# (BM-451) - Bio-Signal Processing

## Course Outline:

**Theory:**

1. **Introduction to Digital Signal Processing**
    1. Analog-to-Digital& Digital-to-Analog Conversion
    2. Digital Signals, Systems, and Difference Equations
    3. Realizations of Digital Systems
2. **Time domain Analysis**
    1. Digital Convolution
    2. Auto and Cross Correlation
3. **Discrete System Stability**
    1. The z-Transforms
    2. Transfer function, pole zero plot, and System Stability
4. **Discrete Time Fourier Transform**
    1. Frequency response of discrete system
    2. Frequency spectra of discrete signals
    3. Discrete Fourier Analysis and Periodic Signal Spectrum
    4. Fast Fourier transform (FFT),
5. **Finite Impulse Response Filter Design**
    1. FIR filter design using window method.
6. **Infinite Impulse Response Filter Design**
    1. IIR filter design using Bilinear Transformation Method
    2. IIR filter design using Pole-Zero placement, and Impulse Invariance methods.
7. **Biomedical Applications**
    1. Detection of Events: ECG rhythm analysis, Maternal Interference in Fetal ECG
    2. EEG wave-shape and wave-complexity: Analysis of event related potentials, coherence analysis, detection of EEG rhythms
    3. PPG wave analysis
    4. Sound wave analysis
    5. EMG Processing ## **List of Practicals:**
8. Impulse and Step Responses
9. Convolution and Correlation
10. Z-transform, Pole-Zero Plot, Stability
11. Frequency response analysis
12. Frequency spectra analysis
13. FIR filter design
14. IIR Filter Design
15. Analysis of Filter behavior
16. Filter simulation
17. PPG Signal Analysis. Signal Peaks. Peak widths. Heart rate. SpO2
18. ECG Waveform Analysis.
19. EEG Processing
20. Feature Extraction from EEG Signals.
21. Sound Processing. Detecting cardiac condition from digital stethoscope
22. Open ended lab 1
23. Open ended lab 2

## Suggested Teaching Methodology:

- Lecturing
- Written Assignments Report Writing

## Suggested Assessment:

**Theory (100%)**

- Sessional (20%)
- Quiz (12%)
- Assignment (8%)
- Midterm (30%)
- Final Term (50%)

**Laboratory (100%)**

- Labs
- Open-Ended Labs

## Recommended Text and Reference Books:


1. Biomedical Signal Analysis, 2nd Ed, Ranagaraj M. Rangayyan, ISBN: 978- 0-470-91139-6, Willey-IEEE Press.
2. Biomedical Signal Analysis: Contemporary methods and Applications, Fabian J, Theis and Anke Meyer, The MIT Press Cambridge, Massachusetts.
3. Biomedical Signal Processing: Principles and Techniques. D. C. Reddy.
4. Fundamentals of Digital Signal Processing. by: Joyce Van de Vegte.
5. Digital Signal Processing: Fundamentals and Applications. by: Li Tan, 2nd Edition.


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