PRIFYSGOL glyndŵr UNIVERSITY

MODULE SPECIFICATION FORM*

Module Title:	**Discrete Time Signal Processing**	Level:	**6**	Credit Value:	**10**

Module code: (if known)	**ENG672**	Cost Centre:	**GAEE**	JACS2 code:	H651

Semester(s) in which to be offered:	**1**	With effect from:	**July 2015**

Office use only: To be completed by AQSU:	Date approved: **July 2015** Date revised: Version No: 1

Existing/New: **Existing**	Title of module being replaced (if any):

Originating Academic area:	**Engineering and Applied Physics**	Module Leader:	**B Klaveness**

Module duration (total hours)	100	**Status:** core/option/elective (identify programme where appropriate):	**Free-standing 10-credit component comprising half of ENG639 (Signal Processing and digital Control).**
Scheduled learning and teaching hours	36		
Independent study hours	64		
Placement hours	0		

Percentage taught by Subjects other than originating Subject (please name other Subjects):	**0%**

Programme(s) in which to be offered: **Enginering European Programme** (Non Award Bearing)	Pre-requisites per programme (between levels):	**None**

Module Aims:

To provide the student with fundamentals of discrete-time signal theory, digital filtering, digital spectrum estimation, with examples and applications arising from various disciplines, so as to prepare the student to solve practical problems. This includes common DSP techniques and an appreciation of the limitation of various implementations of DSP algorithms thus to apply DSP techniques on hardware platforms.

Expected Learning Outcomes

Knowledge and Understanding:
At the completion of this module, the student should be able to:

1. Evaluate various discrete transform of signals;
2. Select a suitable design for FIR (Finite Impulse Response) and IIR (Infinite Impulse Response) digital filters; *(KS 3)*
3. Understand the theoretical principles, limitations and methodologies associated with DSP-based system design;

Key skills for employability

1. Written, oral and media communication skills,
2. Leadership, team working and networking skills
3. Opportunity, creativity and problem solving skills
4. Information technology skills and digital literacy
5. Information management skills
6. Research skills
7. Intercultural and sustainability skills
8. Career management skills
9. Learning to learn (managing personal and professional development, self management)
10. Numeracy

Assessment: *Please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%).*

Assessment is by means of an unseen time-constrained examination covering all outcomes. (This corresponds to one-half (part A) of the examination of ENG639 but will be sat as a separate exam at the end of trimester 1.)

Assessment number (use as appropriate)	Learning Outcomes met	Type of assessment	Weighting	Duration (if exam)	Word count (if coursework)
Assessment One:	1, 2, 3	Examination	100%	2 hr	

Learning and Teaching Strategies:

The module will be delivered through lectures, tutorials and student-driven investigative work. A significant amount of the content is to be achieved through individual study. Approximately one third of the timetabled time will be devoted to formal lectures. The remainder of the time will be allocated to tutorials and to individual study. The application part of the module is done via laboratory work which consists of the implementation of digital filter on a DSK (Texas Instruments, Inc. TMS320), software simulation of digital filter using MATLAB/Simulink. The students will be encouraged to further investigate the topics as directed learning.

Syllabus outline:

Digital signal processing fundamentals: Revision of discrete-time signals. Digital processing of analogue signals. A/D and D/A converters. Sampling theorem and anti-aliasing. The discrete-time Fourier transform (DTFT). The discrete Fourier transform (DFT). The fast Fourier transform (FFT). The z-transform, transfer functions and difference equations.

Filter Design: Finite Impulse Response (FIR) digital filters and Infinite Impulse Response (IIR) digital filters.

FIR Filters: Linear phase. Symmetric and anti-symmetric impulse response. Frequency sampling method. Use of window functions. Quantisation and finite word-length effects.

IIR Filters: Approximation techniques based on differences. Impulse invariance and bilinear z-transformation. Design by pole placement method.

Applications: Implement filter design in CAE software such as MATLAB/Simulink and hardware platform such as TI DSK. An overview of the DSP hardware architecture with specific focus on task related issues. An overview of the DSP software environment.

Bibliography:

Essential reading:

Oppenheim, A. V. et al. (2010), *Discrete-Time Signal Processing*, 3rd Edn., Upper Saddle River, USA, Pearson Edn, Inc.
Mitra, S. K. (2011) *Digital Signal Processing: A Computer-Based Approach*, 4th Edn., McGraw-Hill Higher Education.

Recommended reading:

Hayes, M. (2011) *Digital Signal Processing*, 2nd Edn., Mc Graw-Hill Schaum's Outlines.
Proakis, J. G. and Manolakis, D. K. (2007) *Digital Signal Processing Principles, Algorithms and Applications*, 4th Edn., Upper Saddle River, USA, Pearson Education, Inc.
Kuo, S. M. and Woon-Seng Gan, W. S. (2005) *Digital signal processors: architectures, implementations, and applications*. Upper Saddle River, USA, Pearson Education, Inc.
Ifeachor, E. and Jervis, B. (2002) *Digital Signal Processing: A Practical Approach*, 2nd Edn., USA, Pearson Education, Inc.
Smith, S. W. (1997) *The Scientist and Engineer's Guide to Digital Signal Processing,* California Technical Publishing, USA.

Additional Reading:

http://www.mathworks.com/ (Guides for MATLAB software)
http://www.gnu.org/software/octave/ (Guides for Octave software)
http://www.theiet.org/ (Online resources from the IET)
http://www.ieee.org/index.html (Online resources from the IEEE)

EURASIP journal on applied signal processing, Akron, Ohio: Hindawi Pub. Corp.
IEEE Signal Processing e-Library (Electronic resource): 1950-2005 / IEEE Signal Processing Society. San Diego, USA, IEEE Pub.
IEEE Xplore Digital Library (http://ieeexplore.ieee.org/Xplore/guesthome.jsp) including:
IEEE Transactions on Signal Processing, IEEE Transactions on Control Systems Technology, IEEE Journals and Magazines, IET Transactions on Signal Processing, IET Journals and Magazines.