RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

MEDICAL ELECTRONICS

VII & VIII 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 2018-2022

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 -2018-2022

VII SEMESTER

SI. No	Subject Code	Subject	Credits			
			L	T	P	Total
1.	ML71	Neural networks and Deep Learning	3	1	0	4
2.	ML72	Medical Imaging systems	4	0	0	4
3.	ML73	Management and Entrepreneurship	3	0	0	3
4.	MLE74X	Professional Elective-4	3	0	0	3
5.	MLE75X	Professional Elective –5	3	0	0	3
6.	MLL76	Application Lab	0	0	1	1
7.	MLL77	Hospital training	0	0	1	1
8.	MLSE78	Seminar	0	0	1	1
TOTAL			**16**	**01**	**03**	**20**

PROFESSIONAL ELECTIVE- 4

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLE741	Medical Device Regulations	3	0	0	3
2	MLE742	Computer Communication Networks	3	0	0	3
3	MLE743	Medical Device Design And Development	3	0	0	3
4	MLE744	Healthcare Interoperability	3	0	0	3
5	MLE745	Infrared Imaging and Applications	3	0	0	3

PROFESSIONAL ELECTIVE- 5

Sl. No.	Course Code	Course Name	Credits			
			L	T	P	Total
1	MLE751	Biomaterials and Biomechanics	3	0	0	3
2	MLE752	Pattern Recognition	3	0	0	3
3	MLE753	Smart Wearable Systems	3	0	0	3
4	MLE754	Introduction to Cloud Computing	3	0	0	3
5	MLE755	BioMEMS and Nano technology	3	0	0	3

VIII SEMESTER

SI. No	Subject Code	Subject	Credits			
			L	T	P	Total
1	MLIN 81	Internship	0	0	3	3
2	MLP82	Project Work	0	0	14	14
TOTAL			**00**	**00**	**17**	**17**

VII SEMESTER

NEURAL NETWORKS AND DEEP LEARNING

Course Code: ML71 **Course Credits: 3:1:0**
Prerequisite: Nil **Contact Hours: 42+28**
Course Coordinator(s): Dr. N Sriraam, Dr. Basavaraj Hiremath

Course contents

UNIT I

Overview of Neural networks: Elementary neurophysiology and biological neural network-Mcculloch Pitts neuron model

SIMPLE NEURAL NETS FOR PATTERN CLASSIFICATION: Linear Separability-Hebb net-perceptron

PATTERN ASSOCIATION: Training Algorithms for Pattern Association Heteroassociative Memory Neural Network, Auto associative Net

UNIT II

BACKPROPAGATION NEURAL NET: Backpropagation Architecture and Algorithm-Weight Update Procedures, Learning Rules- Training Deep Neural Networks

UNIT III

NEURAL NETWORKS BASED ON COMPETITION: Fixed-Weight Competitive Nets, Kohonen Self-Organizing Maps, Counter propagation

ADAPTIVE RESONANCE THEORY: Basic Architecture and Operations- ART1

UNIT IV

CONVOLUTIONAL NEURAL NETWORKS: Introduction -Biological Inspiration - Basic Structure of a Convolutional Network - Training a Convolutional Network - Case Studies of Convolutional Architectures - Visualization and Unsupervised Learning -Applications of Convolutional Networks.

UNIT V

DEEP REINFORCEMENT LEARNING: Introduction- Stateless Algorithms: Multi-Armed Bandits - The Basic Framework of Reinforcement Learning- Bootstrapping for Value Function Learning-Case Studies

All networks will be demonstrated using MATLAB/SCILAB

Text books:

1. Laurene Fausett, Fundamentals of Neural Networks, Pearson, 2013
2. Charu C. Aggarwal," Neural Networks and Deep Learning". Springer, 2018

Reference Books:

1. David M. Skapura, “Building Neural Networks”, Addison Wesley, 1996.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, 2016, Deep Learning, The MIT Press, 2016
3. Bose, “Neural Network Fundamentals with graphs, algorithms and applications”, Tata McGraw-Hill, 1995
4. Simon Haykins, “Neural Networks”, Pearson Education Asia, Third Edition,2009
5. S.N. Sivanandam, Sumathi, Deepa “An Introduction to Neural Networks using MATLAB”. Tata McGraw Hill- 2006

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. (PO1,2,3, PSO-1,2) 1.
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)

MEDICAL IMAGING SYSTEMS

Course Code: ML72 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator(s): Dr. Prabha Ravi, Dr. Sanjay H S

Course contents

UNIT I

Introduction to digital image processing: Digital images Image quality Basic image operations. **Radiography** Introduction, X-rays, Interaction with matter, X-ray generators and detectors, Diagnostic methods, Dual-energy imaging, Image characteristics, Image quality, Equipment, Clinical use, Biologic effects and safety.

UNIT II

X-ray computed tomography: Introduction, X-ray detectors in CT , Data acquisition and reconstruction , Imaging , Cardiac CT , Dual-energy CT , Image quality, Equipment , Clinical use , Biologic effects and safety.

UNIT III

Ultrasound Imaging Introduction, Physics Of Acoustic Waves, Generation And Detection of Ultrasound, Ultrasonic Diagnostic Methods, Gray Scale Imaging, Doppler Imaging , Image Quality and Characteristics , equipment ,Clinical Use , Biologic Effects And Safety

UNIT IV

Magnetic resonance imaging: Fundamentals and physics of Nuclear magnetic resonance, Interaction with tissue and NMR parameters Generation and Detection of NMR signal, basic pulse sequences, Instrumentation and data acquisition of MR imaging, Types of pulse sequencing in **i**maging, in vivo methods , Image quality , Clinical use , Biologic effects and safety.

UNIT V

Nuclear medicine imaging: Introduction, Radionuclides, Interaction of γ-photons and particles with matter , Generation and Detection of Nuclear Emission, Diagnostic methods using radiation Detector probes, radionuclide Imaging systems**,** Data acquisition , Imaging , Image quality , Equipment, Clinical use , Biologic effects and safety.

Text Book/s:

1. Shung K. Kirk, Tsui Benjamin, Smith. B. Michael, “Principles of Medical Imaging, 1992
2. Suetens Paul, “Fundamentals of Medical Imaging” Cambridge University Press, 2nd edition, 2008.

Reference Books:

1. Edward E. Christensen, Thomas S. Curry, James E. Dowdey, Robert C. Murry, "Christensen's Introduction to the Physics of Diagnostic Radiology", 4th edition ,Lea & Febiger publication.
2. Introduction to Medical Imaging: Physics, Engineering and Clinical Applications (Cambridge Texts in Biomedical Engineering) 1st Edition by Nadine Barrie Smith (Author), Andrew Webb (Author)
3. Dowsett, Kenny & Johnson, "The physics of Diagnostic Imaging", Chapman & Hall Medical, Madras/London.
4. Advanced Imaging Techniques in Clinical Pathology edited by Francesco M. Sacerdoti, Antonio Giordano, Carlo Cavaliere

Course Outcomes (COs):

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

1. Understand the basic foundations on biological and artificial neural network and the importance of neuron models for pattern classification (PO-1,5; PSO-2)
2. Demonstrate the process of forming association between related patterns through associative networks (PO-2; PSO-1)
3. Apply the principles of back propagation supervised learning for error minimization (PO-1; PSO-1)
4. Understand and analyze the various competition and adaptive resonancebased learning algorithms (PO-5; PSO-2)
5. Understand the structural and functional aspects of convolutional neural networks deep reinforcement learning algorithms (PO-1, 2, PSO-1)

MANAGEMENT & ENTREPRENEURSHIP

Course Code: ML73 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Sanjay H S, Dr. Prabha Ravi

Course contents

UNIT I

Introduction to management: Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories, Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection

UNIT II

Directing & Controlling: Meaning and nature of directing, leadership styles, motivation Theories, Communication- Meaning and importance, Coordination- meaning and importance, Controlling- meaning, steps in controlling, methods of establishing control.

UNIT III

Introduction to entrepreneurship: Meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study

UNIT IV

Entrepreneurship project and resources: Preparation of project and ERP-Meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report.
Enterprise Resource Planning: Meaning and Importance- ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation

UNIT V

Micro and Small Enterprises: Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises, case study (Microsoft), Case study(Captain G R Gopinath),case study (N R Narayana Murthy & Infosys),Case study (Skanray Healthcare), Institutional support

Text Books

1. Understanding Management, Richard Daft, South western college publishing, 2003
2. Management and Entrepreneurship – Kanishka Bedi- Oxford University Press-2017

Reference Books

1. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 5th Edition, 2012.
2. Entrepreneurship Development -Small Business Enterprises -Poornima M Charantimath Pearson Education – 2006.
3. Dynamics of Entrepreneurial Development & Management -Vasant Desai, Himalaya Publishing House.
4. Management & Entrepreneurship for IT industries, K R Phaneesh, Sudha Publications, 2021

Course Outcomes (COs):

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

1. Ascertain the basic concepts of management and organization (PO-1,2,3 PSO-2)
2. Analyze the salient aspects of entrepreneur, planning and staffing (PO-1,2,4,5, PSO – 2,3)
3. Assess the importance of ERP and outline their advantages in entrepreneurship (PO – 6,7, PSO – 1,3)
4. Utilize the resources available effectively through ERP (PO – 1,8,10, PSO – 2)
5. Identify the support system provided for entrepreneurship (PO – 1,2,3,5, PSO – 1,3)

MEDICAL DEVICE REGULATIONS

Course Code: MLE741 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Purnima B.R, Mrs. Tejaswini. S

Course contents

UNIT I

Medical Device Safety and Related ISO Standards: Biomedical Devices: Overview, Labelling, Label, and Language: A Truly Global Matter, Clinical Trials: Legal and Ethical Considerations of Increasing Globalization, Regulatory Affairs for Medical Device Clinical Trials in Asia Pacific

UNIT II

Medical Device Classification and Standards: Medical Device Classification Guide, ISO 13485:2003 Medical Devices — Quality Management Systems — Requirements or Regulatory Purposes, ISO 14971: Application of Risk Management to Medical Devices.

UNIT III

Harmonization of Medical Devices in Asia: Medical Devices in the World Health Organization, Asian Harmonization Working Party, Asia-Pacific Economic Cooperation, Harmonization of Medical Device in ASEAN.

UNIT IV

Medical Device Regulatory System in the United States: United States Medical Device Regulatory Framework, Regulation of Combination Products in the United States Medical Device Regulatory System in Asia-Pacific Region: Medical Device Regulations in Australia & China

UNIT V

Medical Device Regulatory System in European Union: European Union: Medical Device Regulatory System, Regulation of Combination Products in the European Union. Medical Device Regulatory System in Asia-Pacific Region: Medical Device Regulations in India & Singapore

Text Books

1. Handbook of Medical Device Regulatory Affairs in Asia: Jack Wong, Raymond Tong Kaiyu CRC Press, Taylor & Francis group
2. Medical Device Regulations Global overview and guiding principles (WHO)Geneva Latin American
3. Medical Device Regulations: Patricia M. Flood

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. Classify and explain the importance of essential requirements. and Explain the process of conformity assessment and the use of harmonized standards. (PO-3,8,9 & PSO-1)
2. Comprehend the legislative framework for medical device regulation in the world. (PO-3,12 &PSO-2)
3. Resolve if a device or product qualifies as a “medical device”, “active implantable medical device”, “in vitro diagnostic medical device” or “drug device” combination under the definitions contained within the Directives. (PO-3, 8 &PSO-2)
4. Illustrate the importance and process of medical device classification and outline the criteria used in the classification process. (PO-3,4,11 &PSO-3)
5. Outline the role of competent authorities and notified bodies in various nations and their regulation of medical devices (PO-6,7,11 &PSO-3)

COMPUTER COMMUNICATION NETWORKS

Course Code: MLE742 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Chandana S , Dr. Sanjay H S

Course contents

UNIT I

Introduction to Computer Networks: Introduction, advantages & applications of CCN, Computer network: structure, hardware, Topology, software &; architecture, services, reference models: ISO &; TCPIP

UNIT II

Physical Layer: Design issues, Digital Transmission, Media types, multiplexing & its types, Modems, switching techniques, ISDN Data Link Layer: design issues, Error detection &; correction techniques, elementary data link layer protocols, pipelining, performance issues

UNIT III

Medium Access Layer: Network types, LAN, MAN & WAN, LAN protocols, IEEE 801, 802 & 803 standards.

UNIT IV

Network Layer: Design issues, Connected & connectionless services, virtual circuits, datagram subnets, Routing algorithms, adaptive & non-adaptive algorithms, congestion control, internetworking, Internet layer, IP addressing

UNIT V

Transport layer: design & Performance issues, transport protocol mechanisms, TCP Application layer: DNS, Electronic Mail, World Wide Web, Multimedia.

Text Books

1. Andrew S Tanenbaum, “Computer Networks”, PHI, 6th Edition,2021

Reference Books

1. Leon Garcia &Widjaja, “Communication Networks”, Tata McGraw Hill, 2nd Edition, 2004

Course Outcomes (COs):

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

1. Discriminate the functionality between the layers in OSI model and TCP/IP suite. (PO-1,7 & PSO-1)
2. Understand the concept of physical and data link layer. (PO-1,2,7,9,12 & PSO-1)
3. Distinguish the IEEE standards designed to understand the interconnectivity between different LANs. (PO-7,9,12 & PSO-1)
4. Employ different algorithms to route a packet to the destination in different networks needed for process to process delivery. (PO-1,2,3,5 & PSO-1)
5. Study the concepts of transport and application layer. (PO-1,2,7,9,12 & PSO-1)

MEDICAL DEVICE DESIGN AND DEVELOPMENT

Course Code: MLE743 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Tejaswini. S, Mr. Mahendra S J

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 vs 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)

HEALTHCARE INTEROPERABILITY

Course Code: MLE744 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi , Dr.Basavaraj Hiremath

Course contents

UNIT I

Principles of Health Interoperability : The Health Information Revolution. Why Interoperability Is Hard, Models, UML, BPMN, XML and JSON, Information Governance, Standards Development Organizations

UNIT II

Terminologies and SNOMED CT: Coding and Classification Schemes , SNOMED CT , SNOMED CT Concept Model , Implementing Terminologies

UNIT III

HL7 and Interchange Formats: HL7 Version 2, The HL7 v3 RIM, Constrained Information Models.

UNIT IV

HL7 and Interchange Formats: Constrained Information Models, CDA – Clinical Document Architecture, HL7 Dynamic Model, IHE XDS.

UNIT V

Fast Healthcare Interoperability Resources (FHIR): Principles of FHIR, The FHIR RESTful API, FHIR Resources, Conformance and Terminology, Implementing FHIR.

Text Book:

1. Principles of Health Interoperability: SNOMED CT, HL7 and FHIR (Health Information Technology Standards) 3rd ed. 2016 Edition by Tim Benson (Author), Grahame Grieve (Author), Springer Publications

Reference Book:

1. Healthcare Interoperability Standards Compliance Handbook: Conformance and Testing of Healthcare Data Exchange Standards Authors: **Oemig**, Frank, **Snelick**, Robert, Springer Publications

Course outcomes (COs):

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

1. Gin knowledge on the basics and the need of interoperability in healthcare (PO1,4,5,PSO2,3)
2. Describe the benefits of standards-based Health interoperability(PO-1,2 &PSO-1)
3. Understand HL7 standardization processes and entities(PO-1,2, 5&PSO-1)
4. Participate as users in the HL7 & standardization activities(PO-1,2, 5&PSO-1)
5. Understand the uses of Fast Healthcare Interoperability(FHIR)(PO-1,2 &PSO-1)

INFRARED IMAGING & APPLICATIONS

Course Code: MLE745 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Prabha Ravi , Dr. N. Sriraam

Course contents

UNIT I

Introduction to thermography: History and evolution of thermography, Electromagnetic Spectrum, Principles of black body radiation laws: Blackbody, Plank's law, Wien's displacement law, Stefan Boltzmann Law, Emissivity, Kirchoff's law, IR absorption characteristics, Radiometric measurements.

UNIT II

Heat Transfer Mechanisms and measurements: Heat and Temperature, Heat Transfer Mechanism, Principle of Conduction, Convection and Radiation, Temperature measurements: Contact and Noncontact.

UNIT III

Principle of Infrared Camera: Optics, Detectors, Scanning and Imaging, Detector performance parameters: Responsivity, Noise Equivalent Power, Specific detectivity, System performance parameters: Temperature range, Accuracy, Thermal sensitivity, 4 Bar Target, MRTD, MDTD, Calibration of IR camera.

UNIT IV

Passive and Active Techniques: Passive Thermography, Active Thermography: Pulsed Thermography, Lock-in Thermography, Pulsed Phase Thermography, Vibro Thermography, Eddy current Thermography, Frequency Modulated Thermal Wave Imaging

UNIT V

Applications: Standards and Procedures, Diagnosis and Monitoring of Pain-Acupuncture-Breast Thermography and Detection of Breast Cancer-Other Medical Applications-Raynaud's Phenomenon- Pressure Ulcers

Text Book/s:

1. Michael Vollmer, Klaus-Peter Mollmann, Infrared Thermal Imaging: Fundamentals, Research and Applications, John Wiley, 2010.
2. Holst, Gerald C. Common sense approach to thermal imaging. Washington, DC, USA: SPIE Optical Engineering Press, 2000.

Reference Books:

1. F Ring, A Jung and J Żuber, Infrared Imaging. IOP, USA, 2015.
2. Nicholas A. Diakides, Joseph D. Bronzino, Medical Infrared Imaging, CRC Press,2007
3. Xavier P.V. Maldague, Nondestructive Evaluation of Materials by Infrared Thermography, Springer Science & Business Media, 2012

Course outcomes (COs):

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

1. Understand the fundamentals of infrared imaging (PO-1,2 &PSO-1)
2. Apply the temperature measurements for various applications. (PO-1,2 &PSO-1)
3. Demonstrate the working operation of IR Camera (PO-1,2,3 &PSO-1,2)
4. Analyze the various thermography technique procedure (PO-2,4,5&PSO-2)
5. Demonstrate the thermography imaging procedure for various clinical
6. Applications (PO-2,3,5&PSO-3)

BIOMATERIALS AND BIOMECHANICS

Course Code: MLE751 **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,19762.
2. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill publications, 2007 edition.
3. Arthur T Johnson, "Biomechanics & exercise physiology", John Wiley & Sons publications, 2015 edition

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)

PATTERN RECOGNITION

Course Code: MLE752 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Basavaraj Hiremath , Dr. N.Sriraam

Course contents

UNIT I

Introduction: Machine perception, pattern Recognition systems, Design cycles, learning and adaptation
Probability: Random variable, joint distribution and densities, moments of random variable.

UNIT II

Statistical Decision Making: Introduction, Baye's theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, problems.

UNIT III

Non Parametric Decision Making: Introduction, Histograms, kernel and window estimators, nearest neighbour classification techniques, adaptive decision boundaries, adaptive discriminate functions. Minimum Squared Error Discriminant Functions

UNIT IV

Clustering: Introduction, Hierarchical clustering, Single-Linkage Algorithm, Complete-Linkage Algorithm, Average –Linkage Algorithm, Ward's Method Algorithm problems.
Partitional clustering: Forgy's Algorithm, K-means Algorithm, Isodata Algorithm, problems.

UNIT V

Processing of Waveforms and Images: Introduction, gray level scaling transformations, equalization, geometric image scaling and interpolation, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level scaling.

Text Book/s:

1. Pattern Recognition and Iamge Analysis, Earl Gose, Richard Johnson Baugh and Steve jost, PHI (2015)

Reference Books:

1. Richard O.Duda, Peter E.Herd and David & Stork, pattern and classification, john Wiley and sons, Inc 2 Ed.2001.
2. Robert Schlkoff, Pattern Recognition: S tatistical Structural and Neural Approaches, John Wiley and sons, Inc, 2007

Course outcomes (COs):

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

1. To recognize the importance of pattern recognition and its mathematical background (PO-1,2,3 &PSO-1)
2. To have knowledge of statistical decision matching (PO-1,2 &PSO-1).
3. Apply the fundamental concepts of non-parametric decision matching. (PO-2,3,4 &PSO-1)
4. Apply the methods of nonparametric decision matching on practical application and implementation (PO-2,3 4 &PSO-1)
5. To recognize and implement the tools of the pattern recognition on image processing (PO-1,3 &PSO-1)

SMART WEARABLE SYSTEMS

Course Code: MLE753 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Chandana S , Mrs. Tejaswini S

Course content

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 Trade-offs, 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

INTRODUCTION TO CLOUD COMPUTING

Course Code: MLE754 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Dr. Sanjay H S, Dr. Sweeti

Course contents

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 Books

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

BIOMEMS AND NANO TECHNOLOGY

Course Code: MLE755 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours: 42**
Course Coordinator(s): Mrs. Tejaswini S , Dr. N. Sriraam

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

Micro sensors 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 micro machined 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

Nanotechnology: Nanotechnology at the Frontier of Biology and Medicine, Self assembled organic nanotubes, novel Bio- Nano materials for orthopaedics tissue engineering

Text Books

1. Tai-Ran Hsu. MEMS and Microsystems, Design Manufacturing and Nanoscale engineering, John wiley& Sons, 2014
2. Tuan UoDinh, “Nanotechnology in Biology and Medicine, Methods, Devices and Applications”, CRC Press, 2018

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 importance of nano technology for biology and medicine (PO-& PSO-1)

APPLICATION LAB

Course Code: MLL76 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 28**
Course Coordinator(s): Dr Sanjay H S , Dr.Basavaraj Hiremath

Course contents

Application lab intends to provide a support system to students in terms of co-curricular activities with respect to technical writing and research. In this course, more emphasis shall be given to student training component as well as hands-on modules. This course shall be coordinated by the course faculty in association with external subject experts, as required. This course also intends to develop the skillsets required by the students towards the successful completion of their project work (8th semester) and also to aid them in inheriting the industry-based skillsets. Application Lab encompasses hardware and software oriented aspects, the contents of which are mentioned below.

1. Standard approaches involved to commence the student project work
2. Development and testing of various circuitry using different simulation platform
3. Usage of real-time processors for biomedical applications
4. Implementation of biomedical engineering solutions using IOT platform
5. Implementation of biomedical engineering solutions using VI platform
6. Implementation of biomedical engineering solutions using software platform – MATLAB
7. Implementation of biomedical engineering solutions using software platform – SCILAB
8. Implementation of biomedical engineering solutions using software platform – LABVIEW
9. Implementation of biomedical engineering solutions using software platform – PYTHON
10. Usage of data science for various biomedical applications – Deep learning
11. Usage of various useful tools in technical writing
12. Effective report writing with Microsoft and google based tools and approaches

Course Outcomes (COs):

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

1. Understand and implement various biomedical applications using hardware and interfacing platforms (PO-1, 2, 3, 12; PSO-1,2)
2. Use appropriate software module for signal and image processing oriented applications (PO-1, 2, 4, 5; PSO-1,3)
3. Ascertain the importance of technical writing with regard to report and documentation (PO-1, 2, 8, 11, 12; PSO-1,2,3)

HOSPITAL TRAINING

Course Code: MLL77 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 2 per week**
Course Coordinator(s): Dr. N Sriraam, Mrs. Tejaswini

The students are supposed to undergo the hospital training program during which they will have a practical exposure to the importance as well as the usage of biomedical instruments in hospitals. The students shall learn the functional aspects of such equipment being used in clinical setup. This shall cover a variety of diagnostic as well as therapeutic equipment being used for treating the needy. The training program shall be undertaken by the students for an overall of 28 hours after which a detailed report is to be submitted to the department. The evaluation shall be conducted based on a presentation and the corresponding report, for 50 marks altogether. The generic rubrics for the evaluation is as follows

CIE evaluation rubrics				
	Inadequate 3	Average 5	Admirable 7	Outstanding 10
Concepts Involved 10 Marks	Not much of concepts	Concepts are involved but not presented properly	Concepts involved and presented nicely.	Concepts involved related to the Bio medical and presented nicely.
Learning Component Hardware/Software 10 Marks	No hardware or software related information gathered	Overview of either software or Hardware components involved.	Detail study of specific equipment and its hardware or software parts.	Complete knowledge about the process of development either using hardware or using software
Individual's contribution 10 Marks	Only part of a team. There is no much involvement.	Regularly absent and but knows the concept.	Very good involvement and know the concept.	Very good involvement and good leader.
Report – format 10 marks	Only content not formatted	Formatted but no diagrams and Labeling	Properly formatted Diagram and Labeling.	Properly formatted Explanation for the diagram and

				labeling
Report – completeness 10 marks	Only report not all the information.	Information but not in depth.	Proper information, completed but no discussion on result.	Very good report, formatted and with result and scope for suggestions and refinement.

Course outcomes (COs):

1. Realize the importance of biomedical equipment in clinical environment (POs – 1, 2, 3, 4, 10, PSO – 1)
2. Analyse the functional aspects of various biomedical instruments in hospital setup (POs – 5, 11, PSO – 2, 3)
3. Identify the challenges faced by the clinicians and the technicians while using the biomedical instruments in hospitals with patients and suggest feasible solutions for the same (POs – 9, 10, 11, PSOs – 2, 3)

SEMINAR

Course Code: MLSE78 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours: 2 per week**
Course Coordinator(s): Dr C K Narayanappa, Mrs Uma Arun

The students are supposed to deliver a technical seminar encompassing the state-of-the-art technologies and concepts being developed and implemented in the field of biomedical engineering. This component shall be evaluated based on a presentation and the corresponding report. The rubrics for the evaluation of this component is as follows

CIE evaluation rubrics				
	Inadequate 3	Average 5	Admirable 7	Outstanding 10
Concepts Involved 10 Marks	Not much of concepts	Concepts are involved but not presented properly	Concepts involved and presented nicely.	Concepts involved related to the Bio medical and presented nicely.
Learning Component Hardware/Software 10 Marks	No hardware or software related information gathered	Overview of either software or Hardware components involved.	Detail study of specific equipment and its hardware or software parts.	Complete knowledge about the process of development either using hardware or using software
Current challenges and proposed suggestions 10 marks	Not identified the current challenges	Identified the challenges existing	Identified the challenges existing, but inadequate solutions proposed	Identified the challenges existing and adequate solutions proposed
Report – format 10 marks	Only content not formatted	Formatted but no diagrams and Labeling	Properly formatted Diagram and Labeling.	Properly formatted Explanation for the diagram and labeling
Report –	Only report not	Information but	Proper	Very good

completeness 10 marks	all the information.	not in depth.	information, completed but no discussion on result.	report, formatted and with result and scope for suggestions and refinement.

Course outcomes (COs):

1. Realize the importance of recent innovations in the field of biomedical engineering (POs – 1, 2, 3, 4, 10, PSO – 1)
2. Ascertain the various challenges being posed in today's world in the field of biomedical engineering (POs – 5, 11, PSO – 2, 3)
3. Propose feasible solutions for the challenges seen in the field of biomedical engineering (POs – 9, 10, 11, PSOs – 2, 3)

VIII SEMESTER

INTERNSHIP

Course Code: MLIN 81 **Course Credits: 0:0:3**
Prerequisite: Nil **Contact Hours: 6 per week**
Course Coordinator(s): Dr Sanjay H S, Dr. C K Narayanappa

The evaluation of students will be based on an intermediate presentation, along with written report containing a Certificate from the employer. The generic rubrics for evaluation is as given below

Internal assessment: 50 marks
External evaluation: 50 marks

	Inadequate 3	Average 5	Admirable 7	Outstanding 10
Clarity 10 Marks	Hard to follow sequence of information	overview of the information	Information gathered is easy to follow	Information gathered in depth and easy to fallow
Concepts Involved 10 Marks	Not much of concepts	Concepts are involved but not presented properly	Concepts involved and presented nicely.	Concepts involved related to the Bio medical and presented nicely.
Learning Component Hardware/Software 20 Marks	No hardware or software only the information gathering.	Overview of either software or Hardware components involved.	Detail study of specific equipment and its hardware or software parts.	Complete involvement in the process of development either using hardware or using software
Individual's contribution 10 Marks	Only part of a team. There is no much involvement.	Regularly absent and but knows the concept.	Very good involvement and know the concept.	Very good involvement and good leader.

Result and conclusion 20 Marks	No clarity of result and conclusion.	Results are given but no conclusion.	Good results with conclusion.	Very good results and conclusion.
Future work 10 Marks	No information about the future works but mentioned orally.	Mentioned about the future work but not in depth.	Mentioned & presented about the future work.	Future development process is also mentioned.
Report – format 10 marks	Only content not formatted	Formatted but no diagrams and Labeling	Properly formatted Diagram and Labeling.	Properly formatted Explanation for the diagram and labeling
Report – completeness 10 marks	Only report not all the information.	Information but not in depth.	Proper information, completed but no discussion on result.	Very good report, formatted and with result and scope for future study.

Course outcomes (COs):

1. Analyze the functional aspects of complex technical systems/blocks. (POs – 1, 2, 3, 4, PSOs – 1, 2, 3)
2. Apply modern software tools effectively for design and development of complex technical blocks. (POs – 1, 2, 3, 4, 5, PSOs – 2, 3)
3. Demonstrate the effectiveness of teamwork in completing complex tasks within deadlines. (POs-9, PSO-1,3)
4. Ascertain the requirements for constant technology updation. (PO – 12, PSO-2)
5. Create quality technical report describing all aspects of the internship. (PO – 10, PSO-2,3)

PROJECT WORK

Course Code: MLP82 **Course Credits: 0:0:14**
Prerequisite: Nil **Contact Hours: 28 per week**
Course Coordinator(s): Dr. Prabha Ravi, Mrs. Purnima B R

The students are supposed to carry out their project work in teams for a period of one semester in association with industry/academia. The details about the conduction of the project work shall be provided in the project progress monitoring report, which shall be circulated to the students at the beginning of the semester

The evaluation rubrics for the project work is as given below

CIE evaluation criteria		
		Distribution of Marks
0th Review		Recommendation Phase Only
Review paper to be submitted	Assessment of quality of paper	
1st Review	Conducted for 20	Evaluated for 20
2nd / Final Review	Conducted for 40	Evaluated for 40
Progress Monitoring During even Semester	Evaluated for 20	Evaluated for 20
Project Exhibition	Conducted for 50	Reduced to 10
Publication (Conference/ Journal)	Evaluated for 10	Evaluated for 10

Details of the evaluation are as follows

Criteria	**Description**	Approval Authority				
0th Review	Submission and acceptance of the project proposal	Recommendation if and only if the Marks is above 15 (this marks will not be considered for evaluation)				
	To determine the technical contribution of the team in terms of literature review, gap analysis	Brief Literature	Proposed Study and Presentation	Preliminary Work	Q&A	Total
		5	5	5	5	20
1st Review	To determine the progress and suggest the next step depending on	Need and Concept Note	Brief Literature	Implementation	Group/ Individual Contribution	Total

	literature review	5	5	5		5	20
2nd Review	To determine the progress over previous work	Need/ Motivation	Implementation	Literature Review	Group/ Individual Contribution	Overall Technical Content	Total
		5	15	5	5	10	40
Progress Monitoring During even Semester	To assess the regularity, Presentation and communication skills	Evaluated for 20					20

Course Outcomes (COs):

1. Understand and demonstrate the process of implementing the engineering concepts in real time applications (POs – 1, 2, 3, 4, 10; PSO – 1)
2. Clearly identify and justify the problem statement with purpose (POs – 5, 11; PSO – 2, 3)
3. Analyze and evaluate technical block diagrams and propose suitable modifications to improve performance. (POs – 1, 2, 3, 4, 5; PSO – 2, 3)
4. Work effectively as a member or a leader of a team. (POs – 9,10,11; PSO-2,3)
5. Exhibit the soft skills suitable to bring out knowledge depth, oral and written communication effectively (POs – 10, PSOs – 2, 3)