RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2019 – 2020

MEDICAL ELECTRONICS

V & VI SEMESTER B.E

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

About the Institute

Ramaiah Institute of Technology (RIT) (formerly known as M. S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah. The institute is accredited with "A" grade by NAAC in 2014 and all engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with prescribed faculty student ratio and achieves excellent academic results. The institute was a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments have competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 304 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT 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 over 1,35,427 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls and all are air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 64th rank in 2019 among the top 100 engineering colleges across India.

About the Department

The Medical Electronics department at Ramaiah Institute of Technology (MSRIT), Bangalore was started in the year 1996. The department is offering 4-year full time B. E. degree course in Medical Electronics, affiliated to VTU, Belgaum, recognized by Government of Karnataka, approved by AICTE, New Delhi and accredited by NBA. The department is located at Lecture Hall Complex of RIT Campus. The department consists of a highly motivated & qualified faculty and dedicated supporting staff headed by Dr. N. Sriraam, Academy-industry experienced Professor with specialization in biomedical signal processing.

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 skillsets 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

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/Internship (PW /IN)	Extra & Co-curricular activities (EAC)	Total credits in a semester
First	02	09	14	-	-	-	-	-	**25**
Second	04	09	10	-	-	-	-	-	**23**
Third	--	04	-	21	-	-	-	-	**25**
Fourth	-	04	-	21	-	-	-	-	**25**
Fifth	03	-	-	19	03	-	-	-	**25**
Sixth	-	-	-	15	06	-	4	-	**25**
Seventh	-	-	-	14	12	-	-	-	**26**
Eighth	-	-	-	-	04	04	16	02	**26**
Total	**09**	**26**	**24**	**90**	**25**	**04**	**20**	**02**	**200**

SCHEME OF TEACHING

VSEMESTER

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1	ML51	Sensors & Measurements	PC-C	3	0	0	1	4	3
2	ML52	Digital Image Processing	PC-C	4	0	0	0	4	4
3	ML53	Digital Signal Processing	PC-C	4	0	0	0	4	4
4	ML54	Control Systems	PC-C	3	1	0	0	4	5
5	ML55	IPR & Medical Ethics	HSS	2	0	0	1	3	2
6	MLE1X	ELECTIVE GROUP I	PC-E	0	2	1	0	3	6
7	MLL56	P&M Lab	PC-C	0	0	1	0	1	2
8	MLL57	DIP Lab	PC-C	0	0	1	0	1	2
9	MLL58	DSP Lab	PC-C	0	0	1	0	1	2
			Total	16	3	4	2	25	**30**

VI SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1	ML61	Biomedical Instrumentation	PC-C	3	0	0	1	4	3
2	ML62	Medical Image Processing	PC-C	4	0	0	0	4	4
3	ML63	Biomedical Signal Processing	PC-C	3	1	0	0	4	5
4	ML64	Mini-Project	PW/IN	0	0	6	0	6	12
5	MLE2X	ELECTIVE GROUP II	PC-E	3	0	0	1	4	3
6	MLL65	BMI Lab	PC-C	0	0	1	0	1	2
7	MLL66	MIP Lab	PC-C	0	0	1	0	1	2
8	MLL67	BSP Lab	PC-C	0	0	1	0	1	2
			Total	13	1	9	2	25	**33**

ELECTIVE GROUP-I

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1	MLE11	Introduction to mobile App Development	PC-E	0	2	1	0	3	6
2	MLE12	Virtual Instrumentation	PC-E	0	2	1	0	3	6
3	MLE13	Internet of Things-Healthcare	PC-E	0	2	1	0	3	6

ELECTIVE GROUP-II

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1	MLE211	Embedded Real Time Systems	PC-E	3	0	0	1	4	3
2	MLE212	Linear Algebra	PC-E	3	0	0	1	4	3
3	MLE213	ARM Processors	PC-E	3	0	0	1	4	3
4	MLE221	Biomaterials & Bio Mechanics	PC-E	3	0	0	1	4	3
5	MLE222	Biosensors	PC-E	3	0	0	1	4	3
6	MLE223	Biostatistics & Research Methodology	PC-E	3	0	0	1	4	3
7	MLE231	Core JAVA Programming	PC-E	3	0	0	1	4	3
8	MLE232	Introduction Cloud Computing	PC-E	3	0	0	1	4	3
9	MLE233	Clinical Engineering	PC-E	3	0	0	1	4	3

V semester

SENSORS & MEASUREMENTS

Course code:ML51 **Credits: 3:0:0:1**
Prerequisite: Nil **Contact hours:42**
Course Coordinators: Prof. P G Kumaravelu, Mrs.Chandana S

Course contents:

UNIT I

Basics of Sensors & Measurements: Introduction, Automatic Control Devices, Automatic Implanted Therapeutic Devices, Transducers and Measurement of physiological events, Principle of Transduction and Transducible Properties, Accuracy and Precision, Types of Errors,
Self study: Calibration and Standardization.

Resistive Measurements: Thermo resistor, Thermistor and their Biomedical Application, Metallic Strain gauges, strain Gauge as Displacement & Pressure Transducers
Self study: Humidity Sensitive Resistor and their Biomedical Application.

UNIT II

Inductive and Capacitive measurements: Single Inductors, Mutual Inductance LVDT and their Biomedical Application Magnetorheography, Magnetostrictive Tissue Fragmenter. Capacitance Measuring Circuits, Biological Capacitors
Self study: Characteristics of Capacitive Transducers and their Biomedical Application.

UNIT III

Photoelectric and Piezo Electric measurements: Phototube, Photo Multiplier Tube (PMT), Photovoltaic, Photoconductive Cells, Photodiodes, Phototransistor, Comparison of Photoelectric Transducers, Spectrophotometric Applications of Photo Electric Transducers. Piezoelectric Devices
Self study: Pulse Echo Techniques and Their Biomedical Applications.

UNIT IV

Bridge aided measurements: Wheat Stone Bridge, Guarded Wheat Stone Bridge, Kelvin Bridge, Maxwell Bridge, Hay Bridge, Schering Bridge, Application of AC Bridges, Unbalanced Conditions, Wein Bridge.
Self study: Biomedical applications of bridges

UNIT V

Recording Devices: Basic Recording System, Inkjet Recorder, UV Recorders, Thermal Array Recorder, Electrostatic Recorder, Light Gate Array Recorder, Potentiometric Recorder**.**
Self study: biomedical applications of recording devices

Text Books:

1. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – John Wiley and sons, 3rd Edition,2008.
2. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", 1st Edition, Prentice Hall of India, 2007.

References:

1. Ernest o Doebelin and dhanesh N manik, Measurement systems, Application and design ,5thedition,McGraw-Hill, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 1st Edition, New Delhi, 2007.
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, 2nd EditionNew Delhi, 2007.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 3rd Edition New York, 2004.

Course Outcomes (COs):

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

1. Identify various Bio-Medical instruments & the measurements principles. (PO-1,2,4,12,&PSO-1)
2. Accent the fundamentals of different sensors/transducers and recording devices. (PO-1,2, &PSO-1)
3. Comprehend the functional aspectsof sensors in Bio-Medical Instruments. (PO-1,6, & PSO-1)
4. Design bridge circuits for interfacing transducer output to signal conditioning circuits. (PO-2,4, &PSO-1)
5. Analyze the working of sensors used to measure chemical and environmental variables. (PO-1,12, PSO1, PSO-3)

DIGITAL IMAGE PROCESSING

Course code:ML52 **Credits: 4:0:0:0**
Prerequisite: Nil **Contact hours:56**
Course Coordinator(s): Dr. Basavaraj V Hiremath, Dr. C K Narayanappa

Course contents:

UNIT I

Introduction: Origin and importance of DIP, fundamental steps in digital image processing, elements of digital image processing system. Digital image fundamentals: image sensing and acquisition, sampling and quantization, some basic relationships between pixels, some basic transformations.

UNIT II

Morphological Image Processing: preliminaries, dilation and erosion, opening and closing, the Hit-or-miss transformation, some basic morphological algorithms, extensions to gray scale images.

UNIT III

Image enhancement in the spatial domain: Background, basic gray level transformations, histogram processing, enhancement using arithmetic/logic operations, basics of spatial filtering, smoothing and sharpening spatial filters, combining spatial enhancement methods

UNIT IV

Image enhancement in the frequency domain: Background, introduction to the frequency domain, Fourier transform, Discrete Fourier transform, some properties of the 2-dimensional Fourier transform, Fast Fourier Transform, smoothing and sharpening frequency domain filters, homomorphic filtering, implementation, generation of spatial masks from frequency domain specifications.
Color image processing: color fundamentals, color model, Psoudo color processing, Basics of full color processing

UNIT V

Image restoration: Degradation model, Noise models, restoration in the presence of noise only (Spatial and frequency domain filters), Diagonalization of circulant and block circulant matrices, algebraic approach to restoration, Inverse filtering, LMS filtering, constrained least square restoration, interactive restoration, restoration in the spatial domain.

Text Book:

1. R C Gonzalez & R E Woods," Digital Image Processing" , Pearson Education,3e, 2008

Reference Books:

1. A K Jain, "Fundamentals of Digital Image processing", PHI / Pearson Education, 1st edition, 2011
2. Chanda and Majumder, "Digital Image Processing and Analysis", PHI Learning Pvt. Ltd., 2004.

Course outcomes (COs):

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

1. Identify the basic Digital image representation and assess the relationship between the pixels. (PO-1,2,3 & PSO-1)
2. Analyze and implement various morphological image processing algorithms. (PO-1,2,3, & PSO-,1,2)
3. Ascertain the implementation of various enhancement techniques on an image. (PO-1,2,3,5 & PSO-1)
4. Emphasize on the different color models and their uses. (PO-1,2,3 & PSO-1)
5. Discuss various restoration techniques used in image processing. (PO-1,2,3 & PSO-1)

DIGITAL SIGNAL PROCESSING

Course code:ML53 **Credits: 4:0:0:0**
Prerequisites: Signals & Systems **Contact hours:56**
Course Coordinator(s): Mrs. Purnima B R, Dr. Sanjay H.S

Course contents:

Unit - I

Discrete Fourier Transform: Introduction, Definition of DFT & its inverse, Properties of DFT, Convolution using DFT, problems

Unit - II

Fast Fourier Transform: Introduction, Radix-2 decimation in time FFT algorithm, computational efficiency, decimation in frequency FFT algorithm, IFFT algorithms, problems

Unit – III

IIR Filter Design: Introduction, Butterworth filters, Chebyshev filters, general filter forms, design of IIR digital filter through analog filters, impulse invariant transformations, bilinear transformations, design of digital Butter worth & Chebyshev filters, problems

Unit - IV

FIR Filter Design: Introduction, different types of windows- rectangular, Design of FIR filters using different windows, frequency sampling design of FIR filter, comparison of IIR & FIR digital filters.

Unit - V

Realization of Digital Filters: Introduction, Direct form realizations of IIR filters, Signal flow graphs & transposed structures, Cascade & parallel realization of IIR filters, Realization of FIR filters, IIR & FIR lattice structures

Text Books:

1. Ganesh Rao &Vineeth P Gejji "Digital Signal Processing" Cengage Learning India Pvt ltd publication, 2017, Edition
2. V. Udayashankar "Modern Digital Signal Processing" PHI, 2 nd Edition
3. Proakis&Manolakis, PHI "Digital Signal Processing " 4th edition 2003, Pearson international edition
4. A .V Oppenheim & R W Schafer, "Digital Signal Processing"–,Pearson Education / PHI, 4th Edition, 2013.

References:

1. Sanjit K Mitra "Digital Signal Processing" 3rd-edition*,2011*
2. L R Rabiner and B Gold, McGraw Hill. "Theory and applications of DSP" 2nd edition ,McGraw Hill*, 2006*

Course outcomes (COs):

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

1. Incorporate the knowledge about signals and systems and hence appreciate the methods involved to realize discrete Fourier transforms Discrete Fourier Transforms and hence appreciate the efficient methods involved to solve engineering problems (PO-1,2,3,12 & PSO-1,3)
2. Recognize the importance of techniques to solve discrete Fourier transforms faster using FFT (PO-1,2,3 & PSO-1)
3. Comprehend and interpret the various techniques involved in the design and implementation of IIR filters (PO-1,2,3 & PSO-1)
4. Design and implement filter for signal processing in digital format (PO- 1,2,3 & PSO-1)
5. Realize various types of IIR and FIR filters using various approaches (PO-2,12 & PSO-3)

CONTROL SYSTEMS	
Course code:ML54	**Credits: 3:1:0:0**
Pre-requisite: Nil	**Contact hours:42+28**
Course Coordinator(s): Dr.C K Narayanappa, Mr.Mahendra S J	

Course contents:

Unit -I

Introduction to Control Systems: Introduction, Types of control systems, Design considerations, Mechanical translation & rotational systems, Analogous circuits
Block Diagram & Signal flow graph: Introduction, Transfer function, Elements of block diagram, Closed loop transfer function, Block diagram algebra, Signal flow graphs, Electromechanical systems, Introduction to Matlab

Unit -II

Time domain analysis of control systems: Introduction, Typical test signals, First order systems, Formal representation of second order systems, Determination of undamped response, natural frequency & damping ratio, Step response of second order systems, Time domain specifications, System types, Different forms of representation, Steady state & static errors, Approximation of higher order systems, Step response of second order systems with zeros, Generalized error series, response.

Unit -III

Stability of Linear Control systems: Introduction, BIBO stability, Relationship between characteristic equation roots & BIBO stability, Zero input stability, Stability criterion, RH criterion, RH analysis using Matlab
Root Locus: Introduction, The RL concept, Steps for rapid plotting, RL analysis using Matlab

Unit -IV

Frequency Domain Analysis: Correlation between time and frequency response, Frequency domain specifications
Bode Plot: Introduction, Asymptotic approximations, Bode diagram for a practical system, Determination of transfer functions

Unit –V

Stability in the frequency domain: Introduction to polar plots (Inverse polar plots excluded), Mathematical preliminaries, Nyquist Stability Criterion, Assessment of relative stability Nyquist Stability criterion
State Space Theory: Introduction, State & state variables, Selection of state variables, state model, Non-homogenous solution, converting a transfer function to a state model
Note: Matlab based problem solving topics are to be taught as demo sessions.

Text Books:

1. Katsuhiko Ogata, 'Modern Control Engineering', 5th edition, PHI, 2009
2. Nagrath & Gopal, 'Control Systems Engineering', New Age International Publications,

5th Edition, 2008

Course outcomes (COs):

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

1. Comprehend and interpret the basic concepts of control theory. (PO-1,2,3 & PSO-1)
2. Compare the performances of a first and second order system in time domain. (PO-1,2,3 & PSO-1)
3. Analyze the stability of a given system using different stability assessment techniques. (PO-1,2,6 & PSO-1)
4. Assess the various factors involved with the time and frequency domain approaches and to use BODE plot based approach to conclude on the stability of a given system (PO-1,2,6 & PSO-1)
5. Apply polar plot and Nyquist criterion techniques for system stability analysis and to model a given system in state space thereby solving the state space equation. (PO-1,2,6 & PSO-1)

INTELLECTUAL PROPERTY RIGHTS & MEDICAL ETHICS

Course code:ML55 **Credits: 2:0:0:0**
Prerequisite: Nil **Contact hours: 28**
Course Coordinator(s): Dr.N.Sriraam, Mrs.Prabha Ravi

Course contents:

Unit- I

Basic principles of IPR laws: Introduction, History of IPR-GATT,WTO,WIPO & TRIPs ,Role of IPR in Research & Development & Knowledge era ,Concept of property, Marx's theory of property, Constitutional Aspects of Intellectual property ,Different forms of IPR – Overview, copyright, trademarks, Industrial Designs, Layout designs of Integrated circuits, Patents, Geographical Indications, Traditional Knowledge, Plant varieties, Trade secrets

Unit -II

Understanding Copyright & Trademarks Law: Evolution of copy right law in India, Subject matter of copyright, Terms of protections, Concepts-originality/Novelty idea expression, Fixation & fair Use, Copyrights in software protection, Justifications, Infringement of copyright and acquisition in Indian contexts, Case studies ,TRADE MARK-Introduction, Justification, Concepts of subject matter acquisition, Implication and benefits of registration terms of protection of Geographical indication of goods ,Infringements of trademarks, Case studies

Unit -III

Patent: Basic principles of patent laws, Historical background, Basis for IP protection ,Criteria for patentability, Novelty, Utility and Inventive step, Non obviousness, Non Patentable inventions, Searching: Prior art, tangible Vs intangible prior art, search strategy, Pre-grant and post-grant oppositions, grant or refusal of patents, Request for reexamination and revocation, terms of patents and patent renewal, Infringement and prosecution in India, US and other countries , Cost of getting and maintaining patens in India, US and other countries., Importance of patent search in research., Case Studies

Unit -IV

Patent Drafting: Format, Provisional & Complete specifications, Scopes of inventions, description of invention, drawings, claims, Filing requirements: Forms to be sent, Comparison of Patentability in different countries, Filing mechanism-through individual patent office, PCT route & claiming priority from either route, Examples
Industrial Designs: Introduction, Justification, Subject matter of design law definition, Infringement of design rights
Semiconductor & IC Layout Designs: Introduction and history , Semiconductor topography design rights. Infringement, Case studies

Unit -V

Biomedical Ethics: Theory, principles, rules and moral decisions, Belmont report, the principles of biomedical ethics, respect for autonomy, voluntariness, information & informed consent, competency, nonmaleficence, the rule of double effect, beneficence, paternalism, justice, examples.

Text Books:

1. Dr. T Ramakrishna -Basic principles and acquisition of Intellectual Property Rights, CIPRA, NSLIU -2005.
2. Dr.B.L.Wadhera -Intellectual Property Law Handbook, Universal Law Publishing Co. Ltd.. 2002.

Reference Books:

1. Dr. T Ramakrishna -Ownership and Enforcement of Intellectual Property Rights, CIPRA, NSLIU -2005.
2. Intellectual Property Law (Bare Act with short comments) - Universal Law Publishing Co. Ltd.. 2007.
3. The Trade marks Act 1999 (Bare Act with short comments) - Universal Law Publishing Co. Ltd.. 2005.
4. The Patents Act, 1970 (Bare Act with short comments) - as amended by Patents (Amendment) Rules 2006 w.e.f. 5-5-2006. Commercial law publishers (India) Pvt. Ltd., 2006.
5. Thomas T Gordon and Arthur S Cookfair -Patent Fundamentals for Scientist and Engineers, CRC Press 1995.
6. PrabuddhaGanguli -Intellectual Property Rights, TMH Publishing Co. Ltd..2001
7. 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. Provide a holistic approach to the understanding of the national and international IPR and ethics for biomedical engineers in hospitals.(PO-6,8 & PSO-2)
2. Emphasize on the impact of IP laws and ethics in a sustainable economical and social environment.(PO- 7, & PSO3)
3. Illustrate the various legal rules and infringements of different types of IPs. (PO- 10 & PSO-3)
4. Highlight the importance of generating and protecting the IP. (PO-6,11 & PSO-2)
5. Appraise the IP related issues in academic and professional environment. (PO-9,12 & PSO-3)

INTRODUCTION TO MOBILE APP DEVELOPMENT

Course code:MLE11 **Credits: 0:2:1:0**
Pre-requisite: Nil **Contact hours: 56+28**
Course Coordinator(s): Mr. S J Mahendra, Dr. Basavaraj V Hiremath

Course contents:

UNIT- I

Mobile application development in healthcare
Introduction to mobile applications in healthcare, Characteristics and Benefits, Application Model, Infrastructure and Managing Resources, Mobile Software Engineering, Frameworks and Tools, Mobile devices Profiles, Basic mobile based applications in healthcare industry

UNIT -II

Basic healthcareoriented user interfaces
Generic UI Development, VUIs and Mobile Applications in healthcare, Text to Speech techniques, Designing the right UI, Multimodal and Multichannel UI, Gesture based UIs, Screen Elements and Layouts, Voice XML, Java API, Basic user interfaces for healthcare applications

UNIT- III

Design aspects for healthcare
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, Basic mobile applications in hospitals and their design aspects

UNIT- IV

Mobile applications for hospitals
Intents and Services, Storing and Retrieving medical data, Communication via the Web, Notification and Alarms, Graphics and Multimedia, Telephony, Location based services, Packaging and Deployment, Security and Hacking, examples in healthcare

UNIT-V

Tools used for mobile application development
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, Examples in healthcare

Reference Books:

1. ZigurdMednieks, 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 will be able to

1. Enumerate the development aspects of mobile based applications in healthcare. (PO-1,6,7 &PSO-2)
2. Assess the basic interfaces existing for healthcare applications (PO-1,6,7 & PSO-2)
3. Elaborate on the design aspects of healthcare based applications (PO-1,3 & PSO-2)
4. Ascent the various types of mobile based applications in hospitals(PO-1,6,7 & PSO-2)
5. Analyze the basic aspects of tools useful in mobile application development in healthcare (PO-1,3,7 &PSO-2,3)

VIRTUAL INSTRUMENTATION

Course code: MLE12 **Credits: 0:2:1:0**
Pre-requisite: Nil **Contact hours: 56+28**
Course Coordinator(s): Mrs.Purnima B R, Mrs.Tejaswini.S

Course contents:

Unit-I

GRAPHICAL SYSTEM DESIGN: Graphical system design (GSD) model, design flow with GSD, virtual instrumentation. virtual instrument and traditional instrument, hardware and software in virtual instrumentation, virtual instrumentation for test, control and design, virtual instrumentation in the engineering process, virtual instruments beyond personal computer, graphical system design using lab VIEW.
INTRODUCTION TO Lab VIEW: Software environment, block diagram. Data types, data flow program, lab VIEW documentation resources, modular programming.

UNIT- II

REPETITION AND LOOPS: For loops, while loops, structure tunnels, terminals inside or outside loops, shift registers, feed-back nodes, control timing, communicating among multiple-loops, local variables, Global variables, case structure, formula node.

UNIT- III

ARRAYS: Introduction, arrays in LABVIEW, creating one - dimensional array controls, indicators and constants. creating two dimensional arrays, creating multidimensional arrays, initializing array, deleting, inserting, and replacing elements, rows, columns, and pages with in arrays, arrays functions, auto indexing, creating 2-dimensional array using loops, identification of data structure (scalar and arrays) using wire, using auto-indexing to set the FOR loop count matrix operation with arrays, polymorphism.

UNIT- IV

Clusters: Creating Cluster Controls and Indicators, Creating Cluster Constant, Order Of Cluster Elements, Cluster Operations, Assembling Clusters, Disassembling Clusters, Conversion Between Arrays And Clusters, Error Handling, Error Cluster
FILE INPUT/ OUTPUT: File formats, fill I/O functions, path function sample VI's to demonstrate file write & read, generating filenames automatically, String handling: string functions, LABVIEW string formats, examples, parsing of strings.

UNIT -V

PLOTTING DATA: Types of waveforms, waveform graphs, waveform charts, XY graphs, Intensity graphs & charts, Digital waveform graphs, 3D graphs, customizing graphs & charts, configuring a graph or chart, Displaying special planners on the XY graph.
DATA ACQUISITION: Introduction, transducers, signals, signal conditioning. DAQ hardware configuration, DAQ hardware, analog inputs analog outputs

Text Books

1. Jovitha Jerome , 'Virtual Instrumentation using LabVIEW', PHI learning PVT limited LabVIEW

References

1. Jeffrey Travis, Jim Kring, 'Graphical Programming Made Easy and Fun',3rdEdition,Prentice Hall.

Course outcomes (COs):

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

1. Ascent the basics of digital instruments used for various applications (PO-1,3 &PSO-1)
2. Relate the basics of instrumentation to Virtual instrumentation based Approaches. (PO-1,3 & PSO-1)
3. Interpret the functional aspects of the instruments present in VI system (PO-3,5,6 & PSO-1)
4. Comprehend the graphical aspects of VI systems for the design of various instruments
5. (PO-5,6,12 &PSO-1,2)
6. Analyze the various tools existing in VI and to build simple applications in VI (PO-5,12 & PSO-2)

INTERNET OF THINGS-HEALTHCARE

Course code:MLE13 **Credits: 0:2:1:0**
Pre-requisite: Nil **Contact hours: 56+28**
Course Coordinator(s): Mrs.Prabhu Ravikala Vittal, Mrs.Uma Arun

Course contents:

UNIT- I

IOT: An Introduction

Introduction to Embedded Systems-an overview, features. Networked Embedded System-types and overview, wireless communication standards-zigbee, Bluetooth & Wi-Fi. OSI & TCP/IP model in a nutshell. Introduction to the Internet and understand how internet works.
Introduction to Smart Objects or Things.
IOT- understand what IOT is and discuss its application in health-care systems- Patient Monitoring & diagnostics, Home healthcare & Personal care & Fitness.

UNIT- II

IOT Hardware Platform& Sensor Interface: Introduction to CC3100 Wi-Fi Booster Pack: overview & features. Introduction to CC3100 SDK: understand the important APIs. Getting Started with Energia Wi-Fi libraries.Sensorinterface: Temperature sensor, pressure sensor, Light sensor, IR sensor.

UNIT -III

Client-Server Communication Paradigm

Basic Client-Server communication model, Network Sockets, Ports, and Examples of client server communication, Energia client & server class APIs.

UNIT- IV

Embedded Web-Server & IOT Cloud Services

Embedded web server: Basic introduction, its importance and role in IOT. Design of a simple embedded web server: understand the HTTP & HTML basics
Overview of different IOT Cloud Services.

UNIT- V

Application Design & Case Study

Case Study1: Wireless Patient Monitor system
Case Study2: Wearable Fitness & Activity Monitor
Application Design: Design of IOT based pulse oximeter, block diagram, concepts of analog front end, signal process and Wi-Fi integration.

Reference Books:

1. — Getting Started with Internet of Things- CunoPfister, 2011
2. — Interconnecting Smart Objects with IP- J. P Vasseur, Adam Dunkels, 2010

Course outcomes (COs):

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

1. Ascent the basic concepts of IOT in healthcare (PO-1,6,7 & PSO-2,3)
2. Relate the existing hardware platforms and sensor interfaces for various healthcare based Applications (PO-1,5,6,7 &PSO-2,3)
3. Comprehend the ways of communication between the client and the server in IOT (PO-1,3,10 & PSO-2)
4. Enumerate the various services available in IOT (PO-1,3,12 &,PSO-1)
5. Build various applications in healthcare using IOT based approach and substantiate the same with appropriate case studies (PO-1,3,10,12 &PSO-2,3)

SENSORS AND MEASUREMENTS LAB

Course code: MLL56 **Credits: 0:0:1:0**
Prerequisite: Nil **Contact hours: 28**
Course Coordinator(s): Prof. P G Kumaravelu, Mrs.Chandana S

Course contents:

1. Introduction to the sensors and measurements in biomedical engineering.
2. Measurement of change in temperature using thermocouple, thermistor and RTDs.
3. Measurement of weight with the aid of resistive transducer in strain gauge.
4. Measurement of change in displacement with the aid of LVDT.
5. Measurement of change in force with the aid of flex sensor.
6. Measurement of the presence of ethanol using alcohol sensor.
7. Measurement of moisture content in soil using soil moisture sensor module.
8. Measurement of optical variables with the aid of photo diodes and photo transistors.
9. Measurement of environmental parameters like Air pollution. altitude and atmospheric pressure using pollution meter and barometric pressure sensor.
10. Measurement of mean arterial blood pressure, pulse rate and saturated oxygen.

Text Books:

1. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – John Wiley and sons, 3 rd. Edition,2008.
2. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques", 1st Edition, Prentice Hall of India, 2007.

References:

1. Ernest o Doebelin and dhanesh N manik, Measurement systems, Application and design ,5th edition ,McGraw-Hill, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 1st Edition, New Delhi, 2007.
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, 2ndEditionNew Delhi, 2007.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 3rd Edition New York, 2004

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 (PO-1,2,4&PSO-1)
2. Accent the determination of characteristics of sensors used to measure various variables (PO-3,12 &PSO-1,3)
3. Illustrate the usage of various sensors for signal acquisition. (PO-9,12 & PSO-1,3)

DIGITAL IMAGE PROCESSING LAB

Course code: MLL57 **Credits: 0:0:1:0**
Prerequisite: NIL **Contact hours: 28**
Course Coordinator(s): Dr. Basavaraj V Hiremath, Dr. C.K.Narayanappa

Course Contents:

1. Simulation and display of an image, negative of an image (Binary & Gray Scale)
2. Implementation of relationships between pixels.
3. Implementation of transformations of an image.
4. Morphological image processing-dilation and erosion & Duality property on Dilation and Erosion.
5. Morphological image processing-opening and closing & Duality property on opening and closing.
6. Application on dilation and erosion - Boundary Extraction, Hit or Miss transformation
7. Contrast stretching of a low contrast image,
8. Intensity slicing, power law transformations
9. Display of bit planes of an image.
10. Histogram, and histogram equalization.
11. Display of FFT (1-D & 2-D) of an image.
12. Implementation of image smoothening filters. (Low pass and Median filters)
13. Implementation of image sharpening filters. (High pass and derivative filters)
14. Implementation of image restoring techniques.

Note: The above experiments are to be conducted Using MATLAB/SCI lab

Text Book(s):

1. R C Gonzalez & R E Woods, Digital Image Processing, Pearson Education,3e, 2008

Reference Book(s):

1. A K Jain, Fundamentals of Digital Image processing, PHI / Pearson Education, 1st edition, 2011
2. Chanda and Majumder, Digital Image Processing and Analysis,PHI Learning Pvt. Ltd., 2004

Course outcomes (COs):

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

1. The students should be able to use the MATLAB-image processing tool box to
2. Implement the basic representation of a digital image and relationship between the pixels (PO-1,2,3,4, PSO-1)
3. Apply various morphological image processing operations (PO-1,2,3,4,5, PSO-1,2)
4. Apply the various image enhancement and restoration techniques to the given images (PO-1,2,3,4,5 PSO-1,2)

DIGITAL SIGNAL PROCESSING LAB

Course code: MLL58 **Credits: 0:0:1:0**
Prerequisites Signals & Systems **Contact hours: 28**
Course Coordinator(s): Mrs. Purnima B R, Dr.Sanjay H.S

Course contents:

1. Generation of Signals
2. Operations on Signals: Time Scaling,Amplitude Scaling,Shifting
3. Operations on Signals: Circular folding, Circular Shifting
4. Operations on signals:Linear Convolution,Circular Convolution
5. To find discrete Fourier Transform
6. To verify properties of DFT: linearity property, Circular convolution, Multiplication in time domain
7. To verify properties of DFT: Complex conjugate property of DFT, Parseval's theorem,Circular folding
8. To verify properties of DFT: Time shifting and frequency shifting
9. Design of IIR Butterworth filters
10. Design of IIR Chebyshev filters
11. Design of digital IIR butter worth filter using bilinear transformation.
12. Design of digitalIIR Butterworth filters using Bilinear transformation and Impulse invariance techniques
13. To design FIR filters using windowing Technique
14. To Implement A FIR LPF Using Frequency Sampling.

Course outcomes (COs):

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

1. Realize the importance of MATLAB as a potential tool for signal processing applications. (PO-1,2,3,4,5 &, PSO-1)
2. Interpret the basic signal processing concepts for a better understanding of the same. (PO-1,2,3,4,5& PSO-1,2)
3. Design various filters for signal processing using MATLAB. (PO-1,2,3,4,5 & PSO-1,2)

VI Semester

BIOMEDICAL INSTRUMENTATION	
Course code:ML61	**Credits: 3:0:0:1**
Prerequisite: Nil	**Contact hours: 42**
Course Coordinator(s): Dr.Sanjay H S, Mrs. Purnima B R	

Course contents:

UNIT -I

Introduction to Biomedical Instrumentation: Introduction, generalized instrumentation system, alternate operating modes, measurement constraints, classification of biomedical instruments, interfering and modifying inputs, compensation techniques, static and dynamic characteristics, design criteria

Self study: biostatistics, commercial development process, regulations.

UNIT -II

Origin of bioelectric potentials: Electrical activity of the excitable cells, volume conductor fields, functional organization of peripheral nervous system, electroneurogram, electromyogram, electrocardiogram, electroretinogram, electroencephalogram

Self study: Magneto encephalogram.

UNIT -III

Biopotential Electrodes: Electrode-electrolyte interface, polarization, polarisable and non-polarizable electrodes, electrode behaviour and circuit models, electrode-skin interface, motion artifacts, body surface recording electrodes, internal electrodes, electrode arrays, microelectrodes, electrodes for electric stimulation of tissues

Self study: practical aspects involved

UNIT-IV

Biopotential amplifiers: basic requirements, electrocardiograph, problems encountered, transient protection, interference reduction circuits, amplifiers for biopotential signals – design and working, biopotential signal processors, cardiac monitors

Self study: biotelemetry

UNIT-V

Electrical safety: physiological effects of electricity, important susceptibility parameters, distribution of electric power, macroshock and microshock, electrical safety codes and standards, protection against shock, power distribution, equipment design, electrical safety analyzers,

Self study: testing the electric system and appliances

Text Books

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications

Reference Books

1. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications
2. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

Course Outcomes (COs):

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

1. Accent the basics of biomedical instruments used to acquire bioelectric signals from human beings (PO-1,2,3,12 &PSO-1,3)
2. Comprehend the origin of bioelectric potentials in the human body (PO-2,3 &PSO-1)
3. Interpret the importance of biopotential electrodes & amplifier in the process of signal acquisition (PO-1,4 &PSO-1)
4. Recognize and realize the need for the usage of biopotential amplifiers in biomedical instruments and applications (PO-3,4 &PSO-1)
5. Analyze the safety aspects involved with regard to medical instruments (PO-2,3 & PSO-1)

MEDICAL IMAGE PROCESSING

Course code:ML62 **Credits: 4:0:0:0**
Prerequisite: Digital image Processing **Contact hours: 56**
Course Coordinator(s): Dr.Basavaraj V Hiremath, Dr .C. K. Narayanappa

Course contents:

UNIT - I

Introduction: Nature of Biomedical images and importance of biomedical image analysis. Image quality – difficulties in image acquisition, analysis, characterization of image quality, digitization of images, dynamic range, contrast, histogram, blur and spread functions, resolution, signal-to-noise ratio, image sharpness. Characterization of artifacts and its removal, synchronized or multiframe averaging, spatial domain and frequency domain filters, optimal and adaptive filtering, Application: Nuclear medicine.

UNIT – II

Image enhancement: Temporal subtraction, gray-scale transforms, histogram transforms, convolution mask operators, high frequency emphasis, homomorphic filtering for enhancement, adaptive contrast enhancement. Applications: Contrast enhancement of Mammograms.

UNIT - III

Image segmentation: Fundamentals, detection of isolated points, lines and edge detection, thresholding, segmentation: region growing, splitting, merging, graph cuts, morphological watersheds, detection of objects of known geometry. Application: Detection of the breast boundary in mammograms. Shape analysis: shapes and contours, shape factors. Application Shape analysis of Breast Masses and tumors

UNIT - IV

Image registration: Spatial and time series, nature of registration – extrinsic (invasive and non-invasive) and intrinsic (landmark, segmentation and voxel property). Image transformation: Nature of transformations – rigid, affine, projective and curved, domain of transformation – local and global, interaction – interactive, semi-automatic and automatic.Image fusion – Types: multi-view fusion, multi-modal fusion, multi-temporal fusion, multi-focus fusion, Classifications: pixel level, feature level and decision level fusion.Application : Digital subtraction angiography

UNIT - V

Feature extraction: boundary pre-processing, boundary and feature descriptors, region feature descriptors, principal components as descriptors, scale-invariant feature transform (SIFT). Patternrecognition: Patterns and pattern classes, recognition based on decision theoretic methods, structural methods.

Text Books:

1. R C Gonzalez & R E Woods, Digital Image Processing , Pearson Education,3e, 2008
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC Press,2004

Reference Books:

1. A K Jain, 'Fundamentals of Digital Image processing , PHI / Pearson Education, 1st edition, 2011
2. Chanda and Majumder, Digital Image Processing and Analysis, PHI Learning Pvt. Ltd., 2004
3. Wolfgang Birkfellner, Applied Medical Image Processing: A Basic Course, 2010
4. Taylor & Francis, Richard A. Robb "Biomedical Imaging, Visualization, and Analysis", John Wiley & Sons, 1999.

Course outcomes (COs):

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. (PO-1,2,3, 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 descriptors used in feature extraction of images. (PO-1,2,3 PSO-1,2)

BIO MEDICAL SIGNAL PROCESSING

Course code:ML63 **Credits: 3:1:0:0**
Prerequisite: Nil **Contact hours: 42+28**
Course Coordinator(s): Dr. N.Sriraam, Mrs. Purnima B R

Course content:

UNIT -I

Nature of Biomedical Signals &Analysis of Non Stationary signals: The nature of Biomedical Signals, examples of biomedical signals (ECG, EEG,EMG, PCG), objectives of Signal analysis, Difficulties in signal analysis, computer aided diagnosis, Concurrent, coupled and correlated process: illustration of problem with case studies

UNIT -II

Filtering for noise & artifact removal: Physiological interference, noise, Correlation and Covariance, Sampling Theory, Illustration of noiseremoval with case studies, time and frequency domain filtering, homomorphic filtering, Problems

UNIT -III

Event Detection: Detection of events & waves-Derivative Based methods for QRS detection, Pan–Tompkins algorithm for QRS detection, Detection of Dicrotic notch, Correlation Analysis of EEG channels.
Data Reduction techniques-Turning point algorithm, Huffman Coding, problems

UNIT –IV

Wave shape and Waveform Complexity: Analysis of event related potentials, morphological analysis of ECG waves, envelope extraction and analysis, analysis of activity.
Frequency domain Characterization: Estimation of power spectral density function, Measures derived from PSD's, problems.

UNIT V

Advanced Signal processing techniques: Optimal Signal Processing: Wiener Filters, Adaptive Signal Processing, Adaptive Noise Cancellation.
Modeling of Biomedical Systems: Parametric system modeling, Autoregressive or All-Pole modeling, Pole-Zero Modeling.

Text Books:

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis" –, IEEE Press, 2001
2. Biomedical Digital Signal Processing – Willis J Tomkins, PHI,1993.

Reference Book:

1. Biosignal& Biomedical Image Processing – John L Semmlow, Dekker Media Publishing, 2004

Course outcomes (COs):

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

1. Demonstrate an understanding of biomedical signals and identify the need for biomedical signal analysis. (PO-1,2,3,12 & PSO-1,3)
2. Identify physiological interferences and artifacts affecting the biomedical signals and apply various filtering mechanisms for the enhancement of signals. (PO-2,3,10, & PSO-1)
3. Detect various events involved in EEG & ECG signals and apply data reduction techniques. (PO-1,2,12 & PSO-1,3)
4. Analysis of biomedical signal in time and frequency domain. (PO-1,3,10 & PSO-1)
5. Apply advanced signal processing and modeling techniques for the analysis of biomedical signals.(PO-2,4,10 & PSO-1)

EMBEDDED REAL TIME SYSTEMS

Course code:MLE211 **Credits: 3:0:0:1**
Prerequisite: Digital Design, Microcontrollers **Contact hours: 42**
Course coordinator(s): Mrs. Prabhu Ravikala Vittal, Dr. Basavaraj V Hiremath

Course contents:

UNIT-I

Introduction to Embedded Systems:– Model of an Embedded System, Microprocessor vs. Microcontroller, Example: A simple temperature monitor, Classification of MCUs, Current Trends. MCU:- The processor, The Harvard Architecture, GPIO, Power on Reset, Brown Out Reset, Watch Dog Timer, Real Time Clock, Memory Types, Low Power Design.
Self study: Application of Embedded system in various fields

UNIT- II

Elementary ideas of Sensors, ADCs, Actuators. Buses and Protocols:- Elementary ideas of Parallel, I2C, SPI, USB, IEEE 1394, RS-232, RS-422/RS-485, Ethernet, CAN, WLAN, ZigBee, Bluetooth.
Self study: Interfacing the Embedded system with sensors using serial communication protocols.

UNIT- III

Operating system concepts:Embedded operating system, layers of operating systems, History of operating systems, functions performed by operating systems, terms associated with OS & computer usage, The kernel, Tasks/processes, Scheduling algorithms, Treads.
Self study: Semaphores and Shared Data

UNIT- IV

Interrupt handling, inter process (task) communication (IPC), task synchronization, semaphores, priority inversions, device drivers, codes/pseudo codes for OS function.
Real time operating system: Real time tasks, Real time systems, Types of real time tasks, Real time operating systems, rate monotonic algorithm, The earliest deadline first algorithm.
Self study: Multiprocessing and Multitasking

UNIT - V

Embedded Program Development, Integrated Development Environment, Compiler, Assembler, Builder, Disassembly, Linker, Simulator, Downloading the Hex file,
Hardware Simulator. Hardware Software Co-Design, Embedded Product Development Lifecycle Management, Testing.
Self study: Embedded System Examples:- Mobile Phone, Automotive Electronics, RFID, WISENET, Robotics, Biomedical Applications, BMI.

Text Book:

1. Lyla B Das; Embedded Systems: An Integrated Approach, Pearson Education, 2013

Reference Books:

1. Marilyn Wolf; Computers as Components: Principles of Embedded Computing System Design, 3e, Morgan Kaufmann, 2012
2. Peter Barry, Patrick Crowley; Modern Embedded Computing, 1e, Morgan Kaufmann, 2012,
3. Lori M. Matassa, Max Domeika; Break Away with Intel Atom Processors – A Guide to Architecture Migration, 1e, Intel Press, 2010
4. Shibu K V; Introduction to Embedded Systems, 1e, MGH, 2009

Course outcomes (COs):

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

1. Discuss the various components used to build the embedded system for real time application (PO-1& PSO-1)
2. Describe the standards and concepts of serial communication devices for embedded application. (PO-1&PSO-1)
3. Discuss the concepts of Operating system for real time application (PO-1 &PSO-1)
4. Describe the concepts of real time operating system requirement and scheduling the task. (PO-1&PSO-1)
5. Discuss the various tools and softwares used for real time embedded applications. (PO-1&PSO-1)

LINEAR ALGEBRA

Course code: MLE212 **Credits: 3:0:0:1**
Pre requisite: NIL **Contact hours: 42**
Course Coordinator(s): Dr.Narayanappa.C.K, Dr.Basavaraj V Hiremath

Course contents:

UNIT-I

Introduction to Linear Equations and Matrices. Introduction to Linear Systems and Matrices. Gaussian Elimination. The Algebra of Matrices: Four Descriptions of the Product. Inverses and Elementary Matrices. Gaussian Elimination as a Matrix Factorization. Transposes, Symmetry, and Band Matrices: An Application. Numerical and Programming Considerations: Partial Pivoting,
Self Study: Overwriting Matrices, and Ill-Conditioned Systems. Review Exercises.

UNIT-II

Determinants. The Determinant Function. Properties of Determinants. Finding det A Using Signed Elementary Products. Cofactor Expansion: Cramer's Rule. Applications. Review Exercises.
Self Study: Applications

UNIT-III

Vector Spaces. Vectors in 2- and 3-Spaces.Euclidean n-Space. General Vector Spaces. Subspaces, Span, Null Spaces. Linear Independence. Basis and Dimension. The Fundamental Subspaces of a Matrix; Rank. Coordinates and Change of Basis. An Application.
Self Study: Error-Correcting Codes. Cumulative Review Exercises.

UNIT-IV

Linear Transformations, Orthogonal Projections and Least Squares. Matrices as Linear Transformation. Relationships Involving Inner Products. Least Squares and Orthogonal Projections. Orthogonal Bases and the Gram-Schmidt Process. Orthogonal Matrices, QR Decompositions, and Least Squares (Revisited). Encoding the QR Decompositions: A Geometric Approach. General Matrices of Linear of Linear
Self Study: Transformations; Similarity. Review Exercises. Cumulative Review Exercises.

UNIT-V

Eigenvectors and Eigen values. A Brief Introduction to Determinants. Eigen values and Eigenvectors. Diagonalization. Symmetric Matrices. An Application - Difference Equations: Fibonacci Sequences and Markov Processes. An Application -Differential Equations. An Application -- Quadratic Forms. Solving the Eigen value Problem Numerically. Review Exercises.
Self Study: Eigen value Cumulative Review Exercises.

Text Book:

1. Elementary Linear Algebra, Richard O Hill, .Jr. , Academic Press Inc.,1996

Reference Book:

1. Linear Algebra and Its Applications - Gilbert Strang, Cengage Learning, 2006,4e

Course outcomes (COs):

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

1. Assess the importance of linear algebra for basic applications in engineering (PO-1,2 &PSO-1)
2. Ascent the usage of determinants for various applications (PO-1,2 & PSO-1)
3. Interpret the vector spaces and their ability to resolve mathematical problems (PO-1,2 & PSO-1)
4. Reminisce the various transformation techniques in linear algebra (PO-1,2,3 &PSO-1)
5. Extend the vector space concepts to eigen vector and related applications and obtain solutions using the same for various problems (PO-1,2,3 & PSO-1)

ARM PROCESSORS

Course code: MLE213 **Credits: 3:0:0:1**
Pre requisite: NIL **Contact hours: 42**
Course Coordinator(s): Dr.Basavaraj V Hiremath, Mrs.Uma Arun

Course contents:

UNIT -I

ARM embedded systems: The RISC design philosophy, The ARM design philosophy, embedded system hardware, embedded system software. ARM Architecture.

ARM processor fundamentals: Registers, current program status register, pipeline, exceptions, interrupts and vector table, core extensions, Architecture revisions.
Self study - ARM processor families

UNIT -II

Introduction to ARM instruction Set: Data Processing Instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions.
Self study - Conditional Execution

UNIT -III

Introduction to the THUMB Instruction set: Thumb register Usage, ARM-Thumb Interworking, other branch instructions, Data Processing Instructions, Single register Load – store Instructions, Multiple register Load Store Instructions, Stack Instructions.
Self study - Software Interrupt Instruction

UNIT -IV

Interrupts & Exception Handling: Exception Handling**,** Interrupts.
Self study - Interrupt handling schemes

UNIT -V

LPC 2148-Design of system using GPIO's (LCD interface, 4 x 4 Keypad), Timers, ADC, DAC.
Self study– UART

Text Books

1) "Andrew N.Sloss", ARM system Developers Guide,Elsevier,2008
2) "William Hohl", ARM Assembly Language – Fundamentals and Techniques ,CRC Press,2009
3) "J.R.Gibson", ARM Assembly language An Introduction,CENGAGE Learning,2010

Course outcomes (COs):

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

1. Ascent ARM design philosophy, design rules and the functions of ARM embedded hardware and software components. (PO-1,2 &PSO-1)
2. Implement and debug ARM assembly level programs using Keilsoftware. (PO-1,2,3 &v PSO-1)
3. Implement and analyze ARM / THUMB assembly level programs using Keil software. (PO-1,2,3 &PSO-1)
4. Write programs to handle exceptions and interrupts in ARM processor. (PO-2 & PSO-1)
5. Develop embedded C programs to interact with Built in Peripherals (GPIO's, DAC, ADC, Timer/Counter, and UART) of ARM7 LPC 2418. (PO-1,2 &PSO-1)

BIOMATERIALS & BIO MECHANICS

Course code: MLE221 **Credits: 3:0:0:1**
Prerequisite: Nil **Contact hours: 42**
Course Coordinator(s): Dr.Sanjay H S, Mrs.Tejaswini.S

Course content:

UNIT – I

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

UNIT – II

Tissue replacements: Hard tissue replacements: Bone repair & joint implants, Dental Implants, Soft tissue replacements: Blood interfacing implants
Self Study: 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,
Self Study: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,
Self Study: 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,
Self Study: 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,1976Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill publications, 2007 edition
2. Arthur T Johnson, "Biomechanics & exercise physiology", John Wiley & Sons publications, Dhanjoo N Ghista, "Applied Biomedical Engineering Mechanics", CRC Press, 2008 edition
3. Anthony Blazevich, "Sports Biomechanics – Optimizing human performance", A & C Black Publications, 2007 edition
4. Donald R Peterson, Joseph D Bronzino, "Biomechanics-Principles & Applications", CRC press, 2008 edition

Course outcomes (CO):
At the end of the course, students will be able to

1. Ascent the characteristics of different materials that can be used as substitutes for failed organs in human beings. (PO-1,2,3,12 & PSO-1,3)
2. Assess the possibility of tissue& organ replacement based applications in healthcare. (PO-2,3 &PSO-1)
3. Interpret the mechanical concepts related to fluid flow and extend the same for the development of artificial heart and circulatory devices in human beings. (PO-2,3 &PSO-1)
4. Connect the basic mechanical concepts to analyze the functionality of a human body from a mechanical perspective. (PO-1,4 &PSO-1)
5. Extend the biomechanical aspects to illustrate the aerodynamics and hydrodynamics of the human body. (PO-2,3 &PSO-1)

BIO SENSORS

Cours code: MLE222 **Credits: 3:0:0:1**
Prerequisite: Nil **Contact hours: 42**
Course Coordinator: Mrs.Prabha Ravi, Mrs.Tejaswini.S

Course Contents:

UNIT – I

Introduction: Historical Breakthroughs in Medical Sensing Science, Plethysmography, Blood Pressure Measurements, Electrophysiology and Einthoven's Galvanometer, Electrocardiogram, Electroencephalogram, Electromyogram, Microelectrodes and Intracellular Measurements, Pulse Oximetry, Body Temperature Measurement, MEMS and BioMEMS Sensors, Cell-Based Biosensors, Optical Biopsies

Biosensors for Monitoring Glucose: Introduction, Diabetes and the Need for Glucose Monitoring, Monitoring Principles: Transducers Monitoring, Principles: Enzymes, Manufacturing Issues, First Generation Amperometric Glucose Biosensors, Catalytic Transducers, Mediated Devices**,** Currently-Available Home Blood Glucose Monitors, Currently-Available Laboratory Analyzers for Monitoring Glucose*,* Direct Electron Transfer Systems,

Self Study: Implantable Glucose Sensors, Minimally-Invasive Systems, Non-Invasive Systems

UNIT – II

Optical Sensors in Medical Care:

Optics in Medicine, The Diagnostic/Therapeutic Window, Propagation of Light in Tissue, Transport Theory, Diffusion Theory and Monte Carlo Models, Near IR Spectroscopy, Scattering, Spectroscopy, Fick's Law Applied to Brain Blood Flow, Practical Details, NIRS Instrumentation, Pulse Oximetry, Clinical Use, Laser Doppler Flowmetry, Light Scattering and Doppler Shift of Laser Light Elastic and Quasi-Elastic Scattering Doppler Shift, Instrumentation Fiber Optics Geometry and Fiber Types, Signal Processing Principles, Calibration and Standardization of LDF Flow Meters,

Self Study: Applications of the Laser Doppler Principle, Conclusions, Advantages, Disadvantages

UNIT – III

Sensors for Respiratory Monitoring: Physiological and Clinical Relevance, Sensors Based on Respiratory Airflow Detection, Pressure and Acoustic Sensing Devices, Thermal Flow Sensors, Humidity Sensors, Carbon Dioxide Sensing, Capnometry, Indirect Sensors of Respiration, Torso Devices, Strain Gauges, Respiratory Inductance Plethysmography, Magnetometry, Transthoracic Impedance, Plethysmography, Photoplethysmographic Sensors, Mattress Systems and Non-contact Devices, Invasive Sensors, Electrocardiographic Sensors, Electromyographic sensors, Pressure Sensors, Blood Gas Monitors,

Self Study: Transcutaneous pO_2/pCO_2 Electrodes, Pulse Oximeters, Limitations and Artifact Rejection

UNIT – IV

Body Motion Analysis*:* Introduction, Direct Measurement, Goniometry, Accelerometry, Gyroscope, Magnetic Tracking Methods, Clinometer, Velocity Measurement by Ultrasound, Footswitches, Non-contact (Optical) Measurements, Force Measurements, Force Plate, Stabilometers, Instrumented Shoe, Pressure-Distribution Monitor, Related Measurements,

Self Study: Electromyogram, Energy Consumption

UNIT - V

Home Health Care and Telecare: Introduction, Blood Pressure, Respiration, Blood Oxygenation, Body Temperature, Electrocardiogram, Heart Rate and Pulse Rate, Blood Components, Urine Components, Body Weight, Body Fat, Daily Activity, Sleep, Nutrition,

Self Study: Environmental Parameters, Conclusions

Text Books:

1. Sensor Applications, volume 3, "Sensors in Medicine and Healthcare", Oberg, T tagawa, F A Spelman, © 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany

Reference Book:

1. Handbook of Biosensors and Biochips (2 Volume set) By Robert S. Marks, Christopher R. Lowe, David C. Cullen, Howard H. Weetall, Wiley (2007)

Course outcomes (COs):

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

1. Understand the concept of sensors, constructional details and know the glucose monitoring of biosensors. (PO-1,12 &PSO-1)
2. Describe the concepts of optical sensors for medical care.(PO-1,12 &PSO-1)
3. Discuss the principles of sensors for respiratory monitoring.(PO-1,12 &PSO-1)
4. Describe the principle of working of body motion analysis. (PO-1,12 & PSO-1)
5. Interpret and analyze the various applications of Home healthcare. (PO-1,12 &PSO-2)

BIOSTATISTICS & RESEARCH METHODOLOGY

Course code: MLE223 **Credits: 3:0:0:1**
Prerequisite: Nil **Contact hours: 42**
Course Coordinator(s): Dr. N Sriraam , Dr. Sanjay H S

Course content:

UNIT-I

Statistical methods and Variables: Scope of Statistical Methods in Medicine, Role of Statistics in Clinical Medicine, Variables
Self Study: Role of Statistics in Preventive Medicine,

UNIT-II

Statistical Dispersion: Frequency Distribution, Measures of Central Tendency and Location
Self Study: Measures of Dispersion

UNIT- III

Probability and Sampling: Probability, Baye's' Theorem and its Applications, Probability Distributions
Self Study: Role of probability in Sampling.

UNIT-IV

Introduction to Research Methods: Introduction ,Research Question ,Literature Review ,Theoretical Framework or Model Research Protocol ,Formulation of Objectives and Research Hypothesis ,Population under Study ,Statistical Design Sample Size ,Methods of Data Collection,Methods of Dealing with Non-response
Self Study: Data Processing ,The Constraints

UNIT-V

Presentation of Data: Introduction, Basic Principles, Elements of a Table, Classifications, Presentation by Graphs and Diagrams, Time Comparison, Space and Attribute Comparisons, Analysis of Time Series,
Self Study: Special Diagrams for Clinical Research.

Text Book:

1. P. S. S. SundarRao, J. Richard, PHI Learning Pvt. Ltd. "Introduction To Biostatistics And Research Methods" Fifth Edition, 2012

Reference Books:

1. A. K. Sharma, "Text Book of Biostatistics I" Discovery Publishing House, 2005
2. C R Kothari, "Research Methodology- Methods and Techniques", New Age International, 2004

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 dispersionoriented 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. Ascent the basic concepts involved with research methods and approaches (PO-2,4,12 &PSO-1)
5. Present the acquired data in various forms so as to aid in the problem solving based approaches (PO-2,4,12 &PSO-1)

CORE JAVA PROGRAMMING

Course code: MLE231 **Credits: 3:0:0:1**
Prerequisite: Fundamentals of C Programming **Contact hours: 42**
Course coordinators: Mr. Mahendra S J, Dr. Basavaraj V 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, The 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.

Selfstudy: 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 isAlive( ) and join( ), Thread Priorities,Suspending, Resuming, and Stopping Threads.

Self study: Synchronization

UNIT-IV

String Handling, Event Handling: String Handling :The String Constructors, Special String Operations, Character Extraction, String Comparison, Searching and Modifying a String, StringBuffer 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 Collections Framework: Collections Overview, The Collection Interfaces, The Collection Classes: The Array List Class, Linked List Class, HashSet 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, 10th Edition, Tata McGraw Hill, 2017.

Reference Books:

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

Course Delivery: The course will be delivered through lectures, class room interaction, group discussion and exercises, lab sessions and mini project.

Course Learning Outcomes (COs):

At the end of the course, students will be able 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 & PS-O1)
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 &PSO-2)

INTRODUCTION TO CLOUD COMPUTING

Course code: MLE231 **Credits: 3:0:0:1**
Prerequisites: NIL **Contact hours: 42**
Course Coordinator(s): Dr.Sanjay H S, Mrs. Prabha Ravi

Course content:

Unit -I

Cloud computing – An insight: Introduction to cloud computing, cloud essentials, business & IT perspective, benefits & challenges, applications, business models and cloud adoption
Cloud models: Introduction, from collaboration to cloud, cloud models and architecture, value of cloud computing and infrastructure models, scaling a cloud infrastructure

Unit -II

Standards and security: Introduction, legal and regulatory issues, security challenges, cloud data security, network security, host security, database management, risk tolerance
Cloud licensing and major players: Introduction, cloud data centre, moving into cloud, issues in cloud computing, major players in cloud computing, eucalyptus, nimbus, open nebula, cloud-sim

Unit- III

Cloud services: Introduction to services, storage, database, information, process, application, management, platform, security, testing, integration, infrastructure
Software plus services: Introduction, mobile device integration, Microsoft online, intuit quick base, cast iron cloud, bungee connect, map reduce, google file system, Hadoop framework, HDFS

Unit -IV

Cloud management: Introduction and cloud ecosystem, business process management, stack, sourcing, analytics, asset management, resiliency, provisioning, governing, charging models, metering, billing
Virtualization for cloud: Introduction, pros and cons, architecture, virtual machine and types, virtualization in cluster / grid, network, types, machine monitor, desktop infrastructure

Unit -V

Cloud storage and disaster recovery: Introduction, storage providers, disaster recovery planning, disaster management
Applications of cloud computing: cloud comparing approaches, ANEKA - private and public cloud, resource provisioning, COMET CLOUD - architecture, autonomic behavior, applications, implementation

Text Book:

1. M N Rao, “Cloud Computing”, PHI learning private limited (2015 edition)

Reference Books:

1. Dan Marinescu, “Cloud Computing: Theory and Practice”, 1st edition, MK Publishers (2013 edition)
2. Anthony T. Velte, Toby J. Velete, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw Hill, (2010 edition)

Course outcomes (COs):

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

1. Reminisce the basics of cloud and cloud models. (PO-1,2 &PSO-1)
2. Accent the standards and security issues in cloud and cloud licensing approaches. (PO-3&PSO-1)
3. Quote the fundamentals of cloud and relate the same to the software plus services. (PO-1,12 &PSO-1)
4. Explore the techniques and approaches involved with management and virtualization of cloud. (PO-2,12 &PSO-1)
5. Conjoin the principles of cloud computing and cloud storage and expand the same to study the applications of cloud computing. (PO1-1,2,12 &PSO-3)

CLINICAL ENGINEERING

Course code: MLE233 **Credits: 3:0:0:1**
Prerequisites: NIL **Contact hours: 42**
Course Coordinator(s): Dr.N. Sriraam, Prof.P.G. Kumaravelu

Course content:

UNIT- I

Definition, role of clinical engineering within the hospital organization, major functions of a clinical engineering department, flowchart and model of a clinical engineering department, computerized maintenance and management system, clinical information systems,
Self Study: picture archiving and communication systems (PACS).

UNIT-II

Duties and responsibilities, clinical engineer as consultant, clinical engineer as investigator and expert witness.patient safety and clinical engineers, accident investigation, electromagnetic interference,
Self Study: WMTS interference issues.

UNIT-III

Technology evaluation, strategic technology planning, technology and alternatives, risks, hazards, and clinical efficacy, conceptual needs analysis, testing laboratory and engineering evaluation,
Self Study: technical specifications and other requirements.

UNIT-IV

Management engineering in health care, cost effectiveness and productivity, personnel management, medical technology assessment process, in-house clinical
Self Study: technical evaluations, planning strategies, quality.

UNIT-V

Medical technology management practices, health care strategic planning utilizing technology assessment, vendor and service management, medical device research and design, maintenance and repair of medical devices, medical device troubleshooting,
Self Study: safety standards and regulations.

Text Books:

1. Joseph Dyro B.S. Clinical Engineering Handbook, Elsevier Academic Press, 2004.

Reference Books:

1 Yadin David, Clinical Engineering, Principles and Applications in Engineering Series, CRC Press, 2003.
2 Michael Nowicki, The Financial Management of Hospitals and Healthcare Organizations, Blackwell Publishing Ltd, 2004.

Course outcomes (COs):

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

1. Understand the fundamentals of clinical engineering (PO- 1 &PSO-1)
2. Recognize the roles and responsibilities of clinical engineers. (PO-6&PSO-2)
3. Identify the needs of the hospital equipment's as well as to employ the necessary safety standards. (PO-4&PSO-1)
4. Formulate the strategic plans for technology assessment. (PO-2 &PSO-1)
5. Demonstrate the ethical and professionalism in their daily routine. (PO-12 &PSO-3)

BIOMEDICAL INSTRUMENTATION LAB

Course code: MLL65 **Credits: 0:0:1:0**
Prerequisite: Nil **Contact hours: 28**
Course Coordinator(s): Mrs.Prabhu Ravikala Vittal, Dr.Sanjay H S

Course contents:

1. Introduction to various biomedical instruments
2. Assessment of BMI based on selected anthropometric variables in human beings
3. Acquisition of biomedical signals using surface electrodes
4. Design of driven-right-leg system for ECG
5. Design of amplifiers for biomedical applications
6. Design of filters for biomedical applications
7. Development of integrator circuits for EMG based applications
8. Assessment of the functional aspects of electrical safety analyser

Text Books

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications

Reference Books

1. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications
2. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

Course outcomes (COs):

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

1. Accent the basics of biomedical instruments as well as the components of various biomedical instruments (PO-1,2,4 &PSO-1)
2. Comprehend the usage of hardware and simulation based approaches in biomedical instrumentation (PO-3,12 & PSO-1,3)
3. Analyze the results obtained using various Biomedical instruments. (PO-9,12 &PSO-1)

MEDICAL IMAGE PROCESSING LAB

Course code: MLL66 **Credits: 0:0:1:0**
Prerequisite: Digital Image Processing Lab **Contact hours: 28**
Course Coordinator(s): Dr.Basavaraj V Hiremath, Dr.C.K.Narayanappa

Course Contents:

1. Histogram processing and spectra in understanding the information content of medical images
2. Error measures using MSE and NMSE
3. Effect of blurring and noise on the error measure
4. 2-D Convolution
5. Homomorphic filtering
6. Image Segmentation using edge/ boundary detection
7. Image Segmentation using Binary/global Thresholding
8. Medical Image smoothing
9. Medical Image sharpening
10. Image Segmentation using region-oriented segmentation techniques
11. Geometric transformation
12. Basics of fusion Algorithm.
13. Boundary descriptor
14. Regional descriptor

Note: The above experiments are to be conducted Using MATLAB

Text Book:

1. R C Gonzalez & R E Woods, Digital Image Processing, Pearson Education,3e, 2008

Reference Books:

1. A K Jain, Fundamentals of Digital Image processing, PHI / Pearson Education, 1st edition, 2011
2. Chanda and Majumder, Digital Image Processing and Analysis, PHI Learning Pvt. Ltd., 2004

Course outcomes (COs):

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

1. Estimate various error measures for medical images. (PO-1,2,3,4,PSO1)
2. Apply various enhancement and segmentation techniques on medical images. (PO-1,2,3,4 PSO-1)
3. Demonstrate the image registration and description schemes (PO-1,2,4 PSO-1)

BIO MEDCIAL SIGNAL PROCESSING LAB

Course code: MLL67 **Credits: 0:0:1:0**
Prerequisites: NIL **Contact hours: 28**
Course Coordinator(s): Mrs.Purnima B R, Mrs.Prabha Ravi

Course content:

1. Verification of sampling theorem
2. To find signal to noise ratio to evaluate the noise levels in biomedical signals
3. To find the statistical parameters like covariance and correlation coefficient.
4. To perform ensemble averaging to reduce random noise when multiple observations are available.
5. To design notch filter comb filter to remove power line interference and its harmonics
6. To remove higher frequency noise by designing derivative based filters
7. To design filters to remove base line wandering
8. To perform QRS detection using derivative based filters and weighted squared averages
9. To perform QRS detection using PAN Tompkins algorithm
10. To analyze EEG signals using Correlation and coherence techniques
11. To detect the diacritic notch from a PPG signal.
12. To perform data reduction using Turning point algorithm
13. To derive parameters or measures from Fourier spectrum to characterize different spectral features contained therein

Text Book(s):

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis A case study approach by, John Wiley publications,2005.
2. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001

Reference(s):

1. Willis J.Tompkins, Biomedical Digital signal processing, Prentice Hall of India Pvt. Litd., 2000
2. DC Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2005
3. Vinay K Ingle & John G Proakis, “Digital Signal Processing – A Matlab based approach “, Cengage Learning, 2008 edition
4. V Udayashankara, “Modern Digital Signal Processing, PHI, 2012 edition

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 so as to
4. obtain a better understanding of the same (PO-9,12 & PSO-1)