RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

MEDICAL ELECTRONICS

V & VI SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.

About the Department

The Medical Electronics department at M S Ramaiah Institute of Technology (MSRIT), Bangalore was started in the year 1996 and renamed as Medical Electronics Engineering in the year 2020 by Visvesvaraya Technological University (VTU), Belagavi. The department has been accredited by NBA. In 2012, the Department was recognized as a Research Centre by VTU and offers Ph.D. and M.Sc. (Engg.) by research programs. The department is located at Lecture Hall Complex of RIT Campus and includes six established laboratories namely Diagnostic & Therapeutic Equipment Laboratory, Medical Electronics Laboratory, Medical Software Laboratory, Medical Instrumentation Laboratory, Texas Instruments Innovation Laboratory and Centre for Medical Electronics and Computing. The department consists of highly motivated & qualified faculty and dedicated supporting staff headed by Dr. Narayanappa C K having a teaching experience of more than twenty-five years with specialization in control systems and image processing. The current curriculum has been reviewed by experts from GE Healthcare, Philips Innovation Centre, Skanray Healthcare, Forus Healthcare, IIT Madras and MSR Medical College. The department conducts various training programs in addition to the syllabus for giving the students exposure to the latest developments in the industry.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

Provide quality education, motivational academic environment and foster a conducive Institute-industrial relationship to empower the students to face the real-time challenges in the field of engineering and medicine

MISSION OF THE DEPARTMENT

The department shall transform the entrant of the program into professionally competent engineers through innovative curricula, research, practical training and effective collaboration with industry, hospital and academia

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Solve the real-life engineering problems by employing the knowledge and skills of Medical Electronics

PEO 2: Provide a multi-disciplinary environment to link engineering and medical domains

PEO 3: Inculcate professional and ethical values in lifelong learning process

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Acquire and comprehend the basic skill sets of mathematical approaches along with analog and digital electronics essential in the development of biomedical systems

PSO2: Provide hardware and software oriented real-time solutions in healthcare using the knowledge of Biomedical electronics and instrumentation

PSO3: Utilize the concepts of advanced clinical engineering to cater to the requirements of healthcare oriented applications

Curriculum Course Credits Distribution

Batch 2019-2023

Semester	Humanities & Social Sciences (HSS)	Basic Sciences/ Lab (BS)	Engineering Sciences/ Lab (ES)	Professional Courses- Core (Hard core, soft core, Lab) (PC-C)	Professional Courses - Electives (PC-E)	Other Electives (OE)	Project Work (PW)	Internship/other activities (IS/ECA)	Total semester load
First	-	9	11	-	-	-	-	-	**20**
Second	2	8	10	-	-	-	-	-	**20**
Third	-	4	3	18	-	-	-	-	**25**
Fourth	-	7	-	18	-	-	-	-	**25**
Fifth	3	-	-	15	3	3	-	--	**24**
Sixth	-	-	-	11	6	3	4	-	**24**
Seventh	3	-	-	10	6	-	-	1	**20**
Eighth	-	-	-	-	-	-	14	3	**17**
Total	**8**	**28**	**24**	**72**	**15**	**6**	**18**	**4**	**175**

BATCH 2019-2023

V SEMESTER

Sl. No	Subject Code	Subject	Credits			
			L	T	P	Total
1.	ML51	Medical Physics	3	0	0	3
2.	ML52	Biomedical Instrumentation II	4	0	0	4
3.	ML53	Biomedical Image Processing	3	1	0	4
4.	ML54	IPR and Medical Ethics	3	0	0	3
5.	MLE1X	Professional Elective-1	3	1	0	4
6.	MLOE01	Open Elective – 1	3	0	0	3
7.	MLL56	Medical Physics Lab	0	0	1	1
8.	MLL57	Biomedical Instrumentation-1 Lab (some of experiments can be done also using NI-VI and can be used for assessment)	0	0	1	1
9.	MLL58	Biomedical Signal Processing Lab	0	0	1	1
TOTAL			**19**	**02**	**03**	**24**

Note: Minimum of 2 subjects should have a Tutorial component of 1 Credit each.

PROFESSIONAL ELECTIVE- 1

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLE11	App development for medical applications	3	1	0	4
2	MLE12	IOT in healthcare	3	1	0	4
3	MLE13	Introduction to programming using Scilab	3	1	0	4
4	MLE14	JAVA Programming	3	1	0	4
5	MLE15	Python Programming	3	1	0	4
6	MLE16	Modelling and simulation in biomedical Engineering	3	1	0	4

OPEN ELECTIVE – 1

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLOE01	Introduction to Medical Electronics	3	0	0	3
2	MLOE02	BioMEMS	3	0	0	3
3/	MLOE03	Hospital Management	3	0	0	3

VI SEMESTER

SI. No	Subject Code	Subject	Credits			
			L	T	P	Total
1.	ML61	Biostatistics	3	1	0	4
2.	ML62	Real Time processors & Applications	3	1	0	4
3.	MLE2x	Professional Elective – 2	3	0	0	3
4.	MLE3x	Professional Elective – 3	3	0	0	3
5.	ML65	Mini Project/Elective/NPTEL Course	0	0	4	4
6.	MLOE02	Open Elective – 2	3	0	0	3
7.	MLL66	Real Time processors & Applications Lab	0	0	1	1
8.	MLL67	Bio-Medical Instrumentation-II Lab	0	0	1	1
9.	MLL68	Biomedical Image Processing Lab	0	0	1	1
TOTAL			**15**	**02**	**07**	**24**

Note: Minimum of 2 subjects should have a Tutorial component of 1 Credit each.

PROFESSIONAL ELECTIVE - 2

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLE21	Photonics &Lasers in medicine	3	0	0	3
2	MLE22	Medical Robotics	3	0	0	3
3	MLE23	Human Assist Devices	3	0	0	3
4	MLE24	Mechatronics in medicine	3	0	0	3
5	MLE25	Physiological System modelling	3	0	0	3
6	MLE26	Biomimetic Technologies	3	0	0	3

PROFESSIONAL ELECTIVE - 3

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLE31	Wearable Devices	3	0	0	3
2	MLE32	Biosensors	3	0	0	3
3	MLE33	BioMEMS	3	0	0	3
4	MLE34	Biometrics	3	0	0	3
5	MLE35	Health Informatics	3	0	0	3
6	MLE36	Biomaterials & Biomechanics	3	0	0	3

OPEN ELECTIVE - 2

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLOE04	Data Science for Healthcare	3	0	0	3
2	MLOE05	AI in Medicine	3	0	0	3
3	MLOE06	Health Informatics	3	0	0	3

V SEMESTER

MEDICAL PHYSICS

Course Code: ML51 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi, Dr. Narayanappa C K

Course contents

UNIT I

Heat and Kinetic Theory: Heat and Hotness, Kinetic Theory of Matter, Definitions, Unit of Heat, Specific Heat, Latent Heats, Transfer of Heat, Conduction, Convection, Radiation, Diffusion, Transport of Molecules by Diffusion, Diffusion through Membranes, The Respiratory System Surfactants and Breathing, Diffusion and Contact Lenses **Heat and Life:** Energy Requirements of People, Energy from Food, Regulation of Body Temperature, Control of Skin Temperature, Convection, Radiation, Radiative Heating by the Sun, Evaporation, Resistance to Cold, Heat and Soil.

UNIT II

Fluids: Force and Pressure in a Fluid, Pascal's Principle, Hydrostatic Skeleton , Archimedes' Principle, Power Required to Remain Afloat, Buoyancy of Fish, Surface Tension, Soil Water, Insect Locomotion on Water, Contraction of Muscles, Surfactants. **The Motion of Fluids:** Bernoulli's Equation, Viscosity and Poiseuille's Law, Turbulent Flow, Circulation of the Blood, Blood Pressure, Control of Blood Flow, Energetics of Blood Flow, Turbulence in the Blood, Arteriosclerosis and Blood Flow, Power Produced by the Heart. Measurement of Blood Pressure.

UNIT III

Sound & Hearing: Properties of Sound, Some Properties of Waves , Reflection and Refraction, Interference, Diffraction, Hearing and the Ear, Performance of the Ear, Frequency and Pitch, Intensity and Loudness, Bats and Echoes, Sounds Produced by Animals . Acoustic Traps, Clinical Uses of Sound, Ultrasonic Waves

UNIT IV

Optics &vision: Vision, Nature of Light, Structure of the Eye, Accommodation, Eye and the Camera, Aperture and Depth of Field, Lens System of the Eye, Reduced Eye, Retina, Resolving Power of the Eye, Threshold of Vision, Vision and the Nervous System, Defects in Vision, Lens for Myopia, Lens for Presbyopia and Hyperopia, Extension of Vision, Telescope, Microscope, Confocal Microscopy, Fiber Optics.

UNIT V

Electrical and magnetic properties in human body: electrical properties of body tissues, nerve conduction, Ion Channels, Hair Cells, Balance, Taste, and Smell, Electrical Properties of the Heart, Electrical Signals in the Brain, Effects of Electric Shock, Magnetic Properties, Electromagnetic Waves.

Text Books:

1. Paul Davidovits, "Physics in biology and medicine", 3rd edition, Academic press, 2015 edition
2. Irving P Herman, "Physics of the human body", 2nd edition, Springer publications, 2013 edition

Course Outcomes (COs):

On completion of this course, the students shall be able to:

1. Identify and relate the different organs and their functions in a human system. (PO1,2,3,6, PSO1,2)
2. Demonstrate their knowledge on the concepts and of physiological activities: metabolism of the human body, hemodynamic systems, sound and hearing, vision and electromagnetic properties. (PO1,2,3,7, PSO1,2)
3. Apply the behaviour of the importance of the specific physiological activities. (PO1,2,5,8, PSO1,2)
4. Analyse the methods and standards by which measurements and evaluation of the physical characteristics of physiological activities of the human system and evaluation of the physical characteristics of physiological activities of the human system. (PO1,2,3,9, PSO1,2,3)
5. Apply their physics experience and knowledge to analyze new physical situations and to solve physics problems using the appropriate methods in mathematical, theoretical and computational physics. (PO2,6,7,8, PSO2, 3)

BIOMEDICAL INSTRUMENTATION II

Course Code: ML52 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator(s): Dr. Sanjay H.S, Ms. Tejaswini. S

Course contents

UNIT I

Introduction to Diagnostic & Therapeutic Equipment: Basic concepts of diagnosis and therapy and related applications

Blood pressure measuring devices: Blood pressure & Sound: Direct measurements, Harmonic analysis, dynamic properties, System response, bandwidth requirements, pressure waveforms, venous pressure measurement, heart sounds, phonocardiography, cardiac catheterization, indirect measurements, tonometry.

UNIT II

Flow measuring devices: Indicator dilution method with continuous infusion and rapid injection, electromagnetic flowmeters, ultrasonic flowmeters, thermal convection velocity sensors, chamber plethysmography, electric impedance plethysmography, photo-plethysmography

UNIT III

Pulmonary equipment: Pulmonary function measurement, spirometry, pneumotachometers, measurement of volume, pulmonary function analyser, respiratory gas analyser

Neurological equipment: Electroencephalography, electrodes and 10-20 system, EEG bands and diagnostics, Multichannel EEG systems, Block diagram of EEG system, evoked potentials, EEG telemetry, system artifacts and troubleshooting, EMG and its relation with EEG

UNIT IV

Therapeutics & prosthesis: Cardiac pacemakers, electric stimulators, defibrillators, cardioverters, mechanical cardiovascular orthotic and prosthetic devices, haemodialysis, lithotripter, ventilator, incubators, drug delivery devices, surgical instruments, laser applications in therapy,

Gait: basic concepts of Gait and its analysis.

UNIT V

Auditory diagnostics: Hearing mechanism, sound measurement, basic audiometer, pure tone audiometers, speech audiometer, Bekesy approach, evoked response audiometry

Clinical Laboratory Equipment: Spectrophotometry, Automated chemical analyzers, Chromatology, Electrophoresis, Hematology

Text Books

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications, 2014 edition
2. R S Khandpur, "Handbook of biomedical instrumentation", third edition, McGraw Hill publications, 2012 edition

Reference Books

1. Joseph D. Bronzino, "Medical Devices and Systems – The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.
2. Carr& Brown, "Introduction to Biomedical equipment technology, 4th edition, Pearsons publications, 2003 edition

Course Outcomes (COs):

At the end of the course, students will be able to

1. Accent the basics of diagnostic and therapeutic applications in healthcare (PO 1,2,4,12)
2. Comprehend and relate the construction, working and applications of blood pressure and blood flow measuring devices (PO 2,3)
3. Interpret the importance of respiratory and neurological equipment in healthcare (PO 1,3,12)
4. Recognize the need for therapeutic and prosthetic care in hospitals (PO 2,3)
5. Analyze the working of instruments used in audiology and medical laboratories (PO 1,4,5,12)

BIOMEDICAL IMAGE PROCESSING

Course Code: ML53 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. Prabha Ravi , Dr. Sweeti

Course contents

UNIT I

Introduction: Objectives and importance of Biomedical Image analysis, Image quality- Optical density, dynamic range, contrast, histogram, resolution, signal-to-noise ratio, Error bases measures and measure of Acutance. Characterization of artifacts and its removal, multiframe averaging, Spatial and frequency domain image enhancement- gray-scale transforms, histogram transforms, convolution mask operators, high frequency emphasis, homomorphic filtering for enhancement, adaptive contrast enhancement. Applications: Contrast enhancement of Mammograms

UNIT II

Image compression: Introduction, Coding redundancy, spatial and temporal redundancy, Image compression models, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Run-length coding, blocking transform coding, Predictive Coding, wavelet coding, Application: Image compression for teleradiology

UNIT III

Image segmentation: Fundamentals, detection of isolated points, lines and edge detection, thresholding: Global and Optimal, segmentation: region growing, splitting, merging, detection of objects of known geometry: Hough transform used in detection of straight lines. Application: Detection of the breast boundary in mammograms using traditional active deformable contour model

UNIT IV

Representation and Description: Representation Schemes, Conversion between Representation, Geometric property measurement, Boundary descriptors, Regional descriptors

Image fusion: Image Registration, Geometric transformation and Match measurement, Image fusion, Application**:** Image fusion in Digital subtraction angiography

UNIT V

Pattern recognition: Patterns and pattern classes, recognition based on decision theoretic methods- matching, optimum statistical classifiers, neural networks, structural methods- matching shape numbers, string matching, Application: Classification of Breast Masses and Tumors.

Text Books

1. R C Gonzalez & R E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC Press, 2004

Reference Books

1. Wolfgang Birkfellner, Applied Medical Image Processing: A Basic Course, 2010
2. Taylor & Francis, Richard A. Robb "Biomedical Imaging, Visualization, and Analysis", John Wiley & Sons, 1999.
3. Azriel Rosenfeld &Avinash G Kak, "Digital Picture Processing", Academic press, Volume 1 & 2

Course Outcomes (COs):

1. At the end of the course, students will be able to 1. Acquire a basic understanding of the important concepts related to medical image processing. (PO-1,2, PSO-1)
2. Identify and formulate the various artifacts associated with medical images and eliminate the same. (PO1,2,3, PSO-1,2)
3. Recognize and apply various segmentation techniques for medical images (PO-1,2,3, PSO 1,2)
4. Understand the steps of image registration and fusion and their applications. (PO-12,3, PSO1,2)
5. Assess the various types of pattern recognition methods used in classification of medical images. (PO-1,2,3. PSO-1,2)

IPR AND MEDICAL ETHICS

Course Code: ML54 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Purnima B R, Dr. Prabha Ravi

Course contents

UNIT I

Introduction: Definition, Historical background of IP, Economic value of IP, IP System strategy, IPR Governance, Institutions for Administering the IP system, IP Audits, Introduction to different types of IPR.

Industrial Design and Semiconductor Integrated Circuit layout design

Introduction, Protection of Industrial Designs, Semiconductor Integrated Circuit layout design Act 2000

UNIT II

Copyright: Introduction, copyrights in expression, copyrights protection in India, International Association, Enforcement Measures in India, Copy right Act,1957,Rights of Copyright Owner, Information Technology and Copyrights, Exception to Copyright Infringement Fair Use-Doctrine, Copyright Marking and Notice.

UNIT III

Patent: Introduction, History of Patent, criteria for patent, types of patents, Indian Patent Act 1970,Patent Cooperation Treaty, Procedure for obtaining patent, Provisional and complete specification, Rights conferred on patentee, transfer of patent rights, Revocation and Surrender of Patents, Infringement of Patents and Action on Infringement.

UNIT IV

Introduction To Medical Ethics: Introduction, Principle feature of Medical Ethics, Physicians and Patients, Physicians and Society.

UNIT V

Medical research: Objectives, Case study, Importance of medical research, Research in medical practice Ethical requirements Ethics review committee approval Scientific merit, Social value,– Risks and benefits, Informed consent, Confidentiality, Conflict of roles, Honest reporting of results, Whistle blowing,– Unresolved issues

Text Books

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. P.Narayanan, “Intellectual Property Law”, Eastern Law house, 3rd edition, 2018.

Reference Books

1. Dr. B.L. Wadehra, "Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 5th edition, 2012.
2. Prabuddha Ganguli -Intellectual Property Rights, TMH Publishing Co. Ltd..2001
3. D.H. Lawerance, chapter 2, Principles of biomedical ethics: Jones & Bartlett publishers

Course Outcomes (COs):

At the end of the course, students will be able to

1. Access the need, criteria and legal aspects of IPR. (PO-1, 6, 8) (PSO-3)
2. Understand registration, opposition and amendments procedures with regards to Copyright. (PO-1, 6, 8) (PSO-3)
3. Understand registration, opposition and amendments procedures with regards to patents. (PO-1, 6, 8) (PSO-3)
4. Describe the Social responsibility in healthcare systems (PO-1, 6, 8) (PSO-3)
5. Discuss the Bioethics and engineers role (PO-1, 6, 8) (PSO-3)

MEDICAL PHYSICS LABORATORY

Course Code: MLL56 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Prabha Ravi, Dr. C.K. Narayanappa

Course contents

1. Temperature based – Thermistor and thermometer for monitoring of body temperature at different locations on the body
2. Conduct an experiment to assess the Body mass Index and the Basal Metabolism of a given subject.
3. GSR acquisition.
4. Strength based - Hand grip strength measurement using electronic dynamometer
5. Blood flow – Assessment of turbulence and laminar flow of blood using blood pressure measurement approaches.
6. Conduct an experiment to assess the visual acuity of a given subject.
7. Electromyogram – Assessment of the muscular action & Nerve conduction velocity measurement
8. Electrocardiogram – Acquisition of ECG signal (simulation & subject) and Analysis of the signal based on cardiovascular functioning.
9. Electroencephalogram - Acquisition of EEG signal (simulation & subject – ONE CHANNEL; FP1&FP2) and Analysis of the signal based on brain functions.
10. Measurement of pressure in the eye using tonometer
11. Blood flow measurement using ultrasound Doppler blood flow meter.
12. Sensitivity of the ears – usage of audiometry to assess the functionality of the ears and Study of working of Hearing aid.
13. Study of Heart lung machine and hemodialysis working module
14. Fluid based: Demonstration of the basic physics of pressure and flow of fluids and relating the same to human physiology (research experiment) using virtual labs.

Text Books

1. Irving P Herman, “Physics of the human body”, Springer publications, 2016

Reference Books

1. Paul Davidovits, “Physics in biology and medicine”, 5th edition, Academic press, New York, 2018

Course Outcomes (COs):

At the end of the course, students will be able to

1. Apply the basics concepts of physics to realize different aspects of human physiology. (PO-1,2,4,12& PSO-1)
2. Understand the physiology of sensation and response in human body with the perspective of medical physics (PO-1,2, & PSO-1,2)
3. Implement and demonstrate various laws of physics, as applied to human physiology (PO-1, 2,4, & PSO-1, 2)

BIOMEDICAL INSTRUMENTATION-I LABORATORY

Course Code: MLL57 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Sanjay H S, Ms. Tejaswini. S

Course contents

1. Introduction to the Biomedical Instrumentation
2. Measurement of BMI using simple devices
3. Anthropometric measurements using simple devices
4. Measurement of change in temperature using thermocouple, thermistor and RTDs
5. Measurement of weight with the aid of resistive transducer in strain gauge
6. Measurement of change in displacement with the aid of LVDT
7. Measurement of change in force with the aid of flex sensor
8. Measurement of the presence of ethanol using alcohol sensor
9. Measurement of optical variables with the aid of photo diodes and photo transistors
10. Measurement of pH of a given solution using pH meter
11. Assessment of the concentration of a solute in a solution using colorimeter
12. Assessment of various safety aspects for a given equipment using Electrical Safety Analyzer
13. Measurement of Transmittance, Absorbance and concentration of a given solution using Digital Spectrophotometer
14. Assessment of various biomedical signal characteristics with the aid of suitable simulators

Text Books

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications, 2014 edition
2. R S Khandpur, "Handbook of biomedical instrumentation", third edition, McGraw Hill publications, 2012 edition

Reference Books

1. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.
2. Carr& Brown, "Introduction to Biomedical equipment technology, 4th edition, Pearsons publications, 2003 edition

Course Outcomes (COs):

At the end of the course, students will be able to

1. Reminisce the basics of measurements and the generic sensors used for biomedical applications (PO-1,2,4,12& PSO-1)
2. Understand the functional aspects of generic sensors to acquire various information (PO-1,2, & PSO-1,2)
3. Comprehend the usage of hardware and simulation based approaches in biomedical instrumentation (PO-1, 2,4, 12 & PSO-1, 2)

BIOMEDICAL SIGNAL PROCESSING LABORATORY

Course Code: MLL58 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Mrs. Purnima B.R, Mrs. Chandana S

Course contents

1. Operations on Signals: Time Scaling, Amplitude Scaling, Shifting, Circular folding, Circular Shifting, Linear Convolution, Circular Convolution.
2. To verify properties of DFT: linearity property, Circular convolution, Multiplication in time domain Complex conjugate property of DFT, Parseval's theorem, Circular folding, Time shifting and frequency shifting.
3. Verification of Sampling Theorem
4. Design of digital IIR Butterworth filters using Bilinear transformation and impulse invariant methods
5. To design FIR filters using windowing Technique
6. Design and Implementation of Moving Average filters
7. Design and Implementation of Derivative Based Filters
8. Design and Implementation of Notch Filters and Comb Filters
9. To perform QRS detection using PAN-TOMPKINS algorithm
10. To perform derivative based QRS detection
11. Detection of EEG rhythms
12. To perform Spectral Analysis of Biomedical Signals

Text Books

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis" –, Wiley India Publications, 2015

Reference Books

1. Robert J. Schilling, Sandra L Harris, "Fundamentals of Digital Signal Processing using MATLAB, 2011
2. Bio-signal& Biomedical Image Processing – John L Semmlow, Dekker Media

Course Outcomes (COs):

At the end of the course, students will be able to

1. Reminisce the basics of biomedical signal processing using MATLAB. (PO-1,2,4&PSO-1)
2. Accent the design and implementation of various signal processing techniques and apply the same to biomedical signals. (PO-3,12& PSO-1,3)
3. Relate the results obtained to the concepts of biomedical signal processing soas to obtain a better understanding of the same (PO-9,12 & PSO-1)

APP DEVELOPMENT FOR MEDICAL APPLICATIONS

Course Code: MLE11 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Mr. S J Mahendra, Dr. Basavaraj Hiremath V

Course Contents

UNIT I

INTRODUCTION: Mobile Applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Software Engineering – Frameworks and Tools – Mobile devices Profiles.

UNIT II

USER INTERFACE: Generic UI Development – VUIs and Mobile Applications – Text to Speech techniques – Designing the right UI – Multimodal and Multichannel UI – Gesture based UIs – Screen Elements and Layouts – Voice XML – Java API.

UNIT III

APPLICATION DESIGN : Memory Management – Design patterns for limited memory – Work flow for Application Development – Techniques for composing Applications – Dynamic Linking – Plug ins and rules of thumb for using DLLs – Concurrency and Resource Management – Look and feel.

UNIT IV

APPLICATION DEVELOPMENT: Intents and Services – Storing and Retrieving data – Communication via the Web – Notification and Alarms – Graphics and Multimedia – Telephony – Location based services – Packaging and Deployment – Security and Hacking.

UNIT V

TOOLS : Google Android Platform – Eclipse Simulator – Android Application Architecture – Event based programming – Apple iPhone Platform – UI tool kit interfaces – Event handling and Graphics services – Layer Animation.

Text Books:

1. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, “Programming Android”, O‟Reilly, 2011.
2. Reto Meier, Wrox Wiley, “Professional Android 2 Application Development”, 2010.
3. Alasdair Allan, “iPhone Programming”, O‟Reilly, 2010.
4. Wei-Meng Lee, “Beginning iPhone SDK Programming with Objective-C”, Wrox Wiley,2010.
5. Stefan Poslad, “Ubiquitous Computing: Smart Devices, Environments and interactions” Wiley, 2009.

Course Outcomes (COs):

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

1. Be exposed to technology and business trends impacting mobile applications (PO 1.6.11.12 & PSO 2)
2. Be competent with the characterization and architecture of mobile applications. (PO 5,8,11 & PSO 1)
3. Be competent with understanding enterprise scale requirements of mobile applications. (PO 1,3 & PSO 1)
4. Apply decision-making methodologies to evaluate solutions for efficiency, effectiveness and sustainability (PO 2,11 & PSO 2)
5. Be competent with designing and developing mobile applications using one application development framework. (PO 1,7 & PSO 1)

IOT IN HEALTHCARE

Course Code: MLE12 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Mrs. Uma Arun ,Mrs. Tejaswini S

Course Contents

UNIT I

Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

UNIT II

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT

UNIT III

M2M vs IoT An Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

UNIT IV

IoT Reference Architecture- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT
world-Introduction, Technical design Constraints. Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT application

UNIT V

Developing IoT solutions: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi Implementation of IoT with Arduino and Raspberry, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Text books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"**From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence**",** 1st Edition, Academic Press, 2014
2. Vijay Madisetti and Arshdeep Bahga, **"**Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014
3. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
4. CunoPfister, "Getting Started with the Internet of Things", O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

Course Outcomes(COs):

At the end of the course, students will be able to

1. Recognize various devices, sensors and applications. (PO-1,3,12; PSO-1)
2. Apply design concept to IoT solutions. (PO-1,3,4,5, 12; PSO-1,2)
3. Analyze various M2M and IoT architectures. (PO-1,3,5,12; PSO-1,2)
4. Evaluate design issues in IoT applications (PO1,3,5,9,12; PSO-1,2)
5. Create IoT solutions using sensors, actuators and Devices (PO1,3,5,9,12; PSO-1,2).

INTRODUCTION TO PROGRAMMING USING SCILAB

Course Code: MLE13 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr Basavaraj V Hiremath, Dr. Sanjay H S

Course Contents

UNIT I

INTRODUCTION TO SIMULATION SOFTWARE: About SCILAB, SCILAB System, Starting and Quitting SCILAB, Importance of SCILAB, The format Function, Suppressing Output, Entering Long Statements, Command Line Editing. EXPRESSIONS: Variables Numbers, Operators Functions, Expressions.

UNIT II

MATRICES AND ARRAYS: Entering Matrices sum and transpose, subscripts, colon Operator, magic Function. Generating Matrices, The load Function, M-Files, Concatenation, Deleting Rows and Columns, Accessing the elements of a Matrix-Sequential and Discrete, Arrays Multivariate Data, Scalar Expansion.

UNIT III

FLOW CONTROL: If, else, and else if, switch and case, for, while, continue, break try - catch, return. Multidimensional Arrays, Cell Arrays, Characters and Text, Structures

UNIT IV

SCRIPTS & FUNCTIONS: Scripts, Functions, Global Variables, Passing String Arguments to Functions, eval Function, Function Handles, Vectorization, Pre allocation.

UNIT V

Signal Processing using SCILAB: Convolution-1D and 2-D, Removal of artefacts for Biomedical Signal and Images, Biomedical signal and Image enhancement techniques using SCILAB

GRAPHICS: Plotting Process, Editing Process, Preparing Graphs, Basic Plotting Functions, Mesh & Surface Plot, and Image Reading & Writing, Printing graphics.

Text Books/Reference Books

1. Introduction to SCILAB by Rachna Verma and Arvind Verma, 2015 edition.
2. SCILAB-A Beginner's Approach by Anil Kumar Verma, 2004 edition.

Course Outcomes(COs)

The students will be able to:

1. Understand the need for simulation/implementation for the verification of mathematical functions. (PO-1,2; PSO-1)
2. Understand the main features of the SCILAB program development environment to enable their usage in the higher learning. (PO-1,2; PSO-1)
3. Implement simple mathematical functions/equations in numerical computing environment such as SCILAB. (PO-1,2,3; PSO-1)
4. Interpret and visualize simple mathematical functions and operations thereon using plots/display. (PO-1,2; PSO-1)
5. Analyze the program for correctness and determine/estimate/predict the output and verify it under simulation environment using SCILAB tools. (PO-1,2,3; PSO-1,2)

JAVA PROGRAMMING

Course Code: MLE14 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Mr. Mahendra S.J , Dr. Basavaraj Hiremath

Course Contents

UNIT I

Java Fundamentals, Introducing Classes & Methods: Object-Oriented Programming, The Three OOP Principles, Data Types, Variables, and Arrays: The Primitive Types, Type Conversion and Casting, Arrays: One-Dimensional Arrays, Multidimensional Arrays. Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The? Operator, Operator Precedence, Control Statements, Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, This Keyword, Garbage Collection, the finalize () Method, Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, understanding static, introducing final. Self-study: Introducing Nested and Inner Classes.

UNIT II

Inheritance, Packages & Interfaces: Inheritance Basics, using super, creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, using final with Inheritance, Packages, Access Protection, Importing Packages. Self-study: Interfaces.

UNIT III

Exception handling, Multithreaded Programming: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive( ) and join( ), Thread Priorities, Suspending, Resuming, and Stopping Threads. Self-study: Synchronization

UNIT IV

String Handling: The String Constructors, Special String Operations, Character Extraction, String Comparison, Searching and Modifying a String, String Buffer. Event Handling: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model. Self-study: Adapter classes; Inner classes.

UNIT V

The collection Frame Framework: Collections Overview, The Collection Interfaces, The Collection Classes: The Array List Class, Linked List Class, Hash Set Class. Accessing a Collection via Iterator, Storing User-Defined Classes in Collections. Self-study: Working with Maps, Arrays, Why Generic Collections?

Text Books:

1. Herbert Schildt: Java The Complete Reference, 8th Edition, Tata McGraw Hill, 2013.

Reference Books:

1. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2012.
2. Stephanie Bodoff, Dale Green, Kim Haasel: The J2EE Tutorial, 2nd Edition, Pearson Education, 2008.

Course Outcomes (COs):

This course uses assigned readings, lectures, and homework to enable the students to:

1. Recognize the basic object oriented concepts & apply them to create java applications. (PO 2,3,5 & PSO 2)
2. Demonstrate java applications with inheritance and interface concepts. (PO 2,3 & PSO 2)
3. Java applications with multithreading concepts and demonstrate the error handling concepts. (PO 3,5 & PSO 2)
4. Develop java programs using Strings and event handling concepts. (PO 2,3,5 & PSO 2)
5. Develop java programs using collection frame works. (PO 1,2,3,5 & PSO 2)

PYTHON PROGRAMMING

Course Code: MLE15 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. Basavaraj Hiremath , Mr. Mahendra S.J

Course Contents

UNIT I

The way of the program: The Python programming language, What is a program?, What is debugging?, Syntax errors, Runtime errors, Semantic errors, Experimental debugging.

Variables, Expressions and Statements: Values and data types, Variables, Variable names and keywords, Conditional Statements, Evaluating expressions, Operators and operands, Type converter functions, Order of operations, Operations on strings, Input, Composition, The modulus operator.

Iteration: Assignment, Updating variables, The for loop, The while statement, Nested Loops for Nested Data.

Strings: Working with strings as single things, Working with the parts of a string, Length, Traversal and the for loop, Slices, String comparison, Strings are immutable, The in and not in operators, A find function, Looping and counting, Optional parameters, The built-in find method, The split method, Cleaning up your strings, The string format method.

Unit II

Tuples: Tuples are used for grouping data, Tuple assignment, Tuples as return values, Composability of Data Structures.

Lists: List values, Accessing elements, List length, List membership, List operations, List slices, Lists are mutable, List deletion, Objects and references, Aliasing, Cloning lists, Lists and for loops, List parameters, List methods, Pure functions and modifiers, Functions that produce lists, Strings and lists, list and range, Nested lists, Matrices.

Dictionaries: Dictionary operations, dictionary methods, aliasing and copying.

Functions: Functions with arguments and return values,

UNIT III

Random numbers: The time module, The math module, Creating your own modules, Namespaces, Scope and lookup rules,

Files: About files, Writing our first file, Reading a file line-at-a-time, Turning a file into a list of lines, Reading the whole file at once, Working with binary files, Directories, fetching something from the web.

Algorithms: Linear search, Binary search

UNIT IV

Object oriented programming: Classes and Objects — The Basics, Attributes, Adding methods to our class, Instances as arguments and parameters, Converting an instance to a string, Instances as return values, Objects are mutable, Sameness, Copying.

Inheritance: Polymorphism, Generalization, Pure functions, Operator Overloading.

UNIT V

GUI: Creating Graphical User Interfaces, Using Module Tkinter, Building a Basic GUI, Models, Views, and Controllers, Customizing the Visual Style, Few More Widgets.
Databases: Overview, Creating and Populating, Retrieving Data, Updating and Deleting, Using NULL for Missing Data, Using Joins to Combine Tables, Keys and Constraints

Text Books:

1. Downey, A., Elkner, J., & Meyers, C. (2002). How to think like a computer scientist: learning with python. Green Tea Press, Wellesley, Massachusetts.
2. Campbell, J., Gries, P., Montojo, J., & Wilson, G. (2013). Practical programming: an introduction to computer science using Python. Pragmatic Bookshelf, Second Edition.

Course Outcomes (COs):

At the end of the course, student should be able to:

1. Design and implement Python programs utilizing arithmetic expressions, repetition, file Input and Output (PO-1,2, 3 &PSO-1)
2. Define and demonstrate the use of the built-in data structures in Python (PO-1,2, 3,5 & PSO-1)
3. Employ control structures, functions, and arrays to create Python programs (PO-1,2, 3,5 & PSO-1)
4. Understand the concepts of object-oriented programming as used in Python (PO-1,2, 3,5 & PSO-1)
5. Define and demonstrate the use of GUI and databases using Python (PO-1,2, 3 & PSO-1)

MODELLING AND SIMULATION IN BIOMEDICAL ENGINEERING

Course Code: MLE16 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr.N.Sriraam, Mrs. Tejaswini S

Course contents

UNIT I

Introduction: Introduction, classifying medical devices: introduction, Classification Rules, Classification Case study, Classification models, Classification Design process, **The Design Process**: Design Process vss Design Control, Design Models, Managing design, Cross Reference with Regulatory requirements.

UNIT II

Implementing Design Procedure: Review of Guidelines, overall procedure, Audit/ Review Procedure, the Design Process, Implementing a Procedure. **Developing your Product Design specification**: Developing the statement of need, the product design specifications, finding, extracting and analyzing the content.

UNIT III

Generating Ideas and Concepts: The "Engineering's Notebook", Creative space, Generating Concepts/ Ideas, Selecting Concepts and Ideas
Quality in Design: Optimization, Design of Experiments, Failure Mode and Effect Analysis, D4X, Six Sigma.

UNIT IV

Design Realization/ Detailed Design: the Process to design realization, assemble your detailed design team, design calculations, Materials Selection, Computer Aided Design, DX4, Design for usability

UNIT V

Evaluation: Introduction, Risk Analysis, Criteria-Based Evaluation, Computer Based Evaluation, Value to "Healthcare" Analysis, Clinical Studies and Clinical Trials, Literature Review, Format for Formal clinical Evaluation Report

Text Books

1. Peter j Ogrodnik, "Medical Device Design", Elsevier Ltd, 2013

Reference Books

1. Reliable Design of Medical Devices, Second Edition, Richard Fries, © 2006 by Taylor & Francis Group, LLCCRC Press is an imprint of Taylor & Francis Group
2. Medical Devices (1st Edition): Regulations, Standards and Practices, Seeram Ramakrishna LinglingTian Charlene Wang Susan Liao Wee EongTeo eBook ISBN: 9780081002919 Hardcover ISBN: 9780081002896 Imprint: Wood head Publishing, 2015

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand the design Process life cycle of Medical Devices. (PO 1,2,3,6; PSO1,2)
2. Demonstrate the implementing design procedures to develop a better product design specification. (PO1,2,3,7; PSO1,2)
3. Apply the ideas and concepts for a quality design. (PO1,2,5,8; PSO1,2)
4. Analyze the design realization for a detailed design. (PO1,2,3,9; PSO1,2,3)
5. Apply the validation and verification for evaluation. (PO2,6,7,8; PSO2.3)

INTRODUCTION TO MEDICAL ELECTRONICS

Course Code: MLOE01 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Chandana S, Dr. Sanjay H.S

Course contents

UNIT I

Electro-Physiology and Bio-Potential Recording: The origin of Bio-potentials, Bio-potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.

UNIT II

Bio-Chemical and Non Electrical Parameter Measurement: pH, PO2,PCO2, colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters.

UNIT III

Assist Devices: Cardiac pacemakers, DC Defibrillator, Dialyser, Heart lung machine.

UNIT IV

Physical Medicine and Biotelemetry: Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy Telemetry principles, frequency selection, biotelemetry, electrical safety.

UNIT V

Recent Trends in Medical Instrumentation: Thermograph, endoscopy unit, Laser in medicine, cryogenic application, Introduction to telemedicine.

Text Books

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007

Reference Books

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA McGraw-Hill, New Delhi, 2014
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand the electro-physiology and bio-potential recording. (PO-1,2 & PSO- 1)
2. Describe the bio-chemical and non-electrical parameter measurement (PO-1,2 & PSO- 1)
3. Outline the different types of assist Devices. (PO-1 & PSO-1)
4. Describe the concepts of physical medicine and biotelemetry. (PO-1,2 & PSO-1)
5. Discuss the various recent trends in medical instrumentation (PO-1 & PSO-1)

BIOMEMS

Course Code: MLOE02 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Tejaswini S, Ms.Uma Arun

Course contents

UNIT I

MEMS and Microsystem: History of MEMS, Materials in MEMS, Silicon Piezo resistors, Ga As, quartz, polymer. Micromachining- Lithography, thin film deposition, ION Implantation, Diffusion, Oxidation, Chemical and Physical vapour Deposition, Sputtering, Deposition by epitaxial, etching

UNIT II

Microsensors and Actuators: Mechanics for MEMS design - Static bending of then plates, mechanical vibration, thermos mechanics, fracture and thin film mechanics. Mechanical sensors and actuators -beam and cantilever, microplates. Thermal sensors and actuators micromachined thermocouple probe, peltier effect heat pumps, thermal flow sensors.

UNIT III

Physical Micro Sensors: Design of Acoustic Wave sensor, resonator sensor, Capacitive and Piezo resistive pressure sensor.

UNIT IV

Micro actuators: Design of Actuators: Actuation based on thermal forces, Actuation using Shape Memory alloys, Actuations using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar, comb drive actuators). Micromechanical motors and pumps

UNIT V

Micro Fluidics Systems: Fluid Dynamics, laminar flow in circular conduits. fluid flow in micro and nano conduits. Microscale fluid flow - expression for liquid flow in channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, microneedle, micropumps - continuous flow systems.

Text Books

1. Tai-Ran Hsu. MEMS and Microsystems, Design Manufacturing and Nanoscale engineering, John wiley & Sons, 2014

Reference Books

1. G.K. Anantasure, K.J. Vinoy, S. Gopala Krishnan, K.N. Bhat, V.K. Aatre. Micro and Smart systems, Springer ed, 2014

Course Outcomes (COs):

At the end of the course, students will be able to

1. Discuss the basic material s used in MEMs and Microsystems (PO-1 & PSO-1)
2. Explain the various sensors and actuators used in MEMS (PO-1 & PSO-1)
3. Implementation of physical Micro Sensors (PO-1 & PSO-1)
4. Explain the design of actuators based on different techniques (PO-1 & PSO-1)
5. Discuss the properties & types of Micro fluidic systems (PO-& PSO-1)

HOSPITAL MANAGEMENT

Course Code: MLOE03 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi, Mrs. Uma Arun

Course contents

UNIT I

Importance of Hospital Management

Healthcare Industry: An Introduction, A Global View, Healthcare Industry, Pharmaceuticals, Medical Equipment's, Biotechnology, Information Technology, Medical Tourism, The India Scenario, Healthcare Industry, Pharmaceuticals, Biotechnology Medical Insurance, Health and National Economy, Health System Performance.

Health Sector in India: An Introduction, Health Financing, Health Expenditure: Source of Funding, Health Expenditure: Service Providers, Public Health Expenditure, Private Health Expenditure, Health Expenditure by Function,

Health Infrastructure, Public Health Infrastructure, Private Health Infrastructure, Public–Private Partnerships, Human Resources in Health, Demand for Health Workforce, Supply of Health Workforce, Role of Hospitals in the Health Sector

UNIT II

Hospital Management Challenges

Hospital Management Functions: An introduction, Operations Management: An Introduction, Service Quality, Turnaround Time, Cost Reduction, Capacity Management. Case Study: City Cardiac Hospital Metropolitan Surgical Hospital(A).

Finance and Cost Management: Finance Management, Balance Sheet, Profit t and Loss Statement, Cash Flow Statement, Financial Performance, Cost Management, Fixed Costs and Variable Costs, Direct Costs and Indirect Costs, Traditional Method of Cost Allocation, Activity Based Costing, Methodology, Capital Budgeting: A Perspective, Case Study: Metropolitan Surgical Hospital (B) .

UNIT III

Hospital Management Challenges

HR Management: HR Planning and Development, Staffing, Work Systems Design, Reporting Relationships, Case Study: Metropolitan Surgical Hospital (C)

Materials Management: Purchase Management, Inventory Management, Stores Management, Pharmacy Management, Case Study: Metropolitan Surgical Hospital (D)

Hospital Management Support Systems: An Introduction , Clinical Support , Clinical Lab Services , Total Testing Process , Lab Errors , Pre-analytical Phase , Analytical Phase , Post-analytical Phase, Radiology and Imaging Services.

Information Support: Hospital MIS: Hospital Management Decisions, policy Decisions, Strategic Planning Decisions, Operational Planning Decisions, Monitoring and Control Decisions.

UNIT IV

Hospital Management Information System and Case Studies

Hospital Management Information System (HMIS): An MIS Perspective, Basic Characteristics of Hospital MIS, Administrative Support Systems, Medical Records Management, Bio-medical Waste Management, Other Support Systems.

Hospital Operations Management: Case study: CMC Hospital, Vellore (A), Majestic Hospitals, ARAM Hospital (Apollo Group) ,

Hospital Finance and Cost Management: Apollo Hospitals, City Municipal Hospital 208 Hospital Human Resource Management: Case Study: CMC Hospital, Vellore (B), AMC Hospitals, Bangalore Baptist Hospital (A)

UNIT V

Hospital Management Case Studies:

Hospital Materials Management: MPS Hospital, MP Trust Hospital 257

Hospital MIS: Case Study: SJ Hospital, case study; Mahanagar Hospital RD Clinical Lab

Hospital Management Cases: A Framework for Analysis: An Introduction, Patient Health Management, Hospital Health Management, Patient Management vs Hospital Management

A Framework for Case Analysis: A Preliminary Analysis , Final Recommendations , Case Analysis: An Illustration , CMC Hospital, Vellore (A).

Text Book/s:

1. Hospital Management: Text & Cases, K. V. Ramani , Pearson Education India , 2013 , ISBN 9788131794012 , eISBN 9789332514089.

Reference Book/s:

1. D K Sharma & R C Goyal, Hospital Administration & Human Resource Management, PHI 5th edition (2013)

   Hospitals: Facilities Planning and Management , G D Kunders, Mcgraw Hill ,20th reprint.

Course outcomes (COs):

At the end of the course, students will be able to

1. Explain and compare the organizational elements, structure, performance, terminology, and delivery modalities for Indian. and global healthcare systems. (PO-1,6,7 & PSO-2)
2. Understand and apply resource management concepts (personnel, finance, and material resources) and the processes and strategies needed in specific hospital sectors. (PO-7,11 & PSO-2)
3. Develop innovative solutions to strategic, tactical and operational issues in managing healthcare systems and associated information technology through the combined use of information, organizational knowledge, talent management and critical thinking. (PO-5,7& PSO-2)
4. Apply modern change management and innovation management concepts to optimise structures as well as communicate effectively and develop their leadership and teambuilding abilities. (PO-9,12 & PSO-3)
5. Evaluate the ethical, legal, and regulatory requirements of the healthcare industry towards counselling in hospitals and the biomedical waste management. (PO-6,8& PSO-3)

VI SEMESTER

BIOSTATISTICS

Course Code: ML61 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Mrs Tejaswini S, Dr. Sweeti

Course contents

UNIT I

Introduction of Biostatistics: Statistics, Biostatistics, statistical terms, Statistical Data, Organization and Classification of data, Frequency distribution, Representation of data

UNIT II

Descriptive measures: Measures of Central Tendency, Measures of Location or Averages of Partition value, Measures of variability or dispersion

UNIT III

Basic Probability theory: probability, set theory and Venn diagram, probability distribution: Normal, binomial and Poisson Distribution

UNIT IV

Inferential statistics: Inferential statistics, hypothesis testing and test of significance, nonparametric statistical tests.

UNIT V

Inferential statistics: Correlation, Regression, students t-Test, Analysis of Variance, Chi-Square Test

Text Books

1. Veer Bala Rastogi, Medtech Scientific International Pvt. Ltd. “Biostatistics”, Third revised edition 2017.

Reference Books

1. Wayne W Daniel, Chad L Cross, “Biostatistics- Basic Concepts and Methodology for Health Sciences”, tenth edition 2015

Course Outcomes (COs):

At the end of the course, students will be able to

1. Assess the importance of statistics in healthcare (PO-1,6,7 &PSO-2,3)
2. Extend the basic concepts of statistics to statistical descriptive oriented applications (PO-1,2 & PSO-1)
3. Interpret the aspects of probability and sampling to solve problems in statistics (PO-1,2,4 &PSO-2)
4. Interpret the aspects of statistics for obtaining the inference on the sample data (PO-2,4,12 &PSO-
5. Present the acquired inference and to prove the hypothesis (PO-2,4,12 &PSO-1)

REAL TIME PROCESSORS & APPLICATIONS

Course Code: ML62 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Basavaraj Hiremath V, Mrs. Uma Arun

Course contents

UNIT I

Introduction to ARM Cortex M4F Architecture: ARM Cortex M4F processor feature, block diagram, Programming model: processor mode & privilege levels, Register set & Register map, datatype& memory model, ARM Cortex M4F Interrupts & Exception: Exception Model: Exception States, Types, Handlers, vector table, priority, priority grouping, entry & return, NVIC

UNIT II

Introduction to Device peripherals: Clock System: clock tree block diagram, clock sources, Main oscillator, PLL operation, System Clock configuration, GPIO: Functional block diagram, initialization & configuration, Timers: Block Diagram, operating modes, functional description, Timer modes, Timer Interrupts, initialization & configuration, Analog to Digital Converters: Block diagram & functional description, sample sequencer, initialization & configuration

UNIT III

RTOs Kernel: What is RTOs, RTOs necessity, Real Time Scheduling, components of RTOs, RTOs start-up sequence, Overview of Threading modules: Hardware interrupts (Hwi), Software interrupts (Swi), Task, Background Thread (idle), comparison of thread characteristics, thread priorities & premption, introduction to hook function

UNIT IV

RTOs Synchronization modules: Semaphores: overview, where does semaphore fit? Create & delete, semaphore_pend & semaphore_ post, semaphore modes, Context Switching, Deadlocks, RTOs Timing Services: overview of timing services, clock module, configuration of clock module, Timer module, Hardware Abstraction Layer (HAL) for Timer, MailBox: data exchange between threads, creation and using a mailbox, mailbox post & pend, Event Module: Semaphore Vs Event, Event Id, Event_post & Event_pend, pending on multiple semaphores, creation & usage of event, posting event using semaphores

UNIT V

RTOs Debugging: Introduction to RTOs instrumentation, RTOs analyser and UIA, Execution Graph, Load Analysis, Log_info(), Benchmarking with Time Stamp

Text Books

1. TI-RTOS Kernel User's Guide, Texas Instruments, 2018
2. Real Time Operating System for ARM Cortex M Microcontrollers by Jonathan Valvano, 2017

Reference Books

1. NaimDahnoun, Multicore DSP: From Algorithms to Real-time Implementation on the TMS320C66x SoC, Wiley publications, 2018

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand the architecture of ARM Cortex M4F processor and its utilization in Embedded System Applications. (PO1, PO2, PO12, PSO1)
2. Understand the peripherals and its working used with ARM cortex MF4 processor. (PO1, PO2, PO12, PSO1, PSO2)
3. Understand and design Real Time Operating System for Embedded Applications. (PO1, PO2, PO12, PSO1, PSO2)
4. Analyze the RTO's synchronization modules used for developing an algorithm. (PO1, PO2, PO12, PSO1, PSO2)
5. Understand the RTO's Debugger to analyze the user interface facility. (PO1, PO2, PO12, PSO1, PSO2)

PHOTONICS & LASERS IN MEDICINE

Course Code: MLE21 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Chandana S, Mrs. Purnima B.R

Course contents

UNIT I

Fundaments of Photonics: Ray Optics, Wave Optics, Beam Optics, Fourier Optics, Photon Optics, Electromagnetic Optics

UNIT II

Fundamentals of Light-Matter Interactions: Interactions Between Light and a Molecule, Interaction of Light with a Bulk Matter, Fate of Excited State, Various Types of Spectroscopy, Electronic Absorption Spectroscopy, Fluorescence Correlation Spectroscopy (FCS)

UNIT III

Principles of Lasers, Current Laser Technology, and Nonlinear Optics: Principles of Lasers, Current Laser Technologies, Quantitative Description of Light: Nonlinear Optical Processes with Intense Laser Beam, Multiphoton Absorption, Time-Resolved Studies, Laser Safety

UNIT IV

Types of Lasers: Construction, working principle and medical application of following lasers: He-Ne laser, Copper vapour laser, Argon-ion laser, Nitrogen laser - Carbon-dioxide laser ,Excimer laser , X-ray laser - Free electron laser, Ruby laser , Nd:YAG, Organic dyes - Pulsed-CW dye laser.

UNIT V

Effects Of Ultraviolet Radiation On Tissues: Introduction to Ultraviolet Radiation, A Division of the Ultraviolet for Photo biological Studies, UV Sources, Absorption of Ultraviolet, Direct vs. Indirect Effects of UV.
Tissue Diagnostics Using Lasers: Introduction, Light Interaction with Tissue, Spectroscopic Diagnostics of Atherosclerotic Plaque.

Text Books

1. Saleh, B. E. A., &Teich, M. C. (2007). Fundamentals of photonics (2nd ed.). Wiley-Interscience.
2. Paras N. Prasad, Introduction to Biophotonics, A. John Wiley and Sons, Inc. Publications, 2003

3. Mark Csele, “Fundamentals of light sources and lasers”, Wiley Interscience, New Jersey (2004)
4. Ronald W. Waynant “Lasers in Medicine” CRC press. 2001

Reference Books

1. Abraham Katzir, Lasers and Optical Fibers in Medicine,1st Edition, Academic Press2ndDecember 2012

Course Outcomes (COs):

1. Illustrate the functional aspects of Photonics. (PO-1, 2,9; PSO-1)
2. Categorize the interaction of matter with light. (PO-1, 2, 3, 9; PSO-1, 2)
3. Understand the production of Lasers and safety issues during the usage of lasers in any application. (PO-1, 2, 6, 9; PSO-1, 2)
4. Extend the role of lasers to diagnostic and therapeutic applications with respect to healthcare. (PO-1, 2, 5, 9, 10; PSO-1, 2)
5. Interpret the effects of ultra violet rays along with the features of electromagnetic spectrum. (PO-1, 2, 5, 9, 10; PSO-1, 2)

MEDICAL ROBOTICS

Course Code: MLE22 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Sanjay H S , Mr. Mahendra S.J

Course contents

UNIT I

Introduction to medical robotics: robots for navigation (orthopaedic surgery, radiological and stereotaxic navigation, non-invasive navigation for head, navigation for moving targets), movement replication, robots for imaging, rehabilitation and prosthesis
Description of spatial position and orientation: matrices and angles, three joint robots, standardizing kinematic analysis, joint angles, quaternions

UNIT II

Robot kinematics: three joint robot, six joint robot, inverse solution for seven joint robot, eight joint robot, C arm (forward and inverse analysis), center of arc kinematics, surgical microscopes, kinematics and dexterity

UNIT III

Joint velocity & Jacobi matrices: C arm, Jacobi matrices, Jacobi matrices and velocity functions, geometric Jacobi matrix, singularities and dexterity
Motion correlation and tracking: motion correlation, regression and normal equations, support vectors, double correlation

UNIT IV

Motion prediction: MULIN algorithm, least mean square prediction, wavelet based LMS prediction, support vectors for prediction, fast lane methods and performance measures
Motion replication: tremor filtering, forces, joint torques and Jacobi matrices

UNIT V

Applications of surgical robotics: radiosurgery, orthopaedic surgery, urologic surgery, robotic imaging, cardiac surgery, neurosurgery, control modes
Rehabilitation, Neuroprosthetics and Brain-Machine Interfaces: Rehabilitation for Limbs, Brain-Machine Interfaces, Steerable Needles

Text Books

1. Achim Schweikard and Floris Ernst, “Medical Robotics”, Springer publications, 2015 edition

Reference Books

1. Paula Gomes “Medical robotics”, Woodhead publishing series, 2012 edition
2. Hongliang Ren, “Flexible robotics in medicine”, Academic press, 2020 edition

Course Outcomes (COs):

At the end of the course, students will be able to

1. Ascertain the importance of robotics in medical applications. (PO-1, 2, 3; PSO-2)
2. Analyse the spatial as well as kinematic aspects of robotic design. (PO-1, 2, 4, 5; PSO- 2, 3)
3. Assess the velocity and motion based aspects involved in the usage of robotics in medicine. (PO-1, 2, 3, 12; PSO- 1, 3)
4. Describe the various aspects pertaining to the motion prediction and motion replication in medical robotics. (PO-1, 3, 4, 5; PSO- 1, 2)
5. Emphasize on the applications of robotics in surgical as well as rehabilitative applications in healthcare. (PO-1, 2, 5; PSO- 2, 3)

HUMAN ASSIST DEVICES

Course Code: MLE23 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. C.K. Narayanappa, Mr. Mahendra S.J

Course contents

UNIT I

Heart Lung Machine and Artificial Heart: Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its functions.

UNIT II

Cardiac Assist Devices: Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, IntraAortic Balloon Pumping, Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III

Artificial Kidney: Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV

Prosthetic and Orthodic Devices: Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthodic System, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthodic devices, Haptic Devices.

UNIT V

Respiratory and Hearing Aids: Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics.

Text Book/s:

1. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.
2. Andreas. F. Vonracum, Hand book of bio material evalution, Mc-Millan publishers, 1980.
3. Albert M. Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982

4. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel DekkerInc New York 2004. 5. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd.

Course outcomes (COs):

At the end of the course, students will be able to

1. Demonstrate an understanding of the basic concepts of cardiac assist devices and its importance (PO-1 &PSO-1)
2. Demonstrate an understanding of the basic concepts of kidney assist devices and its importance (PO-2 &PSO-2)
3. Demonstrate an understanding of the basic concepts of hearing aids as assistive devices and its role (PO-1 &PSO-1)
4. Demonstrate an understanding of the basic concepts of assistive devices as prosthetic implants in ortho related applications (PO-2 &PSO-2)
5. Have a wide knowledge on the recent trends applicable in assistive devices (PO-7,8 &PSO-3)

MECHATRONICS IN MEDICINE

Course Code: MLE24 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Uma Arun ,Dr. Prabha Ravi

Course contents

UNIT I

Introduction to Mechatronics: Introduction, Mechatronics systems. Mechatronics design concept frame and work, Importance of Mechatronics in medical applications

UNIT II

Sensing technology: Introduction, Transducers and sensors, Sensor technologies and characterization, Machine vision Sensor application in medicine Implantable sensors, External sensors.

UNIT III

Mechatronics in Medical Imaging: Introduction, Mechatronics application in Medical imaging equipment -Ultrasound, MRI, CT scan, Nuclear Imaging

UNIT IV

Applications of mechatronics in medicine: Introduction, Robotics in medicine, Robotic surgery, Nano robotics in medicine, Rehabilitation robotics, Surgical training simulators, Smart instruments and probes

UNIT V

Medical case studies in Mechatronics: Introduction, Handheld robots, Smart probe for detecting kidney stones, breast cancer, Ankle sprain, Active prosthetic knee.

Text Books

1. Mechatronics in Medicine A Biomedical Engineering Approach, McGraw-Hill Education; 1st edition, 2011

Course Outcomes (COs):

At the end of the course, students will be able to

1. Describe a mechatronics system and concept .(PO 1,2 ; PSO1)
2. Demonstrate the concepts of transducers properties.(PO1,2 ;PSO1,2)
3. Apply the different Imaging applications of mechatronics.(PO1,2 ;PSO1,2)
4. Analyse the various methods of applications in medicine .(PO1,2 ;PSO1)
5. Apply different case study of mechatronics.(PO2 ;PSO2)

PHYSIOLOGICAL SYSTEM MODELLING

Course Code: MLE25 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. N Sriraam , Dr. Narayanappa C K

Course contents

UNIT I

Properties of Systems and Electrical Analog: System concept, system properties – Resistance, storage, resistance – compliance, piece-wise linear approximation, electrical analog for compliance, thermal storage, step response of first order systems – resistance-compliance systems, and pulse response of first order systems

UNIT II

Transfer Functions: Transfer functions and its use, Study of transfer function of first order and second order systems, engineering concept in coupled system, example of Transformed signals.

UNIT III

Impedance Concept: Transfer functions with impedance concept, prediction of performance, identification of the system from impedance function, periodic signals, relationship between transfer function and sinusoidal response, evaluation of transfer function from frequency response.

UNIT IV

Feedback Systems: Characteristics of physiological feedback systems, stability analysis of systems.

UNIT V

Simulation of Biological Systems: Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, endocrinal system, functioning of receptors.

Text Book/s:

1. William B. Blesser, “System approach to Bio-medicine”, McGraw-Hill, New York, 1969.
2. Manfred Clynes and John H. Milsum, “Bio-medical engineering system”, McGraw-Hill, New York, 1970.
3. Michael C.K. Khoo,” Physiological Control Systems -Analysis, Simulation and Estimation” Prentice Hall of India Pvt. Ltd., New Delhi, 2001

Reference Books:

1. Douglas S. Rigg, “Control theory and physiological feedback mechanism”, The William & Williams co., Baltimore, 1970.

Course outcomes (COs):

At the end of the course, students will be able to

1. Understand the principles behind the physiological system modelling (PO-1 & PSO-1)
2. Analyse the various resistive and storage properties of the physiological system (PO-2 &PSO2)
3. Demonstrate the importance of impedance (PO-4 &PSO-1)
4. Illustrate the mechanisms of stability and feedback (PO-5 & PSO-2)
5. Apply the concepts for various clinical applications (PO-2&PSO-2)

BIOMIMETIC TECHNOLOGIES

Course Code: MLE26 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Chandana S, Mrs. Uma Arun

Contents

UNIT I

Introduction: Mimicking and Inspiration of nature, difference between synthetic and artificial life, nature as a model for structure and tools, materials and process in biology, robotics emulating biology.

UNIT II

Mechanization of cognition: Introduction to mechanized cognition, Language cognition, sound cognition, Visual cognition.

UNIT III

Robotic Bio mimesis: A Simple Model of Evolutionary Adaptation, Machine Bodies and Brains, Tree Representations, locomotion principles in robotics, Behaviour, Expressivity

UNIT IV

Engineering Muscle actuators: Systems Engineering of Living Muscle Actuators, Biomechatronics, Quantitative Assessment of the Function of Living Muscle actuators, Practical Considerations for the Use of Living Muscle Actuators, Self-Organizing Muscle Tissues, Acellularized–Recellularized ECM Engineered, Tissue Interfaces: Tendon, Nerve, and Vascular

UNIT V

Artificial Support and Replacement of Human Organs: Artificial Kidney, Artificial Lung, Heart and Lung Machine, Artificial Lung, Ventricular Assist Devices, Total Artificial Heart, Total Joint Replacements, Bio-Artificial Pancreas, visual prosthetics and Other Substitutes

Text Books

1. Yoseph Bar Cohen, “Biomimetics Biologically Inspired Technologies”, CRC press, Taylor & Francis, 1st Edition 2006

Reference Books

1. Trung Dung Ngo, “Biomimetic Technologies: Principles and Applications”, woodhead publishing publications, Elsevier, 2015

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand naturally biomimetic designs, synthetic and artificial models of various biological process (PO-1,2 & PSO- 1)
2. Perceive and differentiate various types biomimetic cognition models (PO-1,2 & PSO- 1)
3. Illustrate simple evolutionary aptation and locomotion principles in robotics. (PO-1,2& PSO-1)
4. Understand the working of different cell and tissue actuators. (PO-1,2 & PSO-1)
5. Model Artificial human organs to support vital functions. (PO-1 & PSO-1)

WEARABLE DEVICES

Course Code: MLE31 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Uma Arun , Mrs. Chandana S

Course contents

UNIT I

Introduction: What is Wearable Systems, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Recent developments – Global and Indian Scenario, Types of Wearable Systems, Components of wearable Systems, Physiological Parameters commonly monitored in wearable applications.
Smart Sensors & Vital Parameters: Vital parameters monitored and their significances, Bio-potential signal recordings (ECG, EEG, EMG), Dry Electrodes design and fabrication methods, Smart Sensors – textile electrodes, polymer electrodes, non-contact electrodes, MEMS and Nano Electrode Arrays, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters. Sensors for Wearable Systems, Biomechanical Sensors, Physiological Sign Sensors.

UNIT II

Future Direction & E-Textiles: Fibers and Textiles for Bio electrodes, Fibers and Textiles for Sensing, Active Fiber Electronics and Woven Logics, Fibers and Textiles for Energy Harvesting and Storage, Smart Textiles for Actuation, Textile-Based Communication Devices, Smart Fabrics and Interactive Textiles Platforms. The Commercialization of Smart Fabrics: Intelligent Textiles, Analysis of the Markets: Today and Tomorrow, Common Backbone of Applications, Present Situation and Competitors in Terms of R&D and Commercialization, Market Segmentation, Market Volumes

UNIT III

Energy Harvesting for Self-Powered Wearable Devices: Principles of Energy Harvesting by Using Human Body Heat, Calculated Characteristics of Wearable TEGs, Human Body as a heat source for a wearable thermoelectric power supply, TEG's in wearable devices, Hybrid Thermoelectric-Photovoltaic Wearable Energy Harvesters, TEGs in Clothing, Development of New Technologies for Wearable Thermopiles

UNIT IV

Wireless Communication Technologies for Wearable Systems: System-Level Considerations, Lower-Level Tradeoffs, Recent Applications of Wireless Technology in Wearable Health Monitoring Systems. Design of Wireless Health Platforms, System Architecture Requirements for Wireless Health Platforms, System Design, Micro LEAP: A Wireless Health Platform with Integrated Energy Accounting, Micro LEAP Application: Smart Cane, Micro LEAP Application: Episodic Sampling, Conclusion and Next Generation Platforms.

UNIT V

Wearable Electronic Systems: Applications to Medical Diagnostics/Monitoring, Historical Perspective, Present and Possible Clinical Applications, Sensing Constraints and Possibilities, Discussion and Conclusion. Scenarios for the Interaction Between Personal Health Systems and Chronic Patients, The New Paradigm of Personalized Health: p-Health, The AMI Vision, Challenges of User Interaction Within the Patient-Centered Care Paradigm, Scenarios for the Application of AMI to p-Health. Wearable Systems for Disaster management, Home Health care, Astronauts, Soldiers in battle field, athletes, SIDS, Sleep Apnea Monitoring.

Text Books

1. Annalisa Bonfiglo, Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Edward Sazonov, Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elseiver, 2014

Reference Books

1. Kate Hartman, Make: Wearable Electronics: Design, Prototype and wear your own interactive garments, Maker Media
2. Elijah Hunter, Wearable Technology, Kindle Edition
3. GuangZhong Yang, Body Sensor Networks, Springer

Course Outcomes (COs):

1. Identify, understand and differentiate between different wearable systems used to acquire biomedical signals. (PO1, PO5, PO9, PSO2)
2. Incorporate the knowledge smart sensors in suitable textile material. (PO1, PO2, PO9, PSO2)
3. Understand various energy harvesting scheme in human body. (PO1, PO2, PO3, PO9, PO10, PSO2)
4. Choose various communication protocols for transmission of processed biomedical signals (PO1, PO5, PO9, PO10, PSO2)
5. Design and development of smart wearable system for health monitoring. (PO1, PO5, PO9, PO10, PO12, PSO2, PSO3

BIOSENSORS

Course Code: MLE32 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. N Sriraam, Mrs. Tejaswini S

Course contents

UNIT I

Fundamentals of Biosensors: Introduction and recent developments in biosensors, Electrochemical Biosensor, Optical-based Biosensor, Biorecognition Elements in a Biosensor, Immobilisation Methods, Principles of Biorecognition

UNIT II

Nanomaterial-based Biosensors: Introduction, Metal Nanoparticle-based Biosensors, Nanostructured Metal Oxide-based Biosensors, Carbon Nanotube-based Biosensors, Graphene-based Biosensors, Quantum Dot-based Biosensors

UNIT III

Conducting Polymer-based Biosensors: Introduction, Application of Polyaniline in Biosensors, Conducting Polypyrrole-based Biosensors, Polythiophenes-based Biosensors

UNIT IV

Applications of Biosensors: Biosensors for Food/Water Safety, Biosensors for Detection of Foodborne/Waterborne Pathogens, Biosensors for Mycotoxin Detection, Biosensors for the Defence Industries, Biosensors for Clinical Diagnostics, Biosensors for Environmental Monitoring

UNIT V

Challenges and Prospects in Biosensors: Challenges in Biosensing, Preparation and separation of Samples, Immobilisation of Biomolecules on Suitable Matrices, System Miniaturisation, Future Prospects

Text Books

1. BansiDhar & Chandra Mouli, “Biosensors: Fundamentals and Applications”, Smithers Group publications, 2017

Reference Books

1. Robert S Marks, Christopher R Lowe, David C Cullen, Et. al, “Handbook of Biosencors and Biochips” Viely publications, 2007
2. Raymond Tong, “Wearable Technology in Medicine”, Elsevier, 2018

Course Outcomes (COs):

AT the end of the course, students will be able to

1. Understand fundamental concepts and differentiate between different types of biosensors (PO: 1,3 5; PSO: 1,2)
2. Describe various mechanisms to bio sensing based on principles of nanotechnology (PO: 1,3 5, 9, 10; PSO: 2, 3)
3. Apply the knowledge the bio sensing through conductive material. (PO: 1,3 5, 9, 10; PSO: 2, 3)
4. Apply the knowledge of biosensors for food and water safety, clinical diagnosis and defense installations (PO: 1,3 5, 9, 10; PSO: 2, 3)
5. Illustrate the challenges faced by biosensor industry and methods to overcome the same (PO: 1, 9, 10, 12; PSO: 3)

BIOMEMS

Course Code: MLE33 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Tejaswini S, Mrs. Uma Arun

Course contents

UNIT I

MEMS and Microsystem: History of MEMS, Materials in MEMS, Silicon Piezo resistors, Ga As, quartz, polymer. Micromachining- Lithography, thin film deposition, ION Implantation, Diffusion, Oxidation, Chemical and Physical vapour Deposition, Sputtering, Deposition by epitaxial, etching

UNIT II

Microsensors and Actuators: Mechanics for MEMS design - Static bending of then plates, mechanical vibration, thermos mechanics, fracture and thin film mechanics. Mechanical sensors and actuators -beam and cantilever, microplates. Thermal sensors and actuators micromachined thermocouple probe, peltier effect heat pumps, thermal flow sensors.

UNIT III

Physical Micro Sensors: Design of Acoustic Wave sensor, resonator sensor, Capacitive and Piezo resistive pressure sensor.

UNIT IV

Microactuators: Design of Actuators: Actuation based on thermal forces, Actuation using Shape Memory alloys, Actuations using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar, comb drive actuators). Micromechanical motors and pumps

UNIT V

Micro Fluidics Systems: Fluid Dynamics, laminar flow in circular conduits. fluid flow in micro and nano conduits. Microscale fluid flow - expression for liquid flow in channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, microneedle, micro pumps - continuous flow systems.

Text Books

1. Tai-Ran Hsu. MEMS and Microsystems, Design Manufacturing and Nanoscale engineering, John wiley & Sons, 2014

Reference Books

1. G.K. Anantasure, K.J. Vinoy, S.Gopala Krishnan, K.N. Bhat, V.K. Aatre. Micro and Smart systems, Springer ed, 2014

Course Outcomes (COs):

At the end of the course, students will be able to

1. Discuss the basic material s used in MEMs and Microsystems (PO-1 & PSO-1)
2. Explain the various sensors and actuators used in MEMS (PO-1 & PSO-1)
3. Implementation of physical Micro Sensors (PO-1 & PSO-1)
4. Explain the design of actuators based on different techniques (PO-1 & PSO-1)
5. Discuss the properties & types of Micro fluidic systems (PO-& PSO-1)

BIOMETRICS

Course Code: MLE34 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. C K Narayanappa, Mrs. Chandana S

Course contents

UNIT I

Biometric Fundamentals: Introduction, Benefits of biometric security, Verification and identification, Basic working of biometric matching, Accuracy, False match rate, False non-match rate, Failure to enroll rate, Derived metrics, Layered biometric solutions.

UNIT II

Fingerprint Identification Technology: Finger scan, Features, Components, Operation (Steps), Competing finger Scan technologies, Strength and weakness. Types of algorithms used for interpretation.

UNIT III

Face & Iris Recognition: Facial Scan, Features, Components, Operation (Steps), Competing facial Scan technologies, Strength and weakness.
Iris Scan, Features, Components, Operation (Steps), Competing iris Scan technologies, Strength and weakness.

UNIT IV

Voice Scan: Voice Scan, Features, Components, Operation (Steps), Competing voice Scan (facial) technologies, Strength and weakness.
Other Physiological Biometrics: Hand scan, Retina scan, AFIS (Automatic Finger Print Identification Systems), Behavioral Biometrics, Signature scan- keystroke scan.

UNIT V

Applications: Biometrics Application, Biometric Solution Matrix, Bio privacy, Comparison of privacy factor in different biometrics technologies, Designing privacy sympathetic biometric systems. Biometric Vertical Markets, Biometric standards (BioAPI, BAPI), Biometric middleware, Biometrics for Network Security. Statistical measures of Biometrics. Biometric Transactions.

Text Books

1. Samir Nanavati, Michael Thieme, Raj Nanavati, "Biometrics - Identity Verification in a Networked World", WILEY- Dream Tech, 2009
2. Paul Reid "Biometrics for Network Security", Pearson Education, 2004

Reference Books

1. John D. Woodward, Jr. "Biometrics- The Ultimate Reference"-Wiley Dreamtech.1 edition, 2003

Course Outcomes (COs):

At the end of the course, students will be able to

1. Describe biometric identification system and its accuracy metrics (PO1, PO9, PO10, PSO1, PSO2)
2. Analyze biometric finger print technology and various interpretation algorithms. (PO1, PO6, PO9, PO10, PSO1, PSO2)
3. Demonstrate Face recognition, Iris scan technology and various interpretation algorithms. (PO1, PO6, PO9, PO10, PSO1, PSO2)
4. Compare retina scan, hand scan and behavioral biometrics. (PO1, PO6, PO9, PO10, PSO1, PSO2)
5. Apply the knowledge of biometric identification or verification system in different security systems. (PO1, PO3, PO6, PO9, PO10, PSO1, PSO2, PSO3)

HEALTH INFORMATICS

Course Code: MLE35 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi, Mr. S J Mahendra

Course contents

UNIT I

General Overview: Health information technology, Health informatics, Clinical Informatics, Cybermedicine, eHealth, Health 2.0, Public health informatics.
Applications in Healthcare Management: Health Administration Informatics, Medical integration environment, Health information exchange, Hospital information system, Healthcare workflow, Computer physician order entry, ICU quality and management tools, Laboratory information management system, Laboratory information system, mHealth, Practice management software, Clinical Quality Management System

UNIT II

Health Electronic Records: Electronic health record, Electronic medical record**,** Personal health record, Computer STored Ambulatory Record, ProRec, Health record trust, Canadian EMR, Clear Health, Laika, openEHR, OpenEMR, OpenMRS, VistA, VistA imaging, VistA Web, WorldVistA, ZEPRS,
Decision Support Applications: Clinical decision support system, Computer-aided diagnosis, Medical algorithm, Medical logic module, Physicians' Information and Education Resource.
Languages and Development Platforms: MUMPS

UNIT III

Medical Imaging Applications: Digital radiography, Imaging informatics, Patient registration, Radiology information system, Picture archiving and communication system, Analysis of Functional NeuroImages,3DSlicer, Analyze, CARET, CAVEman, FreeSurfer, ImageJ, In Vesalius, ITK-SNAP, Mango, OsiriX.
Medical and biological signal applications: Medical monitor,H oltermonitor, Automated ECG interpretation, Open ECG project ,MECIF Protocol, SCP-ECG, European Data Format, OpenXDF

UNIT IV

Databases, Digital Libraries and Literature Retrieval: Biological database, Medical literature retrieval, MEDLINE, Entrez, ETBLAST, PMID, PubMed, GoPubMed, Pubget, PubMed Central, UK PubMed Central,TRIP Database, Twease, SciELO.
Telehealth and Telemedicine: Connected Health, Telehealth, Telemedicine, Telecare, Telephone triage, Remote guidance, Tele-epidemiology, Telenursing, Teledermatology,

Telemental Health, Telepsychiatry, Teleradiology, Telerehabilitation, Virtual reality in telerehabilitation, Campus medicus, Wireless Medical Telemetry Service.
Virtual Systems: Virtual Physiological Human, Visible Human Project**.**

UNIT V

Legislation and Regulation: Health Insurance Portability and Accountability Act, Certification Commission for Healthcare Information Technology, Software Systems, Medical software, Dental software, List of freeware health software, List of open source healthcare software, List of neuroimaging software, Mirth, Mpro , Open Dental, Personal Health Application .
Clinical Research Informatics: Translational research informatics, Clinical trial management, Clinical data management system, Case report form, Clinical coder, Clinical data acquisition, Data clarification form, Patient-reported outcome.
Standards, Coding and Nomenclature: Diagnosis codes, Procedure codes.

Text Books

1. Contemporary Health Informatics, Mark L. Braunstein , American Health Information Management Association, 2014
2. Wikipedia Handbook of Biomedical Informatics, pediapress, 2011
3. Biomedical Informatics: Computer Applications in Health Care and Biomedicine , Edward H. Shortliffe , James J. Cimino, et al., Springer; 3rd edition, 2006.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand Health Systems and Policy. (PO-1,2,3 & PSO-1,2)
2. Develop skills in the management of health data, the electronic health record (EHR), health informatics projects and organizational resources. (PO-2,3,4 & PSO-1,2)
3. Know how computers store, access, and process data. (PO- 5,6,7 & PSO-2)
4. Use software applications to solve simple but meaningful real-world problems. (PO-7,8,9& PSO-3)
5. Design and Implement Information Systems Determining the required and available healthcare data and identify an appropriate database design. (PO-9,10,11 & PSO-3)

BIOMATERIALS & BIOMECHANICS

Course Code: MLE36 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. C.K. Narayanappa, Dr. Sanjay H S

Course contents

UNIT I

Introduction to biomaterial science: Characteristics of biomaterials, Metallic biomaterials, Ceramic biomaterials, Polymeric biomaterials, Biodegradable polymeric biomaterials, Biological biomaterials

UNIT II

Tissue replacements: Hard tissue replacements: Bone repair & joint implants, Dental Implants, Soft tissue replacements: Blood interfacing implants, non-blood interfacing implants

UNIT III

Introduction: Substitutive medicine, outlook for organ replacement, design consideration, evaluation process.
Artificial Heart and Circulatory assist devices: Engineering design, Engineering design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses

UNIT IV

Introduction to Biomechanics: A brief history of biomedical fluid mechanics, Fluid characteristics & viscosity, Fundamental methods to measure viscosity, Pipe flow, Bernoulli Equation, Mass conservation, Fluid statistics.

UNIT V

Application of Aerodynamics in Sports: Introduction, Lateral force on the spinning ball of a soccer kick, Analysis of soccer kick, Analysis of basketball foul throw
Application of hydrodynamics in swimming: Buoyancy & flotation, Resistance & propulsion, Resistive & Propulsive forces in swimming, Swimming efficiency & speed

Text Books

1. Joseph D Bronzino, 'Biomedical Engineering Handbook', CRC press, 1995
2. Ratner & Hoffman, “Biomaterial Science, Academic press, 1996
3. Duane Knudson, “Fundamentals of Biomechanics”, 2nd edition, Springer publications

Reference Books

1. David C Cooney, Marcel Dekker "Biomedical Engineering principles" Publications,1976
2. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill publications, 2007 edition
3. 3. Arthur T Johnson, "Biomechanics & exercise physiology", John Wiley & Sons publications

Course Outcomes (COs):

At the end of the course, students will be able to

1. Describe the characteristics of different materials that can be used as substitutes for failed organs in human beings (PO-1, 5,11& PSO-2)
2. Discuss the implementation of mechanical concepts in prosthesis for tissue replacements (PO-1, 7, 11& PSO-1)
3. Discuss the implementation and design of Artificial heart and circulatory assist devices (PO-1, 5& PSO-1)
4. Relate of the basic fluid mechanical concepts to realize the importance of blood flow conceptsin a human body (PO-1, 7, 11& PSO-1)
5. Illustrate the applications of Biomechanical concepts for Aerodynamics in sports and Hydrodynamics in swimming. (PO-& PSO-1)

MINI PROJECT

Course Code: MLP65 **Course Credits: 0:0:4**
Prerequisite: Nil **Contact Hours: 8 Hours per week**
Course Coordinator(s): Mrs. Uma Arun , Mrs. Chandana S

The Mini-project course provides an integrated assessment of the progress of the students toward the desired healthcare technology. It is therefore important to design fair and broad guidelines for better assessment of this course. Mini-project having a course code as ML63 in the department of Medical Electronics (ML) is a one semester course in which students form teams usually of at most five members, select a design project and are supervised by a faculty member.

The students are expected to discuss their progress with their supervisors in regular weekly meetings. The students submit a written report, present and defend their work at the end of the semester. The main purpose of the project is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities. The design project is comprehensive and focuses on professional practice and includes a variety of non-technical issues such as economic factors, safety, reliability, environment and social impacts.

The projects are proposed by the department faculty members. The student(s) will select a project from the same. The students are required to demonstrate their ability to: conduct a literature survey; perform the relevant design, propose a solution to the problem, and implement their design.

Course Outcomes (COs):

At the end of the course, students will be able to

CO1: Understand and demonstrate the process of implementing the engineering concepts in real time application (PO: 1,2,4,9, PSO: 1,2)

CO2: Clearly identify and justify the problem statement with purpose (PO: 2,3,4,5,8,9, PSO: 2,3)

CO3: Works with a group thereby able to practice professional values (PO: 2,3,4,5, PSO: 2,3)

REAL TIME PROCESSORS & APPLICATIONSLABORATORY

Course Code: MLL66 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Basavaraj Hiremath , Mrs. Uma Arun

Course contents

1. Introduction to Hardware & Software Platform:
    a. Overview of Code Composer Studiov9
    b. Installing TI-RTOs
    c. Configuration of GPIO module to blink an LED and read an input pin
2. Configuration of Timer module with interrupt to generate a 1 s delay
3. Configuration of 12-bit ADC module to read a temperature sensor
4. Using RTOs thread: configuring and using Hwi thread
5. Using RTOs thread: configuring and using Swi thread
6. Using RTOs thread: configuring and using Idle thread
7. Using RTOs thread: configuring and using Task thread
8. Semaphores: Creation of semaphore to synchronize between multiple Tasks
9. Clock Function: Use of clock module APIs to determine the sleeptime of tasks
10. MailBox: Passing data between threads by creating and using a mailbox
11. Events: Write a program to create event to handle three Interrupt Service Routines.
12. RTOs Debugging: using UIA and RTOs Analyzer to debug RTOS application

Text Books

1. TI-RTOS Kernel User's Guide, Texas Instruments, 2018
2. Real Time Operating System for ARM Cortex M Microcontrollers by Jonathan Valvano, 2017

Reference Books

1. NaimDahnoun, Multicore DSP: From Algorithms to Real-time Implementation on the TMS320C66x SoC, Wiley publications, 2018

Course Outcomes (COs):

At the end of the course, students will be able to

1. Use the CCS software and use it to operate the GPIO using basic I/O operation. (PO1, PO3, PO4 & PSO-1,2)
2. Implement effectively use concepts of C programming for development of optimized embedded software. (PO1, PO3, PO4 PO5&PSO1, PSO2)
3. Obtain a conceptual and practical foundation for advanced embedded applications. (PO1, PO3, PO4PO5&PSO1, PSO2)

BIO-MEDICAL INSTRUMENTATION-II LAB

Course Code: MLL67 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Sanjay H S, Mrs. Tejaswini S

Course contents

1. Assessment and analysis of movement patterns using GAIT measurement setup
2. Measurement and analysis of physiological signals using nanditharangini hardware module
3. Acquisition of Electrocardiogram and Pulse using the BIPOAC acquisition system and find the physiological parameters associated with the same.
4. Acquisition of Electrocardiogram using the ECG acquisition system (RMS) and find the physiological parameters associated with the same.
5. Acquisition of Electroencephalogram using the EEG acquisition system (RMS) and obtain the parameters for deep thinking with sound effect.
6. Acquisition of Electroencephalogram using the EEG acquisition system (RMS) and obtain the parameters for eye blinking.
7. Acquisition of Electromyogram using the EMG acquisition system (RMS) and calculation of the nerve conduction velocity of the right hand of the subject.
8. Acquisition and analysis of heart sounds with the aid of biopac module.
9. Acquisition of Breath Assessment using Spirometer and find the physiological parameters associated with the same.
10. Acquisition of Audiogram using the PC Based audiometer acquisition system (RMS) and find the air conduction of both Left and Right Ear.
11. Demonstration of the functional aspects and usage of the ventilator and their applications in healthcare
12. Demonstration of the functional aspects and usage of the defibrillator and their applications in healthcare

Text Books

1. John G Webster, “Medical Instrumentation-Application and design”, 3rd edition, John Wiley Publications, 2014
2. R S Khandpur, “Handbook of biomedical instrumentation”, third edition, McGraw Hill publications, 2012

Reference Books

1. Joseph D. Bronzino, “Medical Devices and Systems - The Biomedical Engineering Handbook”, Third Edition – CRC Press, 2006.
2. Carr& Brown, “Introduction to Biomedical equipment technology, 4th edition, Pearsons publications, 2003

Course Outcomes (COs):

At the end of the course, students will be able to

1. Illustrate the applications of various biomedical signals from a diagnostic perspective (PO 1,2,4,12)
2. Diagnose various physiological aspects of human body with the aid of biomedical equipment (PO 2,3)
3. Calculate the necessary therapeutic parameters using biomedical equipment in order to help in various therapeutic approaches (PO 1,4,5,12)

BIOMEDICAL IMAGE PROCESSING LAB

Course Code: MLL68 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr. Prabha Ravi, Dr. Sweeti

Contents:

1. Simulation and display of an image, negative of an image (Binary &Gray Scale)
2. Implementation of relationships between pixels
3. Contrast stretching, Intensity slicing, power law transformations
4. Basic morphological operation and its applications
5. Histogram processing and spectra in understanding the information content of medical images
6. 2-D Convolution
7. Medical Image smoothing (Low pass and Median filters) and Medical Image sharpening (High
2. pass and derivative filters)
8. Implementation of homomorphic filtering technique for image enhancement
9. Error measures using MSE and NMSE
10. Implementation of image restoring techniques
11. Geometric transformation and the assessment of the applications of fusion Algorithm.
12. Boundary descriptor

Text Books:

1. R C Gonzalez & R E Woods, Digital Image Processing, Pearson Education, 4th edition, 2018
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC Press, 2004

Reference Books:

1. Wolfgang Birkfellner, Applied Medical Image Processing: A Basic Course, 2010
2. Richard A. Robb “Biomedical Imaging, Visualization, and Analysis”, John Wiley & Sons, 1999.
3. Azriel Rosenfeld &Avinash G Kak, “Digital Picture Processing”, Academic press, Volume 1 & 2

Course Outcomes (COs):

By the end of the semester students are able to

1. Implement the basic relationship between the pixels. (PO1,2,4, PSO1)
2. Apply the various image enhancement and morphological techniques on a medical image (PO1,2,3,4, PSO1)
3. Demonstrate the image registration and description schemes and Apply various segmentation and restoration techniques on a medical image (PO1,2,3, PSO1)

DATA SCIENCE FOR HEALTHCARE

Course Code: MLOE04 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Tejaswini S, Mrs. Purnima B R

Course contents

UNIT I

Introduction to Healthcare Data Analytics: Healthcare Data Sources and Basic Analytics, Advanced data analytics for healthcare, application and practical system for healthcare, Resources for healthcare data analytics.

UNIT II

Electronics Health Records: A Survey: History of EHR, Components of EHR, Coding system, Benefits of EHR, Barriers of EHR, Challenges of EHR, Phenotyping algorithm

UNIT III

Mining of Sensor Data in Healthcare: A Survey: Mining sensor data in medical informatics, scope and challenges, challenges in Healthcare data analysis, sensor data mining applications, Non clinical Healthcare applications.

UNIT IV

Social Media Analytics for Healthcare: Social Media analysis for detection and tracking of infectious disease outbreak, social media analysis for public health research, analysis of social media use in Healthcare.

UNIT V

Applications and Practical system for Healthcare: Data analytics for Pervasive Health, Fraud detection in Healthcare.

Text Books

1. Chandan K Reddy, Chall C Aggarwal, “Healthcare Data Analytics”, Chapan& Hall/ CRC, CRC Press

Reference Books

1. Sergio Consoli, Diego Reforgiato Recupero, “Data Science for Healthcare” Springer International Publishing, 2019.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Discuss the basic of Healthcare data analytics (PO-1, 5,11& PSO-2)
2. Understand the uses of electronic Health records (PO-1, 7, 11& PSO-1)
3. Implementation mining of sensor data in healthcare (PO-1, 5& PSO-1)
4. Explain the importance of social media in healthcare (PO-1, 7, 11& PSO-1)
5. Apply the analytics in application and practical system for healthcare. (PO-& PSO-1)

AI IN MEDICINE

Course Code: MLOE05 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Basavaraj Hiremath V, Dr. Sanjay H S

Course contents

UNIT I

Introduction to AI: History, state of the art, Need for AI in Medicine. Thinking and acting humanly, intelligent agents, structure of agents.

UNIT II

Problem Solving using AI: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search,
knowledge and reasoning–knowledge representation – first order logic.

UNIT III

Planning with AI: Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT IV

Reasoning Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT V

Learning with AI: Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.

Course Outcomes (COs):

The Student will be able to

1. Identify problems that are amenable to solution by AI methods (PO-1,2&PSO-1)
2. Identify appropriate AI methods to solve a given problem. (PO-1,2,3&PSO-1)
3. Formalize a given problem in the language/framework of different AI methods. (PO-1,2,3 & PSO-1)
4. Summarize the learning methods adopted in AI. (PO-1,2 & PSO-1)
5. Design and perform an empirical evaluation of different algorithms on a problem formalization. (PO-1,2,3 & PSO-1)

Text Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India, 2016.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”, Harlow: Addison Wesley, 2002.

Reference Books:

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, “Introduction to AI Robotics”, MIT Press, 2000.
3. Francis. X. Govers, “Artificial Intelligence for Robotics”, Packt Publishing, 2018.
4. Huimin Lu, Xing Lu, “Artificial Intelligence and Robotics”, Springer, 2017.
5. Michael Brady, Gerhardt, Davidson, “Robotics and Artificial Intelligence”, Springer, 2012.

HEALTH INFORMATICS

Course Code: MLOE06 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi, Mr. Mahendra S.J

Course contents

UNIT I

General Overview: Health information technology, Health informatics, Clinical Informatics, Cyber medicine, eHealth, Health 2.0, Public health informatics.
Applications in Healthcare Management: Health Administration Informatics, Medical integration environment, Health information exchange, Hospital information system, Healthcare workflow, Computer physician order entry, ICU quality and management tools, Laboratory information management system, Laboratory information system, mHealth, Practice management software, Clinical Quality Management System

UNIT II

Health Electronic Records: Electronic health record, Electronic medical record**,** Personal health record, Computer STored Ambulatory Record, ProRec, Health record trust, Canadian EMR, Clear Health, Laika, openEHR, OpenEMR, OpenMRS, VistA, VistA imaging, VistA Web, WorldVistA, ZEPRS,
Decision Support Applications: Clinical decision support system, Computer-aided diagnosis, Medical algorithm, Medical logic module, Physicians' Information and Education Resource.
Languages and Development Platforms: MUMPS

UNIT III

Medical Imaging Applications: Digital radiography, Imaging informatics, Patient registration, Radiology information system, Picture archiving and communication system, Analysis of Functional NeuroImages,3DSlicer, Analyze, CARET, CAVEman, FreeSurfer, ImageJ, InVesalius, ITK-SNAP, Mango, OsiriX.
Medical and biological signal applications: Medical monitor, Holtermonitor, Automated ECG interpretation, Open ECG project ,MECIF Protocol, SCP-ECG, European Data Format, OpenXDF

UNIT IV

Databases, Digital Libraries and Literature Retrieval: Biological database, Medical literature retrieval, MEDLINE, Entrez, ETBLAST, PMID, PubMed, GoPubMed, Pubget, PubMed Central, UK PubMed Central, TRIP Database, Twease, SciELO.
Telehealth and Telemedicine: Connected Health, Telehealth, Telemedicine, Telecare, Telephone triage, Remote guidance, Tele-epidemiology, Telenursing, Tele dermatology, Telemental Health, Tele psychiatry, Tele radiology, Tele rehabilitation, Virtual reality in tele

rehabilitation, Campus medicus, Wireless Medical Telemetry Service.
Virtual Systems: Virtual Physiological Human, Visible Human Project**.**

UNIT V

Legislation and Regulation: Health Insurance Portability and Accountability Act, Certification Commission for Healthcare Information Technology, Software Systems, Medical software, Dental software, List of freeware health software, List of open source healthcare software, List of neuroimaging software, Mirth, Mpro , Open Dental, Personal Health Application .
Clinical Research Informatics: Translational research informatics, Clinical trial management, Clinical data management system, Case report form, Clinical coder, Clinical data acquisition, Data clarification form, Patient-reported outcome.
Standards, Coding and Nomenclature: Diagnosis codes, Procedure codes.

Text Books

1. Contemporary Health Informatics, Mark L. Braunstein , American Health Information Management Association, 2014
2. Wikipedia Handbook of Biomedical Informatics, pediapress, 2011
3. Biomedical Informatics: Computer Applications in Health Care and Biomedicine , Edward H. Shortliffe , James J. Cimino, et al., Springer; 3rd edition, 2006.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Understand Health Systems and Policy. (PO-1,2,3 & PSO-1,2)
2. Develop skills in the management of health data, the electronic health record (EHR), health informatics projects and organizational resources. (PO-2,3,4 & PSO-1,2)
3. Know how computers store, access, and process data. (PO- 5,6,7 & PSO-2)
4. Use software applications to solve simple but meaningful real-world problems. (PO-7,8,9& PSO-3)
5. Design and Implement Information Systems determining the required and available healthcare data and identify an appropriate database design. (PO-9,10,11 & PSO-3)