Kingdom of Saudi Arabia Ministry of Higher Education **Qassim University** College of Engineering	Qassim University جامعة القصيم	المملكة العربية السعودية وزارة التعليم العالي **جامعة القصيم** **كليه الهندسه**

Image Signal Processing

College: Engineering

Department: Electrical

First: Course Definition

1- Course Code 624

2- Units: 3

3 – Semester

4 -Prerequisite

5- Co-requisite

6- Location (if not on main Campus):

Second: Course Objectives

This course aims to systematically develop state-of-the-art Digital Signal Processing algorithms starting with the very fundamental principles behind this exciting and arguable most interesting field of modern electronics. The course enables students to: gain an appreciation of sampling theory, z-transforms and system functions; analyze and design digital filters using signal flow graphs, elementary FIR/IIR filter design techniques, windows and bilinear and band transformations; gain an appreciation of discrete Fourier transforms and the relationship between them; perform and interpret correctly the results of simple and short-time spectral estimation; see fast computation of DFT as decimation-in-time; gain an appreciation of linear, cyclic and sectioned convolution in the context of digital filtering and to implement (fast) filtering algorithms; develop basic multi-rate signal processing elements and identities and to see them applied in typical applications; analyse and design sample rate changing systems; implement multi-rate signal processing systems using polyphase representations of filters; gain an appreciation of maximally decimated filter banks, their limitations and the sources of errors therein; see, in overview, microprocessor architectures for DSP; consider the implementation aspects of simple DSP algorithms. To introduce students to the fundamentals of statistical signal processing, with particular emphasis upon classical and modern estimation theory, parametric and modelling and least squares methods. To give students practical experience of utilising statistical signal processing on real world multimedia signals, such as their

own speech through the provision of structured coursework assignments based upon using MATLAB.

Third: Course Specifications

1- Topics to be covered

Subject	No of Weeks	Units
Signals and Signal Processing • Characterization and Classification of Signals • Typical Signal Processing Operations • Examples of Typical Signals • Typical Signal Processing Applications • Why Digital Signal Processing?	1	3
Discrete-Time Signals and Systems • Discrete-Time Signals • Typical Sequences and Sequence Representation • Discrete-Time Systems • Time-Domain Characterization of LTI • Correlation of Signals	2	6
MATLAB • Use of MATLAB on PWF machines to perform numerical experiments and visualize the results in homework exercises.	1	3
Discrete-Time Fourier Transform • The Continuous-Time Fourier Transform • The Discrete-Time Fourier Transform • Discrete-Time Fourier Transform Theorems • Band-Limited Discrete-Time Signals • The Frequency Response of an LTI Discrete-Time System • Phase and Group Delays	2	6
igital Processing of Continuous-Time Signals • Introduction • Sampling of Continuous-Time Signals • Sampling of Bandpass Signals • Analog Lowpass Filter Design • Design of Analog Highpass, Bandpass, and Bandstop Filters • Anti-Aliasing Filter Design • Reconstruction Filter Design	2	6
Finite Length Discrete Transforms • The Discrete Fourier Transform	2	6

• Relation Between the Fourier Transform and the DFT, and Their Inverses • DFT Symmetry Relations • Discrete Fourier Transform Theorems • Computation of the DFT of Real Sequences		
z-Transform - • Definition and Properties • Rational z-Transforms • Region of Convergence of a Rational z-Transform 307 • The Inverse z-Transform • z-Transform Properties • The Transfer Function	**2**	**6**
LTI Discrete-Time Systems in the Transform Domain • Transfer Function Classification Based on Magnitude Characteristics • Transfer Function Classification Based on Phase Characteristics • Types of linear-Phase Transfer Functions • Inverse Systems	**1**	**3**
Digital Filter Structures • Block Diagram Representation • Basic FIR Digital Filter Structures • Basic IIR Digital Filter Structures	**1**	**3**
FIR Filter Design **IIR Filter Design**	**1**	**3**

2- Course components (Total hrs in the Semester)

Lecture	lab	Other
30	**30**	

3- Intended Learning Outcomes of the Course (ILO's)

a. *Knowledge*

i) Description of the knowledge to be acquired:

. At the end of the course, the student will know :

.١ Thorough grounding in the theoretical and practical aspects of digital signal processing .

.٢ Concepts and mathematical tools in digital signal processing .

3. A good overview of the principles and characteristics of several widely-used compression techniques and standards for audio-visual signals.

ii) Teaching strategies to be used to develop that knowledge

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iii) Methods of assessment of knowledge acquired

Assignments

- **Midterm written exam**
- **Oral exam**
- **Final written exam**

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- **At the end of the course, the student will be able to :**

b1. Apply basic properties of time-invariant linear systems .

b2. Perform sampling, aliasing, convolution, filtering, the pitfalls of spectral estimation .

b3. Visualize and discuss digital filters in the z-domain .

b4. Use the FFT for convolution, de-convolution, filtering .

b5. Apply transforms that reduce correlation between several signal sources .

b6. Explain limits in human perception that are exploited by lossy compression techniques .

b7. Design and implement different frequency selective Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters to meet frequency domain specifications .

b8. Describe engineering trade-offs in filter design. Understand linear and nonlinear phase response.

ii) Teaching strategies to be used to develop these cognitive skills

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iii) Methods of assessment of students cognitive skills

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c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- **At the end of the course, the student will be able to :**

c1- Be competent to use filter-design software .

c2- Explain the above in time and frequency domain representations .

c3- Compute the discrete- time convolution of two signals and classify the discrete time system and the process of signals correlation .

c4- Implement, apply and evaluate simple DSP applications in MATLAB .

c5- Determine the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) of discrete signal.

ii) Teaching strategies to be used to develop these skills

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iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility

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d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

- **At the end of the course, the student will have :**

d1- Matlab / Simulink prototyping and system level design tools .

d2- DSP hardware/software and device drivers' development .

d3- Exploit skills in adaptive and non-linear digital signals to design, for example: telecommunication, radar, sonar, biomedical and access

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ii) Teaching strategies to be used to develop these skills

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iii) Methods of assessment of students numerical and communication skills

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e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

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ii) Teaching strategies to be used to develop these skills-

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iii) Methods of assessment of student's psychomotor skills

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4- Student Assessment Schedule

Serial	*Assessment tool (test, group project, examination etc.)*	*Week due*	*Weight*
1			
2			
3			
4			
5			

5- Student Support

6- Learning Resources

i) Essential Books (References)

Sanjit K. Mitra, "Digital Signal Processing - A Computer Based Approach", McGraw-Hill Science / Engineering / Math, 3rd Edition, 6 January 2005, ISBN-10: 0073048372 .

Richard G. Lyons, "Understanding digital signal processing", Prentice Hall PTR, 2nd Edition, 25 March 2004, ISBN-10: 0131089897 .

Jonathan Stein, "Digital signal processing - a computer science perspective", Wiley-Interscience, 1st Edition, 9 October 2000, ISBN-10: 047129546 .

Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, "Discrete-time signal processing", Prentice Hall, 2nd Edition, 15 February 1999, ISBN-10: 0137549202.

ii) Course Notes

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iii) Recommended Books

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iv) Electronic Books & Web Sites:

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v) Periodicals

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7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

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ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

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iii) Processes for Improvement of Teaching

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iv) Processes for verifying standards of student achievement (e.g. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

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v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

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