

PROGRAMME OBJECTIVES

This programme is designed for hardware and software designers, R&D managers, practicing engineers, and industry planners who seek an understanding of current approaches and evolving directions for DSP technologies. It is also intended for engineers who anticipate future involvement in this area.

ADMISSION REQUIREMENTS

For those with a good bachelor's degree in electrical/ electronic/computer engineering or equivalent degree in other relevant disciplines as the Board of Graduate Studies may approve.

PROGRAMME STRUCTURE

FIRST YEAR - CORE (Compulsory)

Semester 1

Advanced Digital Signal Processing
Real-Time DSP Design and Applications

Semester 2

Distributed Multimedia Systems
VLSI Digital Signal Processors

SECOND YEAR - ELECTIVE (Choose 4 only)

Semester 1

Statistical Signal Processing
Digital Audio Signal Processing
Speech Analysis and Processing
Image Processing and Pattern Recognition

Semester 2

Array Signal Processing
Probability and Random Process
Video Signal Processing
Adaptive Signal Processing

The requirements for the postgraduate degree include satisfactory completion of four cores and four electives as well as a project. The project is examined by dissertation. The project may be undertaken either in NTU or in industry. There is

an alternative to replace a dissertation project by taking one additional elective course plus one smaller-scale project, called *Independent Study Module (ISM)*, which is to be completed in one semester.

PROGRAMME DURATION

The programme is run during evenings. The examinations require attendance during office-hours. Part-Time candidates are expected to obtain their employer's permission for this before admission to the programme. The coursework and project may normally be completed in one year for full-time students or two years for part-time students, respectively.

Semester 1 (Aug-Dec); Semester 2 (Jan-May)

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|-------------|--------------|
| Weeks 1-14* | Lectures |
| Weeks 16-17 | Examinations |
| Others | Vacations |

* One week recess

COURSE CONTENTS

Advanced Digital Signal Processing:

Probability and random processes. Multi-rate digital signal processing. Linear prediction and optimum linear filters. Power spectrum estimation.

Real-Time DSP Design and Applications:

Architectures for general-purpose digital signal processors. Peripherals for DSP applications. Development tools for DSP applications. Digital FIR/IIR filter implementations. Fast Fourier transform implementations.

Distributed Multimedia Systems: Media and media systems. Multimedia storage. Media processing and applications. Media transmission and delivery. Quality of service on distributed multimedia systems. Multimedia applications.

VLSI Digital Signal Processors: Digital signal processors. Classification of architectures. Data and instruction memories. VLSI special instruction-set single chip (SISC) processors. Data path logic design. Rapid prototyping. Code generation for embedded processors. Digital signal multiprocessors. Formal methods for

scheduling, assignment and allocation.

Statistical Signal Processing: Review of random processes. Fundamentals of detection theory. Signal detection in noise. Signal estimation theory. Properties of estimators. Application of signal detection and estimation.

Adaptive Signal Processing: Fundamentals of adaptive signal processing. Gradient-based adaptive FIR and IIR filters. Method of least squares estimation. Recursive least squares. Lattice filters. Nonlinear adaptive filtering. Applications.

Array Signal Processing: Sensor-array fundamentals, Array beamforming. Basic direction finding and geolocation. Advanced direction finding and geolocation. Target tracking. Array geometry optimisation and calibration. Smart antennas and software radio in wireless communications.

Digital Audio Signal Processing: Psychology of hearing. Audio test and measurements. Microphones and loudspeakers. Principles of digital audio. Audio processing and synthesis. Digital audio compression. Digital audio broadcasting.

Speech Analysis and Processing: Fundamentals of speech. Speech enhancement. Dynamic time warping. Hidden Markov models (HMM). Speech recognition and speaker verification systems. Scalar and vector quantization. Linear predictive coding. Transform coding.

Image Processing and Pattern Recognition: Image fundamentals. Image enhancement. Image restoration. Feature selection and extraction. Classification methods. Connectionist approach.

Video Signal Processing: Video basics. Video signal sampling and rate conversion. Video signal filtering and enhancement. Video coding principles and standards. Emerging video communication systems.

Probability and Random Processes: Probability concepts. Random variables. Multiple random variables. Sum of random variables. Gaussian and related distributions. Probability

density function estimation. Random variable simulation. Random processes. Correlation functions. Spectral density. Random processes in linear systems. Optimum linear systems. Nonlinear systems.

For more updated information, please visit our website at:

<http://www.ntu.edu.sg/eee/students/MSc/>, or

http://www.ntu.edu.sg/eee/eee3/MSc_Signal_Processing/msc_signal_prog.asp.

FEES

Every year, tuition fees are reviewed and subject to revision. As and when fees are revised, the new fees will be applicable to all existing and new students. All fees listed are in Singapore dollars (S\$) and are inclusive of Goods and Services Tax (GST) unless otherwise stated. For more update, please refer to

<http://www.ntu.edu.sg/GradStudies/Coursework+Programmes/Fees+and+Financial+Assistance/>.

APPLICATION FOR ADMISSION

Applications for admission are normally announced through the local press and NTU webpage, twice per year — in January for the coming Semester 1 and in September for the coming Semester 2, respectively. Applications forms are to be submitted **electronically** only (any other form of submission will not be considered) via our web page at:

<http://www.ntu.edu.sg/GradStudies/Coursework+Programmes/>.

REQUIRED TOEFL OR EQUIVALENT

For the non-English speaking countries, TOEFL or an equivalent examination is required. The minimum TOEFL score is 570 (paper-based) or 230 (computer-based).

CONTACT INFORMATION

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<http://www.ntu.edu.sg/eee/eee3/cv/ebpng.htm>