

# How to Teach

## Medical Instrumentation

# Biomedical Instrumentation Engineer

- Research and development of (electronic) medical instrument
- System engineer with basic knowledge of medical science
  - System physiology
  - Medical physics
  - Electromagnetism and circuit
  - Electronic device
  - Sensor and analog circuit
  - ADC and DAC
  - Microprocessor system
  - Programmable logic device
  - CAD (schematic, layout and simulation)
  - Signal, system and DSP
  - Data communication and control
  - Embedded software
  - PC software

# Topics

생체계측기 본원리	기초 전공지식	생체전위근 원	전극	생체신호증 폭기	디지털 생체신호처 리	전기안전	센서
<ul style="list-style-type: none"> <li>• 측정대상</li> <li>• 센서</li> <li>• 신호처리</li> <li>• 출력</li> <li>• 비침습</li> <li>• 오차</li> <li>• 동작모드</li> <li>• 신호/잡음 /SNR</li> <li>• 아날로그/ 디지털</li> <li>• 통계/최소 자승오차</li> <li>• 정확도/정밀도/해상도/민감도</li> <li>• 전달함수</li> <li>• 진폭왜곡/ 위상왜곡/ 무왜곡</li> <li>• 설계지침</li> </ul>	<ul style="list-style-type: none"> <li>• 전하/전위/ 전류</li> <li>• R/L/C</li> <li>• 직렬/병렬</li> <li>• 전원</li> <li>• 신호원</li> <li>• Thevenin/No rton</li> <li>• 부하효과</li> <li>• 선형회로</li> <li>• 중첩원리</li> <li>• 정현파</li> <li>• 주파수</li> <li>• Fourier 변환</li> <li>• 스펙트럼</li> <li>• 샘플링/양자화</li> <li>• Matlab</li> </ul>	<ul style="list-style-type: none"> <li>• 세포/신경</li> <li>• 전해질</li> <li>• 이온/농도</li> <li>• 전기전도/ 확산</li> <li>• 반투막</li> <li>• 세포막</li> <li>• 막특성</li> <li>• RMP/AP</li> <li>• 신경전도</li> <li>• 부피 전도계</li> <li>• ENG</li> <li>• EMG</li> <li>• ECG</li> <li>• MCG</li> <li>• EOG/ERG</li> <li>• EP</li> <li>• EEG</li> <li>• MEG</li> </ul>	<ul style="list-style-type: none"> <li>• 전자전류</li> <li>• 이온전류</li> <li>• Interface</li> <li>• 전하 이중층</li> <li>• 분극</li> <li>• Half cell</li> <li>• 분극형</li> <li>• 비분극형</li> <li>• 등가회로</li> <li>• Pt</li> <li>• Ag/AgCl</li> <li>• 접촉 임피던스</li> <li>• 접촉 전위</li> <li>• 표면전극</li> <li>• 바늘전극</li> <li>• 미세전극</li> <li>• 특수전극</li> </ul>	<ul style="list-style-type: none"> <li>• 리드</li> <li>• 신호원 모델링</li> <li>• 사양</li> <li>• Op Amp</li> <li>• 부하효과</li> <li>• 동상성분</li> <li>• 차동성분</li> <li>• 차동증폭</li> <li>• CMRR</li> <li>• 전압이득</li> <li>• 대역폭</li> <li>• GBP</li> <li>• 실제의 Op Amp</li> <li>• 잡음/왜곡</li> <li>• 아날로그 필터</li> <li>• 생체신호증폭기의 종류</li> </ul>	<ul style="list-style-type: none"> <li>• 마이콤</li> <li>• F/W 구조</li> <li>• C 언어</li> <li>• 컴파일</li> <li>• 링크</li> <li>• 정수/실수</li> <li>• 실시간</li> <li>• 초기화</li> <li>• Main loop</li> <li>• Timer</li> <li>• ADC</li> <li>• LPF</li> <li>• HPF</li> <li>• 미분</li> <li>• 절대값</li> <li>• MWI</li> <li>• 링버퍼</li> <li>• Threshold</li> <li>• Averaging</li> <li>• I/O</li> </ul>	<ul style="list-style-type: none"> <li>• 전압/전류</li> <li>• 전류의 영향</li> <li>• Let go 등</li> <li>• 배전</li> <li>• 접지/기준 전위</li> <li>• Macro/Micro shock</li> <li>• 누설용량</li> <li>• 누설전류</li> <li>• 절연</li> <li>• 차폐</li> <li>• 전원설계</li> <li>• 접지분리</li> <li>• 신호결합</li> <li>• 외부기기연결</li> <li>• 안전도 시험</li> </ul>	<ul style="list-style-type: none"> <li>• 전자파스펙트럼</li> <li>• 저항성/스트레인게이지/FSR</li> <li>• Dc 브리지/ 반전증폭</li> <li>• 유도성 /LVDT</li> <li>• Ac 브리지/ 반전증폭</li> <li>• 변조/복조</li> <li>• Phase lock-in</li> <li>• 용량성/압전</li> <li>• 온도/광</li> <li>• Signal Conditioning</li> </ul>

# Topics

혈압/심음	혈류/혈량	생체 임피던스	호흡기 측정	바이오 센서	생화학 분석기	전자기 자극기	보조/치료 기기
<ul style="list-style-type: none"> <li>• 힘/압력</li> <li>• 심혈관계</li> <li>• 혈류역학</li> <li>• 압력센서</li> <li>• IBP</li> <li>• Catheter</li> <li>• P/F/V의 V/I/Q 등가 회로</li> <li>• 2차시스템</li> <li>• NIBP/Oscillographic method</li> <li>• Tonometry</li> <li>• 소리</li> <li>• 청진기</li> <li>• 전자청진기</li> <li>• 심도자술</li> </ul>	<ul style="list-style-type: none"> <li>• 속도/유속</li> <li>• 심박출량</li> <li>• Fick 법</li> <li>• Dye dilution</li> <li>• Thermodilution</li> <li>• EM혈류계</li> <li>• 초음파</li> <li>• 압전센서</li> <li>• Transit time</li> <li>• Doppler</li> <li>• 열대류 센서</li> <li>• Chamber plethysmography</li> <li>• Photoplethysmography</li> </ul>	<ul style="list-style-type: none"> <li>• 생체조직</li> <li>• 도전율</li> <li>• 유전율</li> <li>• 임피던스</li> <li>• Phasor</li> <li>• 파형발생</li> <li>• 정전류원</li> <li>• 전압측정</li> <li>• Phase-sensitive 복조</li> <li>• 2 전극법</li> <li>• 3 전극법</li> <li>• 4 전극법</li> <li>• 체성분 분석</li> <li>• 임피던스 영상법</li> </ul>	<ul style="list-style-type: none"> <li>• 기압/기류/용적</li> <li>• 호흡기</li> <li>• 산소/이산화탄소</li> <li>• 호흡역학</li> <li>• 가스분포/교환</li> <li>• 기압센서</li> <li>• 기류센서</li> <li>• 용적센서</li> <li>• 가스농도 측정</li> <li>• Spirometry</li> <li>• He dilution</li> <li>• N2 washout</li> <li>• CO diffusion</li> </ul>	<ul style="list-style-type: none"> <li>• Blood gas</li> <li>• 산-염기</li> <li>• PO2, PCO2, pH, SO2</li> <li>• 전극</li> <li>• 광센서</li> <li>• Oximeter</li> <li>• ISFET</li> <li>• Pulse oximeter</li> <li>• Transcutaneous sensor</li> <li>• Blood glucose sensor</li> </ul>	<ul style="list-style-type: none"> <li>• Spectrophotometry</li> <li>• Beer's law</li> <li>• Clinical Analyzer</li> <li>• Chromatography</li> <li>• Electrophoresis</li> <li>• Hematology</li> <li>• Cell counter</li> <li>• Morphological analyzer</li> </ul>	<ul style="list-style-type: none"> <li>• Cardiac pacemaker</li> <li>• Bladder stimulator</li> <li>• Muscle stimulator</li> <li>• Nerve stimulator</li> <li>• Cochlear implant</li> <li>• Defibrillator/cardioverter</li> <li>• DBS</li> <li>• Biofeedback system</li> <li>• Magnetic stimulator</li> </ul>	<ul style="list-style-type: none"> <li>• Balloon pump</li> <li>• VAD</li> <li>• Pump oxygenator</li> <li>• TAH</li> <li>• 혈액투석</li> <li>• 쇄석</li> <li>• Ventilator</li> <li>• Incubator</li> <li>• Drug delivery</li> <li>• 마취기</li> <li>• ESU</li> <li>• Ablation</li> <li>• Laser</li> </ul>

# References

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- Carr and Brown, Introduction to Biomedical Equipment Technology, 1998.
- Geddes and Baker, Principles of Applied Biomedical Instrumentation, 1989.
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