

## Graduate - Course Syllabus ( 2026 Fall )

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| Course Title：（中文）醫學信號處理<br><br>（English）Biomedical Signal Processing                                                      |                                                                                                                                                                                                              |                       |          | Department              | Electrical Engineering |
|                                                                                                                           |                                                                                                                                                                                                              |                       |          | Course Number           | 4156114_01             |
| Lecturer：余松年 (Sung-Nien Yu), Room 331, e-mail: <a href="mailto:ieesny@ccu.edu.tw">ieesny@ccu.edu.tw</a> , Tel. ext. 33205 |                                                                                                                                                                                                              |                       |          |                         |                        |
| Credits                                                                                                                   | 3                                                                                                                                                                                                            | Required/<br>Elective | Elective | Under/Graduate          | Graduate level         |
| Prerequisite：none                                                                                                         |                                                                                                                                                                                                              |                       |          |                         |                        |
| Course overview and objectives：                                                                                           |                                                                                                                                                                                                              |                       |          |                         |                        |
| 1. Introduce the properties of biomedical signals.                                                                        |                                                                                                                                                                                                              |                       |          |                         |                        |
| 2. Explore digital signal processing methods suitable for biomedical signals.                                             |                                                                                                                                                                                                              |                       |          |                         |                        |
| Textbook <sup>1</sup>                                                                                                     | Lecture slides.<br>Reference books:<br>1. M. Akay, Biomedical Signal Processing, Academic Press, 1994.<br>2. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons, Inc., 1996. |                       |          |                         |                        |
| Outline                                                                                                                   |                                                                                                                                                                                                              |                       |          | Core Competencies       | Note                   |
| Topics                                                                                                                    | Contents                                                                                                                                                                                                     |                       |          |                         |                        |
| Introduction to biomedical signal processing                                                                              | 1. Examples of biomedical signals<br>2. Medical instrumentation system<br>3. Content of the course                                                                                                           |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |
| The origin of biopotentials                                                                                               | 1. The neuron<br>2. Electrical model of excitable cells<br>3. Synaptic transmission<br>4. Electro-physiological properties of the nervous system                                                             |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |
| Fundamentals of signals and systems                                                                                       | 1. Digital signals and systems<br>2. The z-transform<br>3. Realization of digital systems                                                                                                                    |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |
| Discrete and fast Fourier transform algorithms                                                                            | 1. Decimation-in-time algorithm<br>2. Decimation-in-frequency algorithm                                                                                                                                      |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |
| The periodogram and Blackman-Tukey method                                                                                 | 1. The periodogram<br>2. Blackman-Tukey spectral estimation<br>3. Biomedical applications                                                                                                                    |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |
| Cepstrum analysis                                                                                                         | 1. The cepstra<br>2. The power cepstrum<br>3. The complex cepstrum<br>4. Biomedical applications of cepstrum analysis                                                                                        |                       |          | 1.1, 1.2, 2.1, 4.1, 4.4 |                        |

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| Adaptive noise canceling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1. Principle of adaptive noise canceling<br>2. Adaptive noise canceling with the LMS adaptation algorithm<br>3. Adaptive noise canceling with the RLS adaptation algorithm<br>4. Biomedical applications | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| Adaptive line enhancer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1. The ALE method using the LMS algorithm<br>2. The ALE method using the GAL algorithm<br>3. Biomedical applications                                                                                     | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| Adaptive zero-tracking methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1. The zero-tracking method based on the LMS algorithm<br>2. Adaptive zero-tracking filters based on the RLS algorithm<br>3. Biomedical applications                                                     | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| Autoregressive (AR) methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1. Linear prediction and autoregressive methods<br>2. The autoregression (Yule Walker) method<br>3. The Burg method<br>4. Adaptive AR methods<br>5. Biomedical applications                              | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| The autoregressive moving average (ARMA) methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1. The MLE method<br>2. The Akaike method<br>3. The MYW-ARMA method<br>4. The Durbin method<br>5. The adaptive ARMA method based on the LMS algorithm<br>6. Biomedical applications                      | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| Prony's method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1. Original Prony's method<br>2. Prony's method based on the least squares estimation<br>3. Modified Prony's method based on the LP and SVD algorithms<br>4. Biomedical applications                     | 1.1, 1.2, 2.1, 4.1, 4.4           |  |
| Term Project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1. Oral presentation<br>2. Written report                                                                                                                                                                | 1.1, 1.2, 1.3, 2.1, 3.1, 4.1, 4.4 |  |
| Remarks <sup>2</sup> :<br>Teaching material : <input checked="" type="checkbox"/> Self-edited <input type="checkbox"/> Provided by publisher<br>Teaching Method : <input checked="" type="checkbox"/> Slide <input checked="" type="checkbox"/> Blackboard <input type="checkbox"/> Demonstration <input type="checkbox"/> Practice<br>Grading Policy : <input type="checkbox"/> Attendance (%) <input type="checkbox"/> Quiz (%) <input type="checkbox"/> Homework (%) <input type="checkbox"/> Program (%) <input type="checkbox"/> Experiment (%) <input checked="" type="checkbox"/> Project (34%) <input checked="" type="checkbox"/> Mid-term exam. (33%) <input checked="" type="checkbox"/> Final exam. (33%) <input checked="" type="checkbox"/> Final Present (%) <input type="checkbox"/> Others (%)<br>Teaching Resources : <input checked="" type="checkbox"/> E-course <input type="checkbox"/> Course website <input type="checkbox"/> Others _____<br>Other issues : |                                                                                                                                                                                                          |                                   |  |

Note:

1. Please specify the title, author, publisher, publication year and other information with the textbook information.
2. At the teaching overview section, please fill out the textbooks, teaching methods, grading methods, teaching resources, and other matters related.
3. All courses of graduate institutes must complete this form or provide syllabuses table in original format.