cycle Test-2	September 2nd week	Session 19 to 36	2 Periods
3	Model Test	October 2nd week	Session 1 to 60	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

The course 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 block-diagram system approach	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
UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS DSP–John G.Proakis				
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
UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS DSP–John G.Proakis				
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
UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS DSP–John G.Proakis				
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
UNIT IVFINITE WORD LENGTH EFFECTS DSP–John G.Proakis				
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
UNIT V SPECIAL TOPICS IN DSP DSP–John G.Proakis				
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	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignments/Seminar/online test/quiz	-	5%
Attendance	-	5%
Final exam	-	70%

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

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 hardware and software 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

Electronics Engineering graduates are provided with a strong foundation to passionately apply the fundamental principles of mathematics, science, and engineering knowledge to solve technical problems and also to combine fundamental knowledge of engineering principles with modern techniques to solve realistic, unstructured problems that arise in the field of Engineering and non-engineering efficiently and cost effectively.

PEO2: CORE COMPETENCE

Electronics engineering graduates have proficiency to enhance the skills and experience to apply their engineering knowledge, critical thinking and problem solving abilities in professional engineering practice for a wide variety of technical applications, including the design and usage of modern tools for improvement in the field of Electronics and Communication Engineering.

PEO3: PROFESSIONALISM

Electronics Engineering Graduates will be expected to pursue life-long learning by successfully participating in post graduate or any other professional program for continuous improvement which is a requisite for a successful engineer to become a leader in the work force or educational sector.

PEO4: SKILL

Electronics Engineering Graduates will become skilled in soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, interpersonal relationship, group discussion and leadership ability to become a better professional.

PEO5: ETHICS

Electronics Engineering Graduates are morally boosted to make decisions that are ethical, safe and environmentally-responsible and also to innovate continuously for societal improvement.

Course Teacher	Signature
Mr.B.Karthik	
Mrs.M.Jasmin	

Course Coordinator **HOD/ECE**