INTRODUCTORY NEUROSCIENCE &
NEURO-INSTRUMENTATION

TYPE OF COURSE : New | Elective | UG/PG
COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)
EXAM DATE : 18 Oct 2020

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, 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