SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution &
Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

# Department of Biomedical Engineering

## Minutes of Fourth BOS Meeting

***Venue***

Seminar Hall, Department of BME
Sri Manakula Vinayagar Engineering College
Madagadipet, Puducherry – 605 107

***Date & Time***

26-02-2022 & 10.30 AM

## Minutes of Board of Studies

The fourth Board of Studies meeting for B.Tech. Biomedical Engineering was held on 26th February 2022 at 10.30 A.M in the Seminar Hall, Department of BME, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting

| Sl.No | Name of the Member with Designation and official Address | Responsibility in the BoS |
|---|---|---|
| 1 | **Dr.A.Vijayalakshmi,**<br>Professor and Head<br>Department of Biomedical Engineering,<br>Sri Manakula Vinayagar Engineering College,<br>Puducherry | Chairman |
| 2 | **Dr A K Jayanthy**<br>Professor<br>Department of Biomedical Engineering<br>SRM Institute of Science and Technology,<br>Kattankulathur | Academic Expert |
| 3 | **Dr.M.Arivamudhan**<br>Professor,<br>Department of Electronics and Communication Engineering<br>Government College of Engineering,<br>Dharmapuri-636704 | Academic Expert |
| 4 | **Dr.R.Premkumar**<br>Professor<br>Department of Biomedical Engineering,<br>Rajalakshmi Engineering College, Chennai | Academic Expert |
| 5 | **Mr.V.Ashok**<br>Manager(Technical)<br>Intel Technology India Pvt.Ltd.<br>SRR Elite, Bellandur, Bengaluru,<br>Karnataka 560103 | Industry Expert |
| 6 | **Dr.A. Jayachitra**<br>Professor<br>Specialization: Process Control and Instrumentation | Internal Member |
| 7 | **Dr. P Arunagiri**<br>Professor<br>Specialization: Communication Systems | Internal Member |
| 8 | **Dr.S.Senthil Kumar**<br>Assistant Professor<br>Specialization: Biomedical Instrumentation | Internal Member |
| 9 | **Dr. S. B. Lenin**<br>Associate Professor<br>Specialization:VLSI Design | Internal Member |
| 10 | **Mr.P.M.Bharath**<br>Assistant Professor<br>Specialization: Embedded System Technologies | Internal Member |

| | | |
|---|---|---|
| 11 | **Mr.R.Vignesh Raj**<br>Assistant Professor<br>Specialization: Nano Technology | Internal Member |
| 12 | **Mrs S Jayanthi**<br>Assistant Professor:<br>Specialization: Communication Systems | Internal Member |
| 13 | **Mr..M.Egalite Francis**<br>Assistant Professor<br>Specialization: Maths | Internal Member |
| 14 | **Dr.S.Savithri**<br>Assistant Professor<br>Specialization:Chemistry | Internal Member |
| 15 | **Mr.S.Gowtham**<br>Software Quality Engineer,<br>Rockwell Automation India Pvt.Ltd.,<br>Bengaluru- 560 025 | Alumni Member |

**Agenda of the Meeting**

| Item No. | Particulars |
|---|---|
| **BoS/UG/BME 4.1** | To discuss about the appraisal of third BoS meeting and Confirmation of minutes of the meeting. |
| **BoS/UG/BME 4.2** | To discuss and approve the Curriculum Structure and Syllabi of VII semester courses for B.Tech – Biomedical Engineering under Regulations R 2020 |
| **BoS/UG/BME 4.3** | To discuss and approve the Professional elective and open elective courses syllabi offered for VII semester B.Tech – Biomedical Engineering under Regulations R 2020 |
| **BoS/UG/BME 4.4** | To review the syllabi for IV Semester courses under Regulations R-2020 and VII Semester courses under Regulations R-2019 for B.Tech- Biomedical Engineering. |
| **BoS/UG/BME4.5** | To apprise the BoS members about the Professional elective and open elective courses offered for VI semester of Regulations R-2019 and IV semester under Regulations R-2020 |
| **BoS/UG/BME 4.6** | To discuss the Employability Enhancement courses offered for VI Semester under Autonomous Regulations 2019, I and III semesters Employability Enhancement courses for Autonomous Regulations 2020. |
| **BoS/UG/BME 4.7** | To discuss the academic schedule for the even semester of the Academic Year 2021-22 |
| **BoS/UG/BME 4.8** | To apprise the End Semester Examination conducted in offline mode. |
| **BoS/UG/BME 4.9** | To discuss and recommend the panel of examiners to the Academic Council. |
| **BoS/UG/BME 4.10** | Any other item with the permission of the chair |

**Chairman-BoS/BME**
Dr A Vijayalakshmi

**Minutes of the Meeting**

Dr.A.Vijayalakshmi, Chairman, BoS opened the meeting by a warm welcome and introduced the external experts to the internal members and thanked them for accepting the invitation to conduct Fourth Board of Studies meeting on 26th February 2022.

The Chairman proceeded with the presentation, and the meeting deliberated on agenda items.

**BoS/UG/BME 4.1**

The BoS Chairman reviewed the Third BoS meeting with the members, its implementation and confirmed with the approval for the incorporation of minor modifications as mentioned below:

In the curriculum structure of Regulations 2019, VII Semester

- For Professional Elective-VI, Clinical Engineering course U19BME89 is offered instead of Biomedical Laser Instruments Course.
- Physiological System Modelling (U19BME71) last few topics were removed from each unit to reduce the syllabus
- Dynamics of Biofluids (U19BME75) syllabus was vast and reduced.
- Human Assist Devices (U19BME81) unit titles were changed.
- Neural Networks (U19BME82) Nerve Excitability content was modified.

**The above modifications are approved by BoS members.**

**BoS/UG/BME 4.2**

The Curriculum Structure and Syllabi of VII semester courses for B.Tech - Biomedical Engineering Programme under Regulations R- 2020 were discussed and BoS members suggested the following modifications:

| S.No | Regulation | Semester | Subject with Code | Unit | Particulars |
|---|---|---|---|---|---|
| 1. | R-2020 | VII | Virtual Bioinstrumentation U20BMT718 | 4 | Content to be reduced |

**The BoS members accept the modification and approved the VII semester courses Syllabi. (Annexure I)**

**BoS/UG/BME 4.3**

Professional electives and open electives syllabi offered for VII semester for the students admitted in the academic year 2020-21 were discussed and suggested the following modifications:

| S.No | Regulation | Semester | Subject with Code | Unit | Particulars |
|---|---|---|---|---|---|
| 1. | R-2020 | VII | Nanotechnology in Medicine U20BME720 | - | Syllabus is vast and has to be reduced. |
| 2 | R-2020 | VII | Internet of Things for Healthcare U20BMO705 | 5 | Asked to exclude some topics |

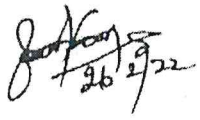
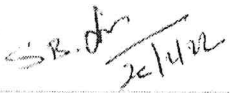
| | |
|---|---|
| | Medical Safety and Standards course is offered instead of MRI and its Clinical Applications Course (U19BME717) and approved by BoS members.<br><br>The BoS members resolved R-2020 Seventh semester Professional and Open electives syllabi with above mentioned changes.<br>**The modifications are incorporated and the Syllabi is given in Annexure II** and approved by BoS members. |
| **BoS/UG/BME 4.4** | The Syllabi for IV Semester courses under Regulations R-2020 and VII Semester courses under Regulations R-2019 for B.Tech- Biomedical Engineering were reviewed.<br>IV Semester Biosignal Processing course (U20BMT409) syllabus for unit 3 and unit 5 were modified and approved by BoS members. (**Annexure III)**<br>**The BoS members accept the modification and approved the curriculum structure**. |
| **BoS/UG/BME4.5** | Professional elective and open elective courses offered for VI semester of Regulations R-2019 and IV semester under Regulations R-2020 were confirmed with the BoS members. |
| **BoS/UG/BME 4.6** | The Employability Enhancement courses offered for VI Semester under Autonomous Regulations 2019, I and III semesters Employability Enhancement courses for Autonomous Regulations 2020 were discussed and approved by the BOS members. |
| **BoS/UG/BME 4.7** | The academic schedule for the even semester of the Academic Year 2021-22 were discussed with the BOS members, The modification in the Conduction of Continuous Assessment Test for Autonomous Regulations 2019 and 2020 and approved by members |
| **BoS/UG/BME 4.8** | The schedule for End semester examinations conducted in offline mode for sixth semester of B.Tech. Biomedical Engineering program under Regulation 2019 and third & first semester for Regulation 2020 were discussed. |
| **BoS/UG/BME 4.9** | The revised list of panel of examiners and question paper setters for the end semester examinations were discussed and confirmed with the members. **(Annexure - IV)** |
| **BoS/UG/BME 4.10** | The department development activities for the Academic Year 2021-22 were presented to the BoS members. |

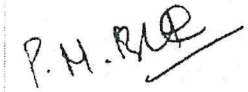
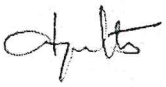
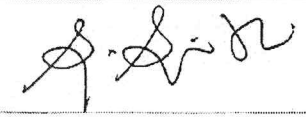
Dr. A.Vijayalakshmi, Chairman – BoS and Head of Department, Biomedical Engineering, concluded the meeting at 12:30 pm with vote of thanks.

**Dr. A.Vijayalakshmi**
Chairman-BoS/BME

## Attendance for BoS4 Meeting

Board of Studies Members:

| Sl. No | Name of the Member with Designation and official Address | Responsibility in the BoS | Signature |
|---|---|---|---|
| 1 | **Dr.A.Vijayalakshmi,**<br>Professor and Head<br>Department of Biomedical Engineering, Sri Manakula Vinayagar Engineering College, Puducherry. | Chairman |  |
| 2 | **Dr A K Jayanthy**<br>Professor, Department of Biomedical Engineering,<br>SRM Institute of Science and Technology, Chennai. | Academic Expert |  |
| 3 | **Dr.M.Arivamudhan**<br>Professor, Department of Electronics and Communication Engineering, Government College of Engineering,<br>Dharmapuri. | Academic Expert |  |
| 4 | **Dr.R.Premkumar**<br>Professor<br>Department of Biomedical Engineering,<br>Rajalakshmi Engineering College, Chennai | Academic Expert |  |
| 5 | **Mr.V.Ashok**<br>Manager(Technical)<br>Intel Technology India Pvt.Ltd.<br>SRR Elite, Bellandur, Bengaluru, Karnataka 560103 | Industry Expert |  |
| 6 | **Dr.A. Jayachitra**<br>Professor<br>Specialization: Process Control and Instrumentation | Internal Member |  |
| 7 | **Dr. P Arunagiri**<br>Professor<br>Specialization: Communication Systems | Internal Member |  |
| 8 | **Dr.S.Senthil Kumar**<br>Assistant Professor<br>Specialization: Biomedical Instrumentation | Internal Member |  |
| 9 | **Dr. S. B. Lenin**<br>Associate Professor<br>Specialization:VLSI Design | Internal Member |  |

| | | | |
|---|---|---|---|
| 10 | **Mr.P.M.Bharath**<br>Assistant Professor<br>Specialization: Embedded System Technologies | Internal Member |  |
| 11 | **Mr.R.Vignesh Raj**<br>Assistant Professor<br>Specialization: Nano Technology | Internal Member |  |
| 12 | **Mrs.S.Jayanthi**<br>Assistant Professor:<br>Specialization: Communication Systems | Internal Member |  |
| 13 | **Mr. M. Egalite Francis**<br>Assistant Professor<br>Specialization: Maths | Internal Member |  |
| 14 | **Dr. S. Savithri**<br>Assistant Professor<br>Specialization:Chemistry | Internal Member |  |
| 15 | **Mr. S. Gowtham**<br>Software Quality Engineer, Rockwell Automation India Pvt. Ltd., Bengaluru. | Alumni Member |  |

**Chairman-BoS/BME**

Dr.A.Vijayalakshmi

## Annexure –I

## ACADEMIC REGULATIONS 2020

### CURRICULUM STRUCTURE

| SEMESTER – VII | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | |
| 1 | U20BMT718 | Virtual Bioinstrumentation | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 2 | U20BMT719 | Medical image processing | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U20BME7XX | Professional Elective – IV | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U20XXO7XX | Open Elective – IV | OE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Practical** | | | | | | | | | | |
| 5 | U20HSP703 | Business Basics for Entrepreneur | HS | 0 | 0 | 2 | 1 | 100 | - | 100 |
| 6 | U20BMP713 | Virtual Bioinstrumentation Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 7 | U20BMP714 | Medical Image Processing Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U20BMP715 | Comprehensive Viva voce | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Project Work** | | | | | | | | | | |
| 9 | U20BMW701 | Project Phase – I | PW | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 10 | U20BMW702 | Internship / Inplant Training | PW | 0 | 0 | 0 | 2 | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 11 | U20BMM707 | Professional Ethics | MC | 2 | 0 | 0 | - | 100 | - | 100 |
| | | | | | | | 20 | 600 | 500 | 1100 |

## PROFESSIONAL ELECTIVE COURSES

| Professional Elective – IV (Offered in Semester VII) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U20BME716 | Dynamics of Biofluids |
| 2 | U20BME717 | Medical Safety and Standards |
| 3 | U20BME718 | Radiological Equipment |
| 4 | U20BME719 | Cryptography and Network Security |
| 5 | U20BME720 | Nanotechnology in Medicine |

## OPEN ELECTIVE COURSES

| (Courses Offered in Semester VII) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U20BMO705 | Internet of Things for Healthcare |
| 2 | U20BMO706 | Telehealth Technology |

| U20BMT718 | VIRTUAL BIOINSTRUMENTATION | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | 45 |

**Course Objectives**

- To understand the fundamental concept of Virtual Instrumentation
- To gain knowledge in programming and dataflow in VI
- To impart adequate knowledge of Data acquisition for VI
- To illustrate the concept of various interfacing technique used in VI
- To implement VI in medical applications

***Course Outcomes***

*After completion of the course, the students will be able to*

**CO1 -** Understand the basic concepts of Virtual instrumentation **(K2)**
**CO2 -** Realize the programming language used in VI **(K2)**
**CO3 -** Analyze the concept of data acquisition using VI **(K2)**
**CO4 -** Interpret the interfacing concept used in LabVIEW. **(K3)**
**CO5 -** Apply the concept of VI for medical applications. **(K3)**

**UNIT I INTRODUCTION** **(9 Hrs)**

History of Virtual Instrumentation, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, LabVIEW basics – graphical programming, LabVIEW environment

**UNIT II PROGRAMMING TECHNIQUES** **(9 Hrs)**

VIS and sub-VIS, loops and charts, arrays, clusters, graphs, case and sequence structures, formula modes, local and global variable, string and file input. Publishing measurement data in the web.

**UNIT III DATA ACQUISITION** **(9 Hrs)**

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input / Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

**UNIT IV INSTRUMENT INTERFACES** **(9 Hrs)**

Current loop, GPIB, System basics, interface basics: USB, PCMCIA, networking basics for office and industrial application VISA and IVI, image acquisition and processing, Motion Control, waveform generator.

**UNIT V BIOMEDICAL APPLICATIONS** **(9 Hrs)**

Virtual applications for ECG, EEG, EMG signals, Air Flow and Lung Volume, Non-invasive Blood Pressure Measurement, Virtual Reality and 3D graphical modelling, Virtual Prototyping.

**Text Books**

1. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in LabVIEW" Prentice Hall PTR, 2001
2. Gary Johnson, "LABVIEW Graphical Programming", 4th Edition, McGraw Hill, 2006.
3. Ronald W. Larsen, "LabVIEW for Engineers", Pearson , 1st Edition, 2010

**Reference Books**

1. Robert H. Bishop," Learning with LabVIEW" , Pearson, First edition, 2014
2. Jerome, "Virtual Instrumentation Using LabView", PHI, 2010.
3. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

4. John Essick," Hands-on Introduction to LabVIEW for Scientists and Engineers ",Oxford University Press, 4th Edition,2018
5. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.

## Web References

1. https://youtu.be/_2IZVC902kg
2. https://youtu.be/78dZ8IjJ52M
3. https://youtu.be/fIy6XT3CdPQ
4. https://youtu.be/U0bQBOEiBQY
5. https://youtu.be/Q8rFSpaa84Q

## COs/POs/PSOs Mapping

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | 3 | 2 | - |
| 2 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | 2 | 2 | 2 | - |
| 3 | 3 | 1 | 1 | 1 | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 |
| 4 | 3 | 2 | 3 | - | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 |
| 5 | 3 | 2 | 2 | - | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

## Annexure – II

### PROFESSIONAL ELECTIVE - IV

| | | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| U20BME720 | NANOTECHNOLOGY IN MEDICINE | 3 | 0 | 0 | 3 | 45 |

### COURSE OBJECTIVES

- To study the basic concept of nanomaterial synthesis.
- To get an adequate knowledge about the materials used in nanotechnology process
- To understand the properties of nanomaterials
- To learn the characterization techniques used in nanomaterials.
- To understand various environmental pollutants and its effects

### COURSE OUTCOMES

*After completion of the course, the students will be able to*

**CO1** - Understand the basic concept of nanomaterial synthesis. **(K2)**
**CO2** - Gain knowledge about the materials used in nanotechnology process. **(K2)**
**CO3** - Understand the properties of nanomaterials **(K3)**
**CO4** - Explain the characterization techniques used in nanomaterials **(K3)**
**CO5** - Analyze the nanomaterials using healthcare and its techniques **(K4)**

### UNIT I SYNTHESIS OF NANOMATERIALS (9 Hrs)

Chemical processes: Chemical precipitation and co-precipitation, polyol, and borohydrate reduction methods, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Microwave assisted synthesis; Sonochemical assisted synthesis, Core-Shell nanostructure, Organic-Inorganic hybrid nanocomposites.

### UNIT II NANOMATERIALS PROCESSES (9 Hrs)

Physical Methods: Inert gas condensation, Arc discharge, RF- plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD) method.

### UNIT III NANOMATERIALS PROPERTIES (9 Hrs)

Size effect of Nanomaterials: Size, shape, density, melting point, wet ability and specific surface area. Diffusion properties - Thermal properties - Electrical properties - Dielectric properties - Magnetic properties - Optical properties - Photoconductivity, Electroluminescence, Photoluminescence.

### UNIT IV CHARACTERIZATION TECHNIQUES (9 Hrs)

XRD, SEM, EDAX, TEM, Elemental mapping, FTIR, UV-Visible spectrophotometer, Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), X-ray Photoelectron Spectroscopy (XPS).

### UNIT V NANOMEDICINE (9 Hrs)

Advance diagnosis - invivo imaging – Nano bioconjugates and their significance Nanoscaffolds - Magnetic Nanoparticles- Multifunctional Inorganic and organic nanoparticles and their biomedical applications - Nanobot medical devices.

### Text Books


1. Harry F. Tibbals, "Medical Nanotechnology and Nanomedicine", 1st Edition, CRC Press, 2011.
2. Hossein Hosseinkhani, "Nanomaterials in Advanced Medicine", Wiley, 2019.

3. Kirthi, A. Vishnu, Karthik, L., Janarthanan, Pushpamalar, "Nanotechnology in Medicine", Springer, 2021.
4. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties Application", Imperial College Press, 2004.

## Reference Books

1. Z.L Wang ," Characterization of Nanophase materials", 1st Edition, Wiley-VCH, 2000.
2. G. Schmidt, "Nanoparticles: From theory to applications", 2nd Edition, Wiley Weinheim, 2004.
3. Gould, Tobochnik, "Introduction to Computer simulation methods", 2nd Edition, Addition Weekly. 2006
4. Zoraida Aguilar, "Nanomaterials for Medical Applications", 1st Edition,Elsevier, 2012.

## Web References

1. https://en.wikipedia.org/wiki/Nanomedicine
2. https://www.medicalnewstoday.com/articles/244972
3. https://www.azonano.com/article.aspx?ArticleID=4840
4. https://youtu.be/ZS1QPndpD2w
5. https://youtu.be/iiT_KJJ1Uhs

## COs/POs/PSOs Mapping

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | - | - | 3 | 3 | 2 | 2 |
| 2 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | - | - | 3 | 3 | 2 | 2 |
| 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | - | - | 3 | 3 | 2 | 2 |
| 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | - | - | 3 | 3 | 2 | 2 |
| 5 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | - | - | 3 | 3 | 2 | 2 |

**Correlation Level: 1- Low; 2 - Medium; 3 – High.**

## OPEN ELECTIVE - IV

| | | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| U20BMO705 | INTERNET OF THINGS FOR HEALTH CARE | 3 | 0 | 0 | 3 | 45 |

### Course Objectives

- To understand the architecture of IoT and its associated protocols
- To gain knowledge on interfacing IoT and cloud
- To analyse the design and development of IoT.
- To get trained with m-IoT components and equipment
- To understand wearable technologies and applications

### Course Outcomes

*After completion of the course, the students will be able to*

**CO1 -** understand the architecture of IoT and its associated protocols **(K2)**
**CO2 -** Gain knowledge on interfacing IoT and cloud **(K2)**
**CO3 -** Analyse the design and development of IoT. **(K3)**
**CO4 -** Understand m-IoT components and equipment **(K2)**
**CO5 -** Gain knowledge in wearable technologies and applications **(K2)**

### UNIT-I INTRODUCTION TO IoT (9 Hrs)

Brief History of IoT, Architectural Layers of IoT, Bluetooth, ZigBee, Wi-Fi, IP-Based Protocols, UPnP, CoAP, MQTT, XMPP,Authentication protocols, IEEE 802.15.4.60

### UNIT-II IoT IN THE CLOUD (9 Hrs)

Network layer, Cloud, Network Technologies, Types of Networks, BAN, Cloud and Virtualization, Cloud terminologies, Types of Cloud, Service Models, Fog and edge customization

### UNIT-III DESIGN & DEVELOPMENT (9 Hrs)

Design Methodology, Embedded computing logic, System on Chips , IoT system building blocks – Arduino board details, IDE programming , Raspberry Pi - Introduction and Interfacing

### UNIT-IV MEDICAL IoT (9 Hrs)

Perception Layer, RFIDs, cameras, Sensors, Introduction to ASICs, pulse oximeters, instrumentation amplifiers, surgical equipment and dependencies, Surgery and its types, role of IoT in surgery.

### UNIT-V APPLICATION OF IoT IN HEALTH CARE (9 Hrs)

Ventilators, Wearable Technologies, smart watches, Computer Assisted Anthropology, Smart Health Organizations

### Text Books


1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra, "Medical Big Data and Internet of Medical Things", CRC Press, 1st edition, 2018.
2. Pankajavalli, P. B., Karthick, G. S. "Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,"IGI Global, 1st edition, 2019.
3. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015

## Reference Books

1.Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar "Internet of Things in Biomedical Engineering", , Academic Press, 2019
2.Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014
3.Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad "A Handbook of Internet of Things in Biomedical and Cyber Physical System" Springer International Publishing,2019
4.Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues "Internet of Medical Things for Smart Healthcare" Springer Singapore,2019
5.Subhas Chandra Mukhopadhyay "Intelligent IoT Systems in Personalized Health Care" Elsevier Science,2020

## Web References

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.digimat.in/nptel/courses/video/108105091/L01.html
3. https://youtu.be/ZlBBZnGjFCg
4. https://youtu.be/UrwbeOIlc68
5. https://youtu.be/gGNz-SduPnM

## COs/POs/PSOs Mapping

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | - | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 1 | - |
| 2 | 3 | 1 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 1 | - |
| 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | 1 | - |
| 4 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 1 | - |
| 5 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 1 | - |

**Correlation Level: 1-Low, 2-Medium, 3- High**

| U20BME717 | MEDICAL SAFETY AND STANDARDS | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 3 | 45 |

**Course Objective**

- To understand how safety is important for health care systems
- To know about various electrical and radiation hazards
- To gain knowledge in quality assessment in healthcare
- To understand hospital accreditation and standards
- To apply the guidelines for medical standards in hospitals

**Course Outcomes**

*After completion of the course, the students will be able to*

**CO1 -** Gain knowledge about hospital safety devices necessary for health care system **(K2)**
**CO2 -** Understand the techniques to shield patient from electrical hazards **(K3)**
**CO3 -** Gain knowledge in radiation safety and control measures **(K2)**
**CO4 -** Apply the various methods to monitor and assess quality in healthcare **(K3)**
**CO5 -** Apply the guidelines for medical standards in hospitals **(K3)**

**UNIT - I HOSPITAL SAFETY** **(9 Hrs)**

Security and Safety of Hospital - Property, Staff & Patients, Safety precautions, Safe medical devices - device requirements - devices for varying age – initial inspection –maintenance-Safe handling and operation - Reporting- Bed rails- Flawed mechanics- removable parts and packaging.

**UNIT - II ELECTRICAL SAFETY** **(9 Hrs)**

Physiological effects of electricity - Electrical faults in medical devices - Micro shock, Macro shock, Leakage current-Electrical isolation - Grounding system - Electrical safety analyzer-Emergency power system - Uninterrupted power supply.

**UNIT - III RADIOLOGICAL SAFETY** **(9 Hrs)**

Fundamentals of radiation detection-Classification of UV radiation - Biological effects of UV - Hazards associated with UV radiation - UV monitor and control measures, LASER - radiation hazards - control measures, Guidelines for CT installations, MRI safety guidelines.

**UNIT - IV QUALITY ASSESSMENT IN HEALTHCARE** **(9 Hrs)**

Quality management-risk management- types of responsibilities – CSR, Individual and institutional Responsibility- MDRA and medical device standards - ICRP regulations for radiation safety- Methods Adopted to monitor the standards, Evaluation of hospital services – Quality Assurance in Hospitals Sop's -TQM in Health care organization - Quality assurance methods.

**UNIT - V HOSPITAL ACCREDITATION AND STANDARDS** **(9 Hrs)**

Accreditation- JCI Accreditation & its Policies, Patient centered standards, Healthcare Organization management standards, Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Providing and Maintaining Fire Alarm Systems, Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment.

**Text Books**

1. Bertil Jacobson and Alan Murray, "Medical Devices use and safety", Reed Elsevier India Pvt. Ltd, New Delhi, 2011.
2. Massimo A.G.Mitolo, "Electrical Safety of Low-voltage System", Mc Graw Hill, 2009.
3."Physical Environment Online: A Guide to The Joint Commission's Safety Standards", HCPro, Inc.2010

## Reference Books


1. Bioethics-"An Introduction for the biosciences", 2nd edition, Ben Mepham, Oxford, 2008.
2. Joint Commission Accreditation Standards for Hospitals ,2nd edition 2003
3. G.D.Kunder, S.Gopinath, A.Katakam, "Hospital Planning, Design and Management", Tata Mcgraw Hil publishers, New Delhi, 1998.
4. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, New York, 1997.
5. Domiel A Vallero "Biomedical Ethics for Engineers", Elsevier Pub.1st edition, 2007


## Web References

1. www.wma.net/what-we-do/education
2. www.medvarsity.com/courses/certificationcourse
3. www.medscape.com/courses/business
4. www.onlinecourses.swayam2.ac.in
5. www.healthcentral.com/healthcare

## COs/POs/PSOs Mapping

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 2 | - | - | - | - | 1 | 3 | 1 | - | - | - | 1 | - | - |
| 2 | 3 | 2 | - | - | - | - | 1 | 3 | 1 | - | - | - | 1 | 2 | - |
| 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | - | - | 2 | 3 |
| 4 | 2 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | - | - | 2 | 3 |
| 5 | 2 | 3 | - | - | - | - | 3 | 3 | 3 | - | - | - | - | 2 | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

## Annexure – III

| U20BMT409 | BIOSIGNAL PROCESSING | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| | | 2 | 2 | 0 | 3 | 60 |

### Course Objectives

- To understand the characteristics of digital filters, design of IIR filters
- To design digital FIR filters and its realization
- To gain knowledge on the signal processing techniques used for ECG in cardiology
- To gain knowledge on the signal processing techniques used for EEG in neurology
- To understand the removal of noise from Biomedical Signal

### Course Outcomes

*After completion of the course, the students will be able to*

**CO1 -** Design and implement IIR digital filters **(K4)**
**CO2 -** Design and implement FIR digital filters **(K4)**
**CO3 -** Identify the process of analyzing ECG Signals **(K3)**
**CO4 -** Analyze the signal processing techniques used for EEG in neurology **(K3)**
**CO5 -** Gain knowledge in the removal of noise from Biomedical Signal **(K3)**

### UNIT I INFINITE IMPULSE RESPONSE FILTERS (12 Hrs)

Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

### UNIT II FINITE IMPULSE RESPONSE FILTERS (12 Hrs)

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

### UNIT III CARDIOLOGICAL SIGNAL PROCESSING (12 Hrs)

Preprocessing of ECG signal, QRS detection Methods- Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms, Automated ECG analysis. Data compression techniques: Turning Point algorithm, AZTEC, CORTES. Adaptive filters, Weiner filter principles, medical Applications of Adaptive Noise Cancellation.

### UNIT IV NEUROLOGICAL SIGNAL PROCESSING (12 Hrs)

Electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Detection of EEG Rhythms, Template matching for EEG spike and wave detection, Sleep EEG classification and epilepsy.

### UNIT V REMOVAL OF NOISE AND ARTIFACTS FROM BIOMEDICAL SIGNAL (12 Hrs)

Random and Structured Noise, Physiological Interference, Stationary and Non-stationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.

### Text Books


1. Rangayyan, R.M."Biomedical signal analysis (Vol. 33)", John Wiley & Sons,2015.
2. Reddy, D.C."Biomedical signal processing: principles and techniques". McGraw-Hill, 2005
3. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012

## Reference Books

1.Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
2.Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2010.
3.StephaneMallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011.
4.Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group, LLC, Second edition. 2012
5.Li Tan , Jean Jiang "Digital Signal Processing fundamentals and Applications", Second edition, Academic Press, 2013

## Web References

1. https://www.youtube.com/watch?v=S_U-s27nPLE
2. https://www.youtube.com/watch?v=bFeYjFtSsrg
3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles
4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069
5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf

## COs/POs/PSOs Mapping

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 3 | 3 | - |
| 2 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 3 | 3 | - |
| 3 | 2 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 3 | 3 | - |
| 4 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 3 | 3 | - |
| 5 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 3 | 3 | - |

**Correlation Level: 1- Low, 2 - Medium, 3 - High**

Annexure –IV

# SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)
(Accredited by NBA-AICTE, New Delhi, ISO 9001:2000 Certified Institution & Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

## Department of Biomedical Engineering
## Panel of Examiners

| S. No. | Name of the Examiner | Highest Qualification | Specialization | Experience (in Years) | Communication Address | Email ID with Mobile Number |
|---|---|---|---|---|---|---|
| 1. | Dr.P.Shanmugaraja | Ph.D | Medical Electronics | 26 | Professor, Department of Electronics and Instrumentation, Annamalai University, Chidambaram | psraja70@gmail.com 9443275120 |
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| 19 | Dr. Ashokan | Ph.D | Biomedical Engineering | 10 | Professor and Head, Department of Biomedical Engineering Kongunadu College of | Hodbme@kongunadu.ac.in 8012505054 |

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|---|---|---|---|---|---|---|
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