INTRODUCTORY NEUROSCIENCE & NEURO-INSTRUMENTATION

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PRE-REQUISITES : Basic Electronics

INTENDED AUDIENCE : Engineering Students, Faculty from Engineering Colleges, Medical Students

COURSE OUTLINE :
This course is a systems, design-oriented course aimed to provide exposure to Neuroscience and its importance in the real world. Neuroscience and Neuro- Instrumentation are popular research areas and this course is an introduction to both. The emphasis is on Electro-physiology with an introduction to standard Biological Stimulators and signal conditioning circuits. Expected course outcomes:

• Introduction to EEG and Event-Related Potentials (ERPs).

• Introduction to Brain-Computer Interface (BCI) and its applications.

• Applications using ERPs to screen for disorders of Cognition.

• Introduction to ERP stimulators and signal conditioning circuits.

• Demonstration of EEGLab and ERPLab for EEG and ERP signal processing

ABOUT INSTRUCTOR :
Prof. Mahesh Jayachandra is a Physician Researcher specialized in Neurophysiology, both Experimental and Cognitive. He is Facility Technology Manager (Neurophysiology) at Center for Bio-Systems Science and Engineering, IISc. He is also Adjunct Faculty and Head, Lab of Cognitive Neurophysiology, Division of Mental Health and Neuroscience, St. John's Research Institute, Bangalore, and Head, Bio-Engineering Group Rat Cyborg Project Coordinator at NDRF(IEI), Bangalore. He received his MBBS from Armed Forces Medical College (AFMC), Pune, MD (ECFMG, USA) and PhD from the Neural & Behavioral Sciences Program, SUNY-Health Sciences Center, Brooklyn, New York. He completed post-doctoral fellowships at the Laboratory of Clinical Investigation, Yale University, New Haven, CT; Dynamic Brain Imaging Laboratory, Albert Einstein College of Medicine, The Bronx, NY; and the Program in Cognitive Neuroscience & Schizophrenia, Nathan Kline Institute of Psychiatric Research, Orangeburg, NY.

COURSE PLAN :

Week 1: Introduction to Neurophysiology, Basic Operation of Human Brain

Week 2: EEG introduction, EEG recording systems, Understanding EEG waveforms, Applications of EEG analysis

Week 3: Epilepsy a classic Neurophysiological disorder, Types of Epilepsy, Role of EEG Signal Processing for Epilepsy Classification / Screening

Week 4: Signal Conditioning for EEG and ECG signal processing with demonstration of ECG signal processing circuits

Week 5: Cortical Auditory Event Potential (CAEP), Different Event Related Potentials and their applications: MMN and P300.

Week 6: EEGLAB and ERPLAB Signal Processing Demo using MATLAB

Week 7: Brain Computer Interface: Introduction, Applications, Existing BCI Sensors

Week 8: Electrophysiology Techniques for BCI: Technologies of BCI kits, Recording Brain Waves In humans and animals, "Touching" Infrared, Epidermal Electrodes

Week 9: Completing the BCI Loop in Humans without Neurosurgery: Designing Magnetic stimulators

Week 10: Invasive Techniques to acquire neurological signals, Types of implants and signal conditioning systems

Week 11: Tetrodes Fabrication, Microneedle Fabrication, Implanting Tetrodes and microneedles on a rat model.

Week 12: Design and Fabrication of Closed Loop Rat Training System, Signal acquisition and post-processing