INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

EMBEDDED SYSTEMS IN BIOMEDICAL APPLICATIONS								
I Semester: ES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BESE17	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Digital Image Processing, Embedded Systems.								

I. COURSE OVERVIEW:

This course focuses on the fundamental concepts and practical aspects of embedded systems as they apply to biomedical engineering. Students will learn how to design, program, and implement embedded systems for various biomedical applications, including medical devices, wearable health monitors, and other healthcare, related technologies.

II. COURSES OBJECTIVES:

The students will try to learn

I. The role of embedded systems in biomedical applications and their significance in modern healthcare technology.
II. The design and implement embedded systems for biomedical devices with a focus on reliability, safety and efficiency.
III. Analyze the challenges specific to biomedical applications and propose appropriate solutions.
IV. Demonstrate hands-on skills in programming and interfacing microcontrollers commonly used in biomedical systems.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Understand the basic principles of embedded systems and their applications in biomedical engineering.
CO 2 Analyze the requirements of biomedical applications and design embedded systems to meet those Requirements.
CO 3 Develop software for embedded systems in biomedical applications.
CO 4 Understand the principles of signal processing and apply them to biomedical signals.
CO 5 Develop a project that applies embedded systems to a biomedical application.
CO 6 Analyze the performance of embedded systems in biomedical applications.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO EMBEDDED SYSTEMS IN BIOMEDICAL APPLICATIONS (9)

Definition and characteristics of embedded systems, overview of biomedical engineering and its applications, key challenges and opportunities in biomedical embedded systems.

MODULE – II: BIOMEDICAL SIGNAL ORIGIN, DYNAMICS AND MODELLING (9)
The nature of biomedical signals:Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG) etc., Biomedical signal origin & dynamics of ECG, ECG;ECG lead system, ECG signal characteristics; Non-Stationarities in ECG signal, Cardiac Arrhythmias, EEG data acquisition, EEG lead system, EEG signal characteristics

MODULE – III: EMBEDDED PROGRAMMING FOR BIOMEDICAL DEVICES (9)

Embedded programming languages (e.g., C/C++) and IDEs. Real-time operating systems (RTOS) for biomedical systems, device drivers and communication protocols.

MODULE –IV: SIGNAL PROCESSING IN BIOMEDICAL EMBEDDED SYSTEMS (9)
Basics of signal processing in biomedical data, filtering, amplification, and noise reduction techniques, digital signal processing algorithms for biomedical signals.

MODULE – V: WIRELESS COMMUNICATION IN BIOMEDICAL DEVICES (9)
Wireless technologies and standards (e.g., Bluetooth, Wi-Fi, Zigbee), data transmission and security considerations, wearable health monitoring systems.

V. TEXT BOOKS:

1. "Introduction to Biomedical Engineering," John Enderle et al.
2. "Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers," Jonathan W. Valvano.

VI. REFERENCE BOOKS:

1. Embedded Microcomputer Systems, real Time Interfacing – Jonathan W. Valvano, Brookes / Cole, 1999, Thomas Learning.
2. The AVR Microcontroller and Embedded Systems: Using Assembly and C by M. A. Mazida, 2nd , Edition, person Education limited, 2011.
3. ARM Assembly Language William Hohl, CRC Press, ISBN:978-81-89643-04-1.

VII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper - I
5. Model question paper - II
6. Lecture notes
7. Power point presentations
8. Early Lecture Readiness Videos