ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ
(ವಿ ಟಿ ಯು ಅಧಿನಿಯಮ ೧೯೯೪ ರ ಅಡಿಯಲ್ಲಿ ಕರ್ನಾಟಕ ಸರ್ಕಾರದಿಂದ ಸ್ಥಾಪಿತವಾದ ರಾಜ್ಯ ವಿಶ್ವವಿದ್ಯಾಲಯ)
VISVESVARAYA TECHNOLOGICAL UNIVERSITY
(State University of Government of Karnataka Established as per the VTU Act, 1994)
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REF: VTU/BGM/ACA/2022-23/ 3282

DATE: 23 SEP 2022

CIRCULAR

Subject: - 20LBI13, 20LBI14 and 20LBI15 courses updated regarding...
Reference: Hon'ble Vice Chancellor's approval dated 20.09.2022

This is with reference to the subject cited above, in Biomedical Signal Processing and Instrumentation PG program, the following courses' syllabi are updated by the Electronics and Instrumentation Board of Studies of VTU Belagavi.

- 20LBI13-Modern Medical Instrumentation
- 20LBI14- Advance Biomedical Signal Processing and
- 20LBI15- Medical Image Techniques and Systems

The updated portion of the syllabus has been highlighted for information

The Principal of the colleges, where this program is being offered is hereby informed to bring the content of this circular to the notice of all concerned.

Encl: Syllabi of above mentioned courses

Sd/-
REGISTRAR

To,

1. The Principals of Engineering Colleges under the ambit of VTU Belagavi (where this program is offered).

Copy to.

1. To the Hon'ble Vice-Chancellor through the secretary to VC, VTU Belagavi for information
2. The Registrar (Evaluation), VTU Belagavi for information and needful
   - QPDS section -P Manjunath
3. The Director I/c. ITI SMU, VTU Belagavi for information and to make arrangements to upload circular on the VTU web portal.
4. The chairperson BoS in EIE, VTU Belagavi

Registrar

Modern Medical Instrumentation			
Course Code	20LBI13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Bioelectric Signals and Electrodes : Sources of biomedical signals, basic medical instrumentation system, PC based medical instruments, General constraints in design of medical instrumentation systems, origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.

Module-2

Biomedical Recording Systems & Recorders : Electrocardiograph-block diagram, ECG leads, effects of artifacts, multi-channel, ECG machine, Phonocardiograph-origin of heart sounds, microphones and amplifiers for PCG, Electroencephalograph- block diagram, computerized analysis of EEG, Electromyograph, biofeedback instrumentation.

Module-3

Patient Monitoring Systems & Oximeters: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement ,Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method. Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter, Bio-telemetry – Radio telemetry, Portable & Landline Telemetry for ECG

Module-4

Blood Flow Meters, Cardiac Pacemakers and Defibrillators:
Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator. Defibrillator electrodes, DC defibrillator with synchronizer.

Module-5

Respiratory & Advanced Diagnostic & Therapeutic Instruments: Pulmonary function measurement, basic spirometer, ultrasonic spirometer, Pneumotachometer, Measurement of volume by Nitrogen washout technique. Artificial kidney-Principle and haemodialysis machine. Lithotripters- principle, modern lithotripter-block diagram and working. Anaesthesia-Need for anaesthesia, delivery of anaesthesia, anaesthesia machine. Infusion pumps-principle and programmable volumetric infusion pump.

Course Outcomes: After going through this course the student will be able to;

1. Discuss the sources of biomedical signals, design a medical instrumentation system taking into account the general constraints.
2. Describe the different types of electrodes used for picking the bioelectric signals.
3. Design suitable recording systems considering the characteristics of bioelectric potentials.
4. Discuss the instrumentation used for measuring the nonelectrical parameters.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. R. S. Khandpur , Handbook of Biomedical Instrumentation, Tata McGraw-Hill ,2nd Edition, 2008.
2. J. G. Webster, Medical instrumentation: Application & Design, Wiley Publications, 3rd Edition, 2008.

Reference Books:

1. Leslie Cromwell & others, Biomedical Instrumentation and Measurements, Wiley Publications, 2nd Edition, 2010.
2. Richard Aston, Principles of Biomedical Instrumentation and Measurement, Prentice Hall of India, 4th Edition, 2005.

Advanced Biomedical Signal Processing			
Course Code	20LBI14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing, Difficulties in signal acquisition. Noise amplifier, Baseline Wander, Powerline Interference

ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

Module-2

ECG Data Reduction: Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques: Karhunen - Loeve Transform, Other data compression Techniques: DPCM, Huffman coding, Data compression Techniques comparison.

Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software and limitations of signal averaging.

Module-3

Frequency Domain Analysis: Introduction, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG,

Time Series Analysis: Introduction, AR models, Estimation of AR parameters by method of least squares and Durbin's algorithm, ARMA models. Spectral modelling and analysis of PCG signals, correlation, convolution

Module-4

Spectral Estimation: Introduction, Blackman- tukey method, The periodogram, Pisarenko's Harmonic decomposition, Prony' method, Evaluation of prosthetic heart valves using PSD techniques. Comparison of the PSD estimation methods.

Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, The matched filter, Detection of the P wave , Identification of heart sounds, Morphological analysis of ECG waves, analysis of activity.

Module-5

Adaptive Filtering: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, Cancellation of 60 Hz interference in ECG, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.

EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.

Course Outcomes: Upon completion of this course, the student should be able to:

1. Implement the various types of processing techniques carried out on biomedical signals which meet the current Industry needs.
2. Develop an interest to design new modelled algorithm more and more continually.
3. Develop an interest to simulate the models and validate its functionality in real time systems.
4. Demonstrate an ability to integrate different concepts to develop new models that suits current trends of Industries and analyze its performance.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)- Arnon Cohen, CRC press, 1986.
2. Biomedical Signal Analysis-A case study approach - Rangaraj M. Rangayyan, Wiley-IEEE Press, 2002.
3. Biomedical Signal Processing Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2012.
4. Biomedical Digital Signal Processing - Willis J. Tompkins, PHI, 2000.

Reference Books:

1. Biomedical Signal Processing in Cardiac and Neurological Applications", Leif Sörnmo & Pablo Laguna, 1st edition. Academic Press, 2005

Medical Imaging Techniques and Systems			
Course Code	20LBI15	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Medical Imaging: Basic imaging principle, Imaging Modalities-Projection radiography, Computed Tomography, Nuclear medicine, Ultrasound imaging, Magnetic Resonance Imaging.
X-Ray and Radiography: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, X-Ray image characteristics, Biological effects of ionizing radiation.

Module-2

Computed Tomography : Conventional tomography, Computed tomography principle, Generations of CT machines – First, Second, Third, Fourth, Fifth, Sixth & Seventh, Projection function,
Reconstruction algorithms – Back Projection Method, 2D Fourier Transform Method, Filtered Back Projection Method, Iteration Method, Parallel Beam Reconstruction, Fan Beam Reconstruction, Helical CT Reconstruction.

Module-3

Ultrasound Imaging: Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Transducer Arrays, A mode, B mode, M mode scanners, Tissue characterization, Colour Doppler flow imaging, Echocardiography.

Module-4

Radio Nuclide Imaging: Interaction of nuclear particles and matter, Nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET.
Infrared Imaging: Physics of thermography – imaging systems – pyroelectric vidicon camera clinical thermography – liquid crystal thermography.

Module-5

Magnetic Resonance Imaging: Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager. Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to Functional MRI. Application, Functional Imaging, Echoplanar imaging, MR Angiography, Cardiac MRI

Course Outcomes: After going through this course the student will be able to;

1. Explain the principle, components and procedure of different imaging modalities.
2. Select suitable imaging technique for particular application.
3. Analyze the images obtained from different imaging techniques for diagnosis and treatment.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Principles of Medical Imaging, K Kirk Shung, Michael B Smith & Benjamim M W Tsui, Academic Press Inc.
2. Hand Book of Biomedical Instrumentation, R S Khandpur, Tata McGraw Hill Publication, Second Edition.

Reference Books:

1. Medical Imaging Signals and Systems, Jerry L Prince & Jonathan M Links, Pearson Prentice Hall.
2. The physics of medical imaging, Steve Webb, Adam Hilger, Bristol, England, Philadelphia, USA, 1988.
3. Basics of MRI, Ray H Hashemi & William G Bradley Jr, Lippincott Williams & Wilkins.
4. Diagnostic Ultrasound Principles & Instruments, 5th Edition, Frederick W Kremkau.
5. 2D Echocardiography, Jay N Schapira, Williams & Wilkins