

RAMAIAH Institute of Technology

CURRICULUM

Outcome Based Education

Academic year 2023 – 2024

MEDICAL ELECTRONICS ENGINEERING

V & VI SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY

(Autonomous Institute, Affiliated to VTU) Bangalore – 560054.

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 11 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 has also been conferred autonomous status for Ph.D. program since 2021. 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 67% 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 & Centre for Bio and Energy Materials Innovation. Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.

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 is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), 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. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, 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, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank for School of Architecture in India for the year 2023.

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 Project Laboratory. 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 twentyfive 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 socioeconomic 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.

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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

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2021-25

Semester Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03					22
Engineering Sciences (ESC)	11	09							20
Humanities, Social Sciences and Management (HSMC)		02	01	01	03	03			10
Ability Enhancement Course (AEC)	01	01	01	01	01		03		08
Universal Human Values (UHV)			02						02
Professional Core Courses (PCC)			11	12	11	05	04		43
Integrated Professional Core Course (IPCC)			03	03	03		04		13
Professional Elective Courses (PEC)					03	06	03		12
Institutional Open Elective Courses (IOE)						03	03		06
Internship (INT)				02		02		05	09
Mini Project / Project Work (PW)						03	03	09	15
Non Credit Mandatory Courses (NCMC)			Yes		Yes				
Total Credits	20	20	21	22	21	22	20	14	160

SCHEME OF TEACHING V SEMESTER

SI.	Course Code	Course	Teaching Category			C	Credit	5	Total Contact
No			Dept.		L	Τ	Р	Total	hours/week
1	MD51	Medical Physics	MD	PCC	2	1	0	3	4
2	MD52	Digital Image Processing	MD	IPCC	2	0	1	3	4
3	MD53	Biomedical Instrumentation	MD	PCC	3	0	0	3	3
4	MD54	Diagnostic and Therapeutic Equipment	MD	РСС	3	0	0	3	3
5	MDE55x	Program Elective Course – 1	MD	PEC	2	0	1	3	4
6	MDL56	Medical Physics Lab	MD	PCC	0	0	1	1	2
7	MDL57	Biomedical Instrumentation Lab	MD	PCC	0	0	1	1	2
8	AL58	Research Methodology & Intellectual Property Rights	MD	HSMC	3	0	0	3	3
9	AEC510	Ability Enhancement Course – V	MD	AEC	1	0	0	1	1
	TOTAL				1	2	3	21	26
10	HS59	Environmental Studies *	NCMC	HSMC	0	0	0	0	1
	TOTAL					2	3	21	27

PROGRAM ELECTIVE COURSE -1

SI.	Course	Course Name		Cr	edits	
No.	Code	Course Name	L	Т	Р	Total
1	MDE551	Virtual Instrumentation	2	1	0	3
2	MDE552	Python Programming	2	1	0	3
3	MDE553	JAVA Programming	2	1	0	3

* Environmental Studies is under the category of NCMC, 1 hour of teaching per week has to be allocated in the timetable.

Nomenclature: IPCC: Integrated Professional Core Course, PCC: Professional Core Course, HSMC: Humanity and Social Science & Management Courses, PEC: Professional Elective Courses, AEC–Ability Enhancement Courses,

NCMC: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: XXE55x, where x=1,2,3,4,5

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L: T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Innovation/ Societal/ Entrepreneurship based Internship: At the End of fourth Semester four - weeks Summer Internship Shall Be Carried Out – Based On industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. All the students admitted shall have to undergo mandatory internship of 04 weeks during the vacation of IV semester. A Viva-Voce examination shall be conducted during VI semester and the prescribed credit shall be included in VI semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; 8th semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the 8th semester grade card.

The Non-Credit Mandatory Course The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfil the requirements during subsequent semester/s to appear for CIE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

SCHEME OF TEACHING VI SEMESTER

SI.	Course Code	Course	Teaching	Category		(Credits		Total Contact
No		Course	Dept.	Category	L	Т	Р	Total	hours/week
1	AL61	Management & Entrepreneurship	MD	HSMC	3	0	0	3	3
2	MD62	Biomedical Image Processing	MD	PCC	3	0	0	3	3
3	MDE63x	Program Elective Course – 2	MD	PEC	2	1	0	3	4
4	MDE64x	Program Elective Course – 3	MD	PEC	3	0	0	3	3
5	MDL65	Diagnostics and Therapeutic Equipment Lab	MD	PCC	0	0	1	1	2
6	MDL66	Biomedical Image Processing Lab	MD	PCC	0	0	1	1	2
7	MDOE0x	Institutional Open Elective – 1	MD	IOE	3	0	0	3	3
8	MDP67	Mini Project	MD	PW	0	0	3	3	6
9	INT68	Innovation / Societal / Entrepreneurship based Internship	MD	INT	0	0	2	2	_
	TOTAL				14	1	7	22	26

PROGRAM ELECTIVE COURSE - 2

Sl.	Course	Course Name		Credits				
No.	Code			Т	Р	Total		
1	MDE631	Biostatistics	2	1	0	3		
2	MDE632	Data Mining and Its Applications in Medicine	2	1	0	3		
3	MDE633	Biomechanics	2	1	0	3		

PROGRAM ELECTIVE COURSE - 3

Sl.	Course	Course Name	Credits					
No.	Code	Course Manie	L	Т	Р	Total		
1	MDE641	Medical Device Regulations	3	0	0	3		
2	MDE642	Medical Device Design & Development	3	0	0	3		
3	MDE643	Physiological System Modelling	3	0	0	3		

INSTITUTIONAL OPEN ELECTIVE – 1

Sl.	Course	Course Name	Credits					
No.	Code	Course Manie	L	Т	Р	Total		
1	MDOE01	Introduction to Medical Electronics	3	0	0	3		
2	MDOE02	Mechatronics in Medicine	3	0	0	3		
3	MDOE03	Hospital Management	3	0	0	3		

Nomenclature, PCC: Professional Core Course, PEC: Professional Elective Courses, IOE: Institutional Open Elective, PW: Mini Project, INT –Internship L –Lecture, T – Tutorial, P- Practical/ Drawing/ Project work

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Institutional Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall not be allowed if,

- 1. The candidate has studied the same course during the previous semesters of the program.
- 2. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- 3. A similar course, under any category, is prescribed in the higher semesters of the program.
- 4. The minimum students' strength for offering open electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course that will provide a platform for students to enhance their practical knowledge and skills

through the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session as per the rubrics defined by the department.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project shall be based on the evaluation of the project report, project presentation skill, and question and answer session as per the rubrics defined by the parent department.

SEE component for Mini-Project: SEE will be conducted by the two examiners appointed by the Institute. SEE marks awarded for the mini project shall be based on the evaluation of the project work report, project presentation skill, and question and answer session.

Research/Industrial Internship - At the end of the sixth/seventh semester (in two cycles to accommodate all the students) Research/Industrial Internship shall be carried out – Based on Industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. All the students admitted shall have to undergo a mandatory internship of 24 weeks during the vacation of VI/VII semesters. A Viva-Voce examination shall be conducted during the VII semester and the prescribed credit shall be included in VII semesters. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent examination after satisfying the internship requirements.

Research internship Students have to take up research internships at Centres of Excellence (CoE) established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is basically intended to give you the flavour of current research going on in a particular topic/s. The internships serve this purpose. They help students get familiarized with the field, the skill needed the effort amount and kind of effort required for carrying out research in that field.

Industry internships: Is an extended period of work experience undertaken by /Institute students looking to supplement their degree with professional development. The students are allowed to prepare themselves for the workplace and develop practical skills as well as academic ones. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with "unexpected contingencies" helps students recognize, appreciate, and adapt to organizational realities by tempering knowledge with practical constraints.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; 8th semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the 8th semester grade card.

MEDICAL PHYSICS						
Course Code: MD51	Credits: 2:1:0					
Prerequisite: Nil	Contact Hours: 28L+14T					
Course Coordinator: Dr. Prabha Ravi and Dr. M. Lakshminarayana						

Course Contents

Unit I

Introduction to Medical Physics: Metabolism in Human Body: Conservation of Energy and Heat Flow, Energy Content of Body Fuel: Metabolizable Energy, Energy Storage, Energy Storage Molecules: Production of ATP, Usage of ATP, Metabolic Rates: Basal Metabolic Rate, Metabolic Rates during Common Activities, Loss of Body Heat: Modes of Heat Loss, Body Temperature.

- Pedagogy : Chalk board, power point presentations
- Links : https://www.youtube.com/watch?v=a-bhAg8sRj8

Unit II

Physics of Fluid Flow in Human Body: Characteristic Pressures in the Body: Basic Physics of Pressure and Flow of Fluids: Law of Laplace, Fluids in Motion, Equation of Continuity, Bernoulli's Equation, Interactions among the Flow Parameters, Resistance in Flow-Viscous Flow and Poiseuille's Law, Diffusion, Pressure and Flow in the Body, Motion of Humans in Fluids: Swimming.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=jblB-2jnIEE

Unit III

Physics of Speech and Hearing: Physics of Sound Waves: Properties of Sound waves, Intensity of Sound waves, Sound travels from One medium to another, Resonant Cavities, Speech Production: Types of Sounds, Systems in Speech Production, Physics of Human Hearing: Auditory Sensitivity, Connection to Hearing Perception, Other Vibrations in the Body: Cardiac and other Sources of Sounds.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=tJW_a6JeXD8

Unit IV

Physics of Light and Vision: Structure of the Eye, Focusing and Imaging with Lenses: Image Formation, Scientific basis for Imaging, Refractive Surfaces, Imaging and Detection by the Eye: Transmission of Light in Eye, Accommodation, Binocular Vision, Effects of Changing Pupil Size and Depth of Field, Imperfect Human Vision, Correction of Vision, Vision Impairment, Visual Perception.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=HHQnfaib1Q4

Unit V

Electrical and Magnetic Properties in Human Body: Electrical Properties of Body Tissues, Nerve Conduction: Cell Membranes and Ion Distributions, Types of Cell Membrane Excitations, Ion Channels, Hair Cells, Balance, Taste and Smell, Electrical Properties of the Heart, Electrical Signals in the Brain, Effects of Electric Shock, Magnetic Properties, Electromagnetic Waves.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=LMS0EyboI5w

Text Book:

1. Irving P Herman, "Physics of the Human Body", 2nd edition, Springer Publications, 2016.

Reference Book:

- 1. Paul Davidovits, "Physics in Biology and Medicine", 5th edition, Academic Press, 2018.
- 2. John Roderick Cameron, James G. Skofronick, Roderick M. Grant "Physics of the Body" Medical Physics Pub. (1999), ISBN : 9780944838914, 094483891X.
- 3. John Roderick Cameron, James G. Skofronick, Roderick M. Grant "Medical Physics", Physics Pub.(1992), ISBN: 9780944838259, 0944838251.

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks							
Assessment Tool	Marks	Course outcomes addressed					
Internal test-I	30	CO1, CO2					
Internal test-II	30	CO3, CO4, CO5					
Average of the two internal tests shall be taken for 30 marks.							
Other Components							
Multiple choice questions	10	CO1, CO2					
Assignments	10	CO1, CO2, CO3, CO4, CO5					
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5					

DIGITAL IMAGE PROCESSING

Course Code: MD52

Credits: 2:0:1

Prerequisite: Nil

Contact Hours: 28L+14P

Course Coordinator: Dr. C K Narayanappa and Dr Basavaraj Hiremath

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.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/w/v/VZEW,VZE8,VZEc,VZE3,VZE1, VZEg,VZEr,VZEt,VZE7

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.

- Pedagogy: Chalk board, power point presentations
- Links:http://a.impartus.com/ilc/w/v/VZE5,VZE0,VZEU,VZEC,VZEP,VZEM,VZEI,VZEn,,V ZE9,VZE2,VZEj

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.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/w/v/VZEi,VZEK,VZEd,VZEF,VG1B,VZER,VG1a,VZEh, VZEA,VZEs,VQd0,VZE4

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, Pseudo color processing, Basics of full color processing.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/w/v/VZEE,VZEz,VZEH,VZE6,VZES

Unit V

Image restoration: Degradation model, Noise models, restoration in the presence of noise only (Spatial and frequency domain filters), Linear position invariant degradations, estimating of degradation function, Inverse filtering, Minimum Mean Square Error filtering, constrained least square filtering.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/w/v/VZEu,VZEL

Text Books:

- 1. R C Gonzalez & R E Woods," Digital Image Processing", Pearson Education, 4e, 2018.
- 2. A K Jain, "Fundamentals of Digital Image processing ", PHI / Pearson Education, 2011
- 3. Chanda and Majumder," Digital Image Processing and Analysis", PHI Learning Pvt. Ltd., 2011.

Course Outcomes (COs):

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

- 1. Identify the basic Digital image representation and analyze the relationship between the pixels. (PO-1,2,3; PSO-1)
- 2. Analyze and implement morphological image processing. (PO-1,2,3; PSO-1,2)
- 3. Analyze the aspects involved with respect to various enhancement techniques on an image. (PO-1,2,3,5; PSO-1).
- 4. Emphasize on the different color models and their importance. (PO-1,2,3; PSO-1)
- 5. Discuss various restoration technique used in image processing. (PO-1,2,3; PSO-1)

Continuous Internal Evaluation (CIE): 50 Marks							
Assessment Tool	Marks	Course outcomes addressed					
Internal test-I	30	CO1, CO2					
Internal test-II	30	CO3, CO4, CO5					
Average of the two internal tests shall be taken f	or 30 marks.						
Other components							
Multiple choice questions	10	CO1, CO2					
Assignment	10	CO1, CO2, CO3, CO4, CO5					
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5					

BIOMEDICAL INSTRUMENTATION

Course Code: MD53

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Tejaswini. S and Dr S J Mahendra

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, commercial development process, regulations.

Origin of bioelectric potentials: Electrical activity of the excitable cells, volume conductor fields, functional organization of peripheral nervous system

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=iK-6q4nnmtA&list=PLVsrfTSlZ42OoOyhz WoDgZrL9iineZxQ

Unit II

Physiological Transducers: Introduction, Classification of transducers, Performance characteristics of transducers, displacement, position and motion transducer, pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fibre sensors, biosensors, smart sensors

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=PA-qoyEMLuY

Unit III

Bio potential Electrodes: Electrode-electrolyte interface, polarization, polarisable and nonpolarizable electrodes, electrode behaviour and circuit models, electrode-skin interface, motion artefacts, body surface recording electrodes, internal electrodes, electrode arrays, microelectrodes, electrodes for electric stimulation of tissues, practical aspects involved.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=YcKFS0ke1Qg&t=555s

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, biotelemetry.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=981Rv_8rQmo&t=139s

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 analysers, testing the electric system and appliances.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=MP9XbxWeBYo

Text Books:

1. John G Webster, "Medical Instrumentation-Application and design", 4th edition, John Wiley Publications, 2009.

Reference Books:

- 1. R S Khandpur, "Handbook of biomedical Instrumentation", 3 rd edition, Tata McGraw Hill publications (2017)
- 2. 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 instrumentation used to acquire bio potential signals from human beings. (PO-1,2,3,12&PSO-1,3)
- 2. Comprehend the origin of bio potentials from human body. (PO-2,3&PSO-1)
- 3. Interpret the importance of bio potentials electrodes in the process of signal acquisition. (PO-1, 4&PSO-1)
- 4. Recognize and realize the need for usage of bio potential amplifiers in biomedical instruments and applications. (PO-3, 4 & PSO-1)
- 5. Analyze the safety aspects involved with electricity in medical instruments.(PO-2,3&PSO-1)

Continuous Internal Evaluation (CIE): 50 Marks							
Assessment Tool	Marks	Course outcomes addressed					
Internal test-I	30	CO1, CO2					
Internal test-II	30	CO3, CO4, CO5					
Average of the two internal tests shall be	taken for 30 mar	·ks.					
Other components							
Multiple choice questions	10	CO1, CO2					
Assignment	10	CO1, CO2, CO3, CO4, CO5					
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5					

DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

Course Code: MD54

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Contact Hours: 421

Course Coordinator: Dr. Tejaswini. S and Dr. Mahendra S J

Course Contents

Unit I

Introduction to Diagnostic & Therapeutic Equipment: Basic concepts of diagnosis and therapy and related applications. **Blood pressure measuring devices**: Blood pressure & Sound: Direct measurements, Harmonic analysis, dynamic properties, System response, bandwidth requirements, pressure waveforms, venous pressure measurement, heart sounds, phonocardiography, cardiac catheterization, indirect measurements, tonometry.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.youtube.com/watch?v=kADb7Kz3tn4&list=PLkfCsh3Ut7ielrCzTj1n_DQ 25V9aAau7g
- Impartus: https://a.impartus.com/ilc/#/course/2912990/1280

Unit II

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

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://www.youtube.com/watch?v=JeTdxynMkLs
- Impartus: https://a.impartus.com/ilc/#/course/2912990/1280

Unit III

Pulmonary equipment: Pulmonary function measurement, spirometry, pneumotachometers, measurement of volume, pulmonary function analyzer, respiratory gas analyzer. **Neurological equipment**: Electroencephalography, electrodes and 10-20 system, EEG bands and diagnostics, Multichannel EEG systems, Block diagram of EEG system, evoked potentials, EEG telemetry, system artifacts and troubleshooting, EMG and its relation with EEG.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://www.youtube.com/watch?v=JZ0V8cZDyt8
- Impartus: https://a.impartus.com/ilc/#/course/2912990/1280

Unit IV

Therapeutics & prosthesis: Cardiac pacemakers, electric stimulators, defibrillators, cardioverters, mechanical cardiovascular orthotic and prosthetic devices, hemodialysis, lithotripter, ventilator, incubators, drug delivery devices, surgical instruments, laser applications in therapy. **Gait:** Basic concepts of Gait and its analysis.

• Pedagogy: Chalk and Talk, PowerPoint Presentations

- Links: https://www.youtube.com/watch?v=mz4EwMhn9tA
- Impartus: https://a.impartus.com/ilc/#/course/2912990/1280

Unit V

Auditory diagnostics: Hearing mechanism, sound measurement, basic audiometer, pure tone audiometers, speech audiometer, Bekesy approach, evoked response audiometry. Clinical Laboratory Equipment: Spectrophotometry, Automated chemical analyzers, Chromatology, Electrophoresis, Hematology.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Impartus: https://a.impartus.com/ilc/#/course/2912990/1280

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks							
Assessment Tool	Marks	Course outcomes addressed					
Internal test-I	30	CO1, CO2					
Internal test-II	30	CO3, CO4, CO5					
Average of the two internal tests shall be	taken for 30 mar	ks.					
Other components							
Multiple choice questions	10	CO1, CO2					
Assignment	10	CO1, CO2, CO3, CO4, CO5					
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5					

VIRTUAL INSTRUMENTATION

Course Code: MDE551

Credits: 2:0:1

Prerequisite: Nil

Contact Hours: 28L+14P

Course Coordinator: Dr. Tejaswini S and Dr. M. Lakshminarayana

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.

- Pedagogy: Chalk board, power point presentations ٠
- Links: https://www.youtube.com/watch?v=ajGH5s93D7Q •

Unit II

Introduction to LabVIEW: Software environment, block diagram. Data types, data flow program, lab VIEW documentation resources, modular programming. 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.

- Pedagogy: Chalk board, power point presentations •
- Links: https://www.youtube.com/watch?v=hnx9WI2D9zU •

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.

- Pedagogy: Chalk board, power point presentations •
- Links: https://www.youtube.com/watch?v=AKUV1 x5Y1E •

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.

- Pedagogy: Chalk board, power point presentations •
- Links: https://www.youtube.com/watch?v=m4QZIzeMPGw

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.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=pP0ETel1myI&list=PLckZZXwYAE8qSUyc5h

Text Books:

1. Jovitha Jerome, 'Virtual Instrumentation using LabVIEW', PHI learning, 2010

Reference Books:

1. Jeffrey Travis, Jim Kring, 'Graphical Programming Made Easy and Fun',3rd Edition, Prentice Hall, 2015

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 (PO-5,6,12 & PSO-1,2)
- 5. Analyze the various tools existing in VI and to build simple applications in VI (PO-5,12 & PSO-2)

Continuous Internal Evaluation (CIE): 50 Marks			
Assessment Tool	Marks	Course outcomes addressed	
Internal test-I	30	CO1, CO2	
Internal test-II	30	CO3, CO4, CO5	
Average of the two internal tests shall be taken for 30 marks.			
Other components			
Multiple choice questions	10	CO1, CO2	
Assignment	10	CO1, CO2, CO3, CO4, CO5	
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5	

PYTHON PROGRAMMING

Course Code: MDE552

Credits: 2:1:0

Prerequisite: Nil

Contact Hours: 28L+14T

Course Coordinator: Dr Basavaraj V Hiremath and Dr. Mahendra S.J

Course Contents

Unit I

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

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

Iteration: Assignment, Updating variables, the for loop, the while statement, The Collatz (3n + 1) Sequence, Nested Loops for Nested Data. **Functions:** Functions with arguments and return values, Lambda Functions.

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: https://www.learnbyexample.org/python/ https://www.learnpython.org/ https://pythontutor.com/visualize.html#mode=edit

Unit II

Tuples: Tuples are used for grouping data, Tuple assignment, Tuples as return values, Composability of Data Structures. **Lists**: List values, accessing elements, List length, List membership, List operations, List slices, Lists are mutable, List deletion, Objects and references, Aliasing, Cloning lists, Lists and for loops, List parameters, List methods, Pure functions and modifiers, Functions that produce lists, Strings and lists, list and range, Nested lists, Matrices. **Dictionaries**: Dictionary operations, dictionary methods, aliasing and copying.

- Pedagogy : Chalk and talk, Power point presentation, Videos
- Link: https://www.learnbyexample.org/python/ https://www.learnpython.org/ https://pythontutor.com/visualize.html#mode=edit

Unit III

Modules: Random numbers, the time module, the math module, creating your own modules, Namespaces, Scope and lookup rules, Attributes and the dot Operator. **Files**: About files, writing our first file, Reading a file line-at-a-time, turning a file into a list of lines, Reading the whole file at once, working with binary files, Directories, fetching something from the web. Algorithms: Linear search, Binary search, merging two sorted lists.

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: https://www.learnbyexample.org/python/ https://www.learnpython.org/ https://pythontutor.com/visualize.html#mode=edit

Unit IV

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: https://www.learnbyexample.org/python/ https://www.learnpython.org/ https://pythontutor.com/visualize.html#mode=edit

Unit V

Exceptions: Catching exceptions, Raising our own exceptions, the finally clause of the try statement.

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: https://www.learnbyexample.org/python/

https://www.learnpython.org/ https://pythontutor.com/visualize.html#mode=edit

Text Books:

1. Downey, A., Elkner, J., & Meyers, C. (2012). How to think like a computer scientist: learning with python. Green Tea Press, Wellesley, Massachusetts.

Reference Books:

- Al Sweigart, "Automate the Boring Stuff with Python", 1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18, except 12) for lambda functions use this link: https://www.learnbyexample.org/python-lambda-function/
- Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link)

Course Outcome (COs):

At the end of the course the student will be able to:

- 1. Design and implement Python programs utilizing arithmetic expression, repetition, file input and output (PO-1,2,3 & PSO-1)
- 2. Define and demonstrate the use of the built-in data structures in Python (PO-1,2,3,5 & PSO-1)
- 3. Develop programs using modules and files (PO-1,2,3,5 & PSO-1)
- 4. Interpret the concepts of Object-Oriented Programming as used in Python (PO-1,2,3,5 & PSO-1)
- 5. Demonstrate the use of built-in functions for string processing and exception handling (PO-1, 2, 3, 5 & PSO-1)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment (Program execution &	10	CO1, CO2, CO3, CO4, CO5
verification)		
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

JAVA PROGRAMMING

Course Code: MDE553

Credits: 2:1:0

Prerequisite: Nil

Contact Hours: 28L+14T

Course Coordinator: Dr. Mahendra S.J and Dr.Basavaraj Hiremath

Course Contents

Unit I

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: http://a.impartus.com/ilc/#/video/id/3793989
 https://www.youtube.com/watchv=bm0OyhwFDuY&list=PLsyeobzWxl7pe_IiTfNyr55kwJP
 WbgxB5

Unit II

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: http://a.impartus.com/ilc/#/video/id/3793989
 https://www.youtube.com/watchv=bm0OyhwFDuY&list=PLsyeobzWxl7pe_IiTfNyr55kwJP
 WbgxB5

Unit III

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: http://a.impartus.com/ilc/#/video/id/3793989 https://www.youtube.com/watchv=bm0OyhwFDuY&list=PLsyeobzWx17pe_IiTfNyr55kwJ PWbgxB5

Unit IV

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: http://a.impartus.com/ilc/#/video/id/3793989 https://www.youtube.com/watchv=bm0OyhwFDuY&list=PLsyeobzWx17pe_IiTfNyr55kwJP WbgxB5

Unit V

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

- Pedagogy: Chalk and talk, Power point presentation, Videos
- Link: http://a.impartus.com/ilc/#/video/id/3793989
- https://www.youtube.com/watchv=bm0OyhwFDuY&list=PLsyeobzWxl7pe_IiTfNyr55kwJP WbgxB5

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment (Program execution &	10	
verification)		01, 02, 003, 004, 005
Semester End Examination (SEE):	100	CO1, CO2, CO3, CO4, CO5

MEDICAL PHYSICS LABORATORY

Course Code: MDL56

Credits: 0:0:1

Prerequisite: Nil

Contact Hours: 14P

Course Coordinator: Dr. Prabha Ravi and Dr. M. Lakshminarayana

Course Contents

- 1. Temperature based Thermistor and thermometer for monitoring of body temperature at different locations on the body.
- 2. Heat based Usage of Infrared light for heat therapy based applications.
- 3. Water based Total body water assessment with the aid of GSR acquisition.
- 4. Strength based Hand grip strength measurement using electronic dynamometer.
- 5. Fluid based: Demonstration of the basic physics of pressure and flow of fluids and relating the same to human physiology (research experiment).
- 6. Pressure based Electrooculography measurement of pressure in the eye.
- 7. Blood flow Assessment of turbulence and laminar flow of blood using blood pressure measurement approaches.
- 8. Electromyogram Assessment of the muscular action.
- 9. Electromyogram Nerve conduction velocity measurement.
- 10. Sound in medicine usage of stethoscope to assess the sound inside the body.
- 11. Sensitivity of the ears usage of audiometry to assess the functionality of the ears.
- 12. Sensitivity of the ears usage of BERA to assess the functionality of the ears.

Text Books:

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

Reference Books:

Paul Davidovits, "Physics in biology and medicine", 5th edition, Academic press, New York, 2018

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	20	CO1, CO2, CO3
Other components		
Quiz	10	CO1, CO2, CO3
Observation	10	CO1, CO2, CO3
Record	10	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

BIOMEDICAL INSTRUMENTATION LABORATORY

Course Code: MDL57

Credits: 0:0:1

Prerequisite: Nil

Contact Hours: 14P

Course Coordinator: Dr. Tejaswini. S and Dr. S J Mahendra

Course Contents

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	20	CO1, CO2, CO3
Other components		
Quiz	10	CO1, CO2, CO3
Observation	10	CO1, CO2, CO3
Record	10	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS

Course Code: AL58

Credits: 3:0:0

Prerequisite: Nil

1 cuits. 5.0.0

Contact Hours: 42L

Course Coordinator: Dr. N Sriraam and Dr. Y S Sumathy

Course Contents

Unit I

Research Methodology-Introduction: Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Conceptualizing Research, Critical and Creative Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments, and Attributions.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments. **Experimental Designs:** Introduction to Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit III

Method of Data Collection: Primary and Secondary Data Collection. **Sampling Design:** Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design. **Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors, Level of Significance. Procedure for Hypothesis Testing: Mean, Variance, Proportions. Chi-square Test, Analysis of Variance (One Way ANOVA), and Covariance (ANOCOVA).

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Unit IV

Intellectual Property Rights-Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. TRIPS Agreement, Patent Cooperation Treaty (PCT). **Patents:** Brief history of Patents-Indian and Global Scenario, Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. Non Patentable Inventions. Rights Conferred to a Patentee, Basmati Rice Patent Case.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Unit V

Design: What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design,

Trademarks: Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements, Types of Reliefs, Case Studies. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights, Case studies

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Text Books:

- 1. C. R Kothari, Gourav Garg, Research Methodology Methods and Techniques. New Age International Publishers.
- 2. Dr. B L Wadehra Law relating to Intellectual property. Universal Law Publishing Co.
- Dipankar Deb, Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4

Course Outcomes (COs):

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

- 1. Possess the knowledge of research and conduct a literature review. (PO-8, 10, 12).
- 2. Apply the knowledge of research design and design of experiments. (PO-4, 8, 10, 12)
- 3. Analyse data collection methods, analysis, and sampling design. (PO-4, 8, 10, 12)
- 4. Understand the global and Indian scenarios of patents and patent applications. (PO-8, 10,12)
- 5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs. (PO-8, 10, 12)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-1	30	CO1, CO2, CO3
Internal test-2	30	CO4, CO5
The average of the two internal tests will be taken for 30 marks		
Other Components		
Assignment	10	CO1, CO2
Quiz	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE - V		
Course Code: AEC510 Credits: 1:0:0		
Prerequisite: Nil	Contact Hours: 14L	
Course Coordinator: Any Department		

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

ENVIRONMENTAL STUDIES

Course Code: HS59

Credits: 0:0:0

Prerequisite: Nil

Contact Hours: 14L

Course Coordinator: Dr. Sweeti

Course Content

Unit I

Environment, Ecology and Biodiversity

Definition, scope, and importance. Multidisciplinary nature of Environmental studies. Food chain and food web. Energy flow and material cycling in the ecosystem. Biodiversity and threats to biodiversity. Concept of sustainable development: Definition, objectives, and applications.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Models
- Link: https://youtu.be/I_bnGkviWOU

https://youtu.be/Ar04qG1P8Es

Unit II

Natural resources

Forest resources: Ecological importance of forests. Water resources: Global water resources distribution. Mineral resources: Environmental effects of extracting and processing Mineral resources. Food resources: Effects of modern agriculture. Land resources: Soil erosion and Desertification.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/vsXv3anIBSU https://youtu.be/1rOVPqaUyv8

Unit III

Energy sources

Growing energy needs. Conventional and non-conventional / Renewable and Non-renewable energy sources. Bio Energy-Ethanol and Bio mass energy. Energy of the future – Hydrogen fuel cells and Nuclear energy. Environmental Impact Assessment (EIA): Definition, Objectives and benefits. Step by step procedure of conducting EIA.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Animations, Models
- Link: https://youtu.be/mh51mAUexK4 https://youtu.be/XS-eXqppf_w

Unit IV

Environmental pollution

Definition, Causes, Effects and control measures of Water pollution, Air pollution and Soil/ land pollution. Management of Municipal Solid Waste and treatment methods of municipal solid waste.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos
- Link: https://youtu.be/NRoFvz8Ugeo https://youtu.be/DAQapF-F4Vw

Unit V

Environmental protection

Global warming and Climate change, Acid rain, Ozone layer depletion. Salient features of Environmental Protection Act, Air & Water Acts. Functions of Central and State Pollution Control Boards.

- Pedagogy/Course delivery tools: Chalk and Talk, PowerPoint presentations, Videos, Open source softwares
- Link: https://youtu.be/iV-BvYwl4Y8 https://youtu.be/BYqLRGawoH0

Text Books:

1. S M Prakash – Environmental Studies, Elite Publishers, 2007.

Reference Books:

1. P. Venugopala Rao – Principles of Environmental Science & Engineering Prentice Hall of India, 1st edition, 2006.

Web links and video Lectures (e- Resources):

- 1. https://youtu.be/I_bnGkviWOU
- 2. https://youtu.be/vsXv3anIBSU
- 3. https://youtu.be/mh51mAUexK4
- 4. https://youtu.be/NRoFvz8Ugeo
- 5. https://youtu.be/iV-BvYwl4Y8

Course Outcomes (COs):

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

- 1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
- 2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)
- 3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
- 4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
- 5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Assignment – MCQ, Objectives	10	CO1, CO2
Assignment – Quiz, Group presentation	10	CO3, CO4
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

VI SEMESTER

MANAGEMENT & ENTREPRENEURSHIP

Course Code: AL61

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Y S Sumathy and Dr. Prabha Ravi

Course Contents

Unit I

Introduction to Management: Definition of Management, Its nature and purpose, Contributions of F.W. Taylor and Henry Fayol to management theory, Functions of managers. **Planning:** Types of plans, steps in planning, the planning process, Management by Objectives (MBO), **Organizing:** The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, Principle of span of management, the structure and process of organizing.

- Pedagogy: Chalk board, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_mg33/preview https://www.digimat.in/nptel/courses/video/110107150/L01.html

Unit II

Staffing: Situational factors affecting staffing. Leading: Human factors in managing, definition of leadership, Ingredients of leadership Controlling: Basic control process, Critical control points and standards, Control as a feedback system, Feed forward control, Requirements for effective controls.

- Pedagogy: Chalk board, power point presentations
- Links: https://nptel.ac.in/courses/110107150

Unit III

Introduction to Entrepreneurship: The Foundations of Entrepreneurship: What is an Entrepreneurship. The benefits of Entrepreneurship, The potential drawbacks of Entrepreneurship; Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation and Entrepreneurship, Creative Thinking, Barriers to Creativity.

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=Hgj_kRrvbhQ&list=PL7oBzLzHZ1wXW3mtolxV 5nIGn48NLKwrb

Unit IV

The Entrepreneurial Journey: Crafting a Business Plan: The benefits of creating a business plan, the elements of a business plan; Forms of Business Ownership and Buying an Existing Business: Sole proprietorships and partnership.

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M8EGZbmNUu UM7Vh2GkdbB1R

Unit V

Launching the Business: Franchising and the Entrepreneur: Types of Franchising, the benefits of buying a Franchise; E-Commerce and the Entrepreneur: Factors to consider before launching into E-commerce, Ten Myths of E-Commerce.

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PS m81k9U8NjaVJkR

Text Books:

- 1. Harold Koontz, H. Weihrich, and A.R. Aryasri, Principles of Management, Tata McGraw-Hill, New Delhi, 2004.
- 2. Essentials of Entrepreneurship and Small Business Management Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)

References Books:

- 1. Innovation & Entrepreneurship Peter Drucker (Harper, 2006)
- 2. Entrepreneurship: The Art, Science, and Process for Success Charles Bamford & Garry Bruton (McGraw-Hill, 2015)
- 3. Management and Entrepreneurship-NVR Naidu, T Krishna Rao, I.K. International Publishing House Pvt. Ltd.@ 2008
- 4. Poornima M Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2006.

Course Outcomes (COs):

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

- 1. Plan and organize for the manpower in the given type of organization (PO: 6,9,11)
- 2. Use staffing Leading and controlling function for the given organization. (PO: 6,8,9,10)
- 3. Understand the fundamentals of entrepreneurship with the goal of fulfilling the requirements of the industries and holding the responsibilities towards the society. (PO-6,7,8)
- 4. Design a basic business plan by considering case studies and show the involvement of ownership in Business. (PO-3,7,8,11)
- 5. Start a new small business with the help of E-Commerce and the current available technologies. (PO-5,11)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
The average of the two internal tests will be taken for 30 marks		
Other Components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

BIOMEDICAL IMAGE PROCESSING

Course Code: MD62

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Prabha Ravi and Dr. Sweeti

Course Contents

Unit I

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

- Pedagogy: Chalk board, power point presentations.
- Links: http://a.impartus.com/ilc/#/course/2755819/1250

Unit II

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

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/#/course/2755819/1250

Unit III

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

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/#/course/2755819/1250

Unit IV

Representation and Description: Boundary Representation: Chain codes, Minimum-Perimeter Polygons, Signatures, Skeletons, Medial axis, Distance Transform, Boundary descriptors- Shape Numbers, Fourier Descriptors, Statistical Moments, Regional descriptors- Topological, Texture. **Image fusion:** Image Registration, Image fusion, Application: Image fusion in Digital subtraction angiography.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/#/course/2755819/1250

Unit V

Pattern recognition: Patterns and pattern classes, pattern classification by prototype matching: matching structural prototypes-matching shape numbers, string matching, optimum statistical classifiers, Neural Networks: The Perceptron, Multilayer feedforward Neural Networks, Forward pass through a feedforward Neural Networks, Application: Classification of Breast Masses and Tumours.

- Pedagogy: Chalk board, power point presentations
- Links: http://a.impartus.com/ilc/#/course/2755819/1250

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

- 1. Acquire a basic understanding of the important concepts related to medical image processing. (PO-1,2& PSO-1)
- 2. Identify and formulate the various artifacts associated with medical images and eliminate the same. (PO1,2,3 & PSO-1,2)
- 3. Recognize and apply various segmentation techniques for medical images (PO-1,2,3 & PSO 1,2)
- 4. Understand the steps of image registration and fusion and their applications. (PO-12,3 & PSO1,2)
- 5. Assess the various types of descriptors used in feature extraction of images. (PO-1,2,3 & PSO-1,2)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

BIOSTATISTICS

Course Code: MDE631

Credits: 2:1:0

Prerequisite: Nil

Contact Hours: 28L+14T

Course Coordinator: Dr. Tejaswini S and Dr. C K Narayanappa

Course Contents

Unit I

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

- Pedagogy: Chalk board, power point presentations
- Links: https://a.impartus.com/ilc/#/course/1248155/1112

Unit II

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

- Pedagogy: Chalk board, power point presentations
- Links: https://a.impartus.com/ilc/#/course/1248155/1112

Unit III

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

- Pedagogy: Chalk board, power point presentations
- Links: https://a.impartus.com/ilc/#/course/1248155/1112

Unit IV

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

- Pedagogy: Chalk board, power point presentations
- Links: https://a.impartus.com/ilc/#/course/1248155/1112

Unit V

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

- Pedagogy: Chalk board, power point presentations
- Links: https://a.impartus.com/ilc/#/course/1248155/1112

Text Books:

1. Veer Bala Rastogi, MedTech Scientific International Pvt. Ltd. "Biostatistics", Third revised edition 2017.

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

DATA MINING AND ITS APPLICATIONS IN MEDICINE

Course Code: MDE632

Credits: 2:1:0

Prerequisite: Nil

Contact Hours: 28L+14T

Course Coordinator: Dr. Sweeti and Dr. Y S Sumathy

Course Contents

Unit I

Data Mining Concepts: What is data mining, Major issues in data mining, Data objects and attribute types, Basic statistical descriptions of data, Data visualization, Measuring Data Similarity and Dissimilarity- Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes.

- Pedagogy: Chalk board, power point presentations
- Links: https://ia800702.us.archive.org/7/items/datamining_201811/DS-book%20u5.pdf https://www.wi.hswismar.de/~cleve/vorl/projects/dm/ss13/HierarClustern/Literatur/WittenFra nk-DM-3rd.pdf

Unit II

Data Preprocessing: Data Preprocessing: An Overview, Data cleaning, Data integration, Data reduction- Wavelet transform, PCA, Data Transformation and Data Discretization- Data Transformation Strategies Overview, Data Transformation by Normalization, Discretization by Binning, Discretization by Histogram Analysis, Discretization by Cluster, Decision Tree, and Correlation Analyses

- Pedagogy: Chalk board, power point presentations
- Links: https://ia800702.us.archive.org/7/items/datamining_201811/DS-book%20u5.pdf https://www.wi.hswismar.de/~cleve/vorl/projects/dm/ss13/HierarClustern/Literatur/WittenFra nk-DM-3rd.pdf

Unit III

Data Warehouse: Basic Concepts, Data Warehouse Modeling- Data Cube, Stars, Snowflakes, and Fact Constellations Schemas for Multidimensional Data Models, Dimensions, Measures, Typical OLAP Operations

Data Cube Computation: Preliminary Concepts, Multiway Array Aggregation for Full Cube Computation, BUC: Computing Iceberg Cubes from the Apex Cuboid Downward

- Pedagogy: Chalk board, power point presentations
- Links: https://ia800702.us.archive.org/7/items/datamining_201811/DS-book%20u5.pdf https://www.wi.hswismar.de/~cleve/vorl/projects/dm/ss13/HierarClustern/Literatur/WittenFra nk-DM-3rd.pdf

Unit IV

Mining frequent Patterns: Apriori Algorithm: Finding Frequent Item sets by Confined Candidate Generation, Generating Association Rules from Frequent Itemsets, Correlation analysis using lift, Pattern Mining: A Road Map

Classification: Basic concept, Decision Tree Induction Attribute Selection Measures,

- Pedagogy: Chalk board, power point presentations
- Links: https://ia800702.us.archive.org/7/items/datamining_201811/DS-book%20u5.pdf https://www.wi.hswismar.de/~cleve/vorl/projects/dm/ss13/HierarClustern/Literatur/WittenFra nk-DM-3rd.pdf

Unit V

Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves, Techniques to Improve Classification Accuracy-Bagging

Advanced Classification methods: Support Vector machines- Linearly Separable and Inseparable data, k-Nearest-Neighbor Classifiers, Fuzzy Set Approaches.

- Pedagogy: Chalk board, power point presentations.
- Links: https://ia800702.us.archive.org/7/items/datamining_201811/DS-book%20u5.pdf https://www.wi.hswismar.de/~cleve/vorl/projects/dm/ss13/HierarClustern/Literatur/WittenFra nk-DM-3rd.pdf

Text Books:

- 1. Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 2000 (ISBN: 1-55860-489-8), 3rd edition.
- 2. Ian H. Witten and Eibe Frank, Data Mining: practical machine learning tools and techniques with Java implementations, Morgan Kaufmann Publishers, San Francisco, CA, (2000).

Reference Books:

- 1. Alex A. Freitas, Data mining and knowledge discovery with evolutionary algorithms, Sprtiner, 2010
- 2. Dorian Pyle, Data Preparation for Data Mining, Morgan Kaufmann, 1999

Course Outcomes (COs):

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

- 1. Understand the foundation level of data mining. (PO-1,2,3 & PSO1)
- 2. Interpret various data pre-processing principles. (PO-1,2,3 & PSO-1,2)
- 3. Interpret various data warehouse principles. (PO-1,2,3 & PSO-1,2)
- 4. Analyze the data mining algorithms and basic concept for classification. (PO-2,3,4,5 & PSO-2)
- 5. Perform model evaluation & selection, and interpret advanced classification methods. (PO-3,4,5 & PSO-2, 3)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

BIOMECHANICS

Course Code: MDE633	Credits: 2:1:0
Prerequisite: Nil	Contact Hours: 28L+14T

Course Coordinator: Dr. Uma Arun and Dr. M. Lakshminarayana

Course Contents

Unit I

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.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.slideshare.net/03122937136/1-introduction-of-biomechanics https://www.slideshare.net/klharrison/biomechanics-1-intro-levers-planes-and-axis-2015

Unit II

Exercise Biomechanics: Introduction, Physics of movement, Energy cost of movement, Walking & running, Carrying loads, Sustained work

- Pedagogy: Chalk board, power point presentations
- Links: https://www.slideshare.net/mariatiku/biomechanic https://www.studocu.com/en-us/document/le-moyne-college/lifespan-anddevelopment/ppt10-lecture-notes-exph-312-ppt-10/41287346

Unit III

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.slideshare.net/abhisheksinghyadav2/aerodynamics-56092397 https://www.hoddereducation.co.uk/media/resources/he/Sport/9781471878633/97814718786 33_Ch14.pdf

Unit IV

Application of hydrodynamics in swimming: Buoyancy &flotation, Resistance & propulsion, Resistive & Propulsive forces in swimming, Swimming efficiency & speed

- Pedagogy: Chalk board, power point presentations
- Links: https://slideplayer.com/slide/8061563/ The fluid mechanics of swimming https://www.slideserve.com/mya/biomechanics-of-swimming https://www.slideshare.net/manjabeta/biomechanic-of-swimming

Unit V

Fundamental concepts of Gait: gait cycle, Gait phases, Gait variables, Gait analysis: Observational techniques, Instrumental analysis, Video based analysis, electromagnetic & Electromyographic analysis

- Pedagogy: Chalk board, power point presentations
- Links: https://www.academia.edu/8149653/GAIT Gait in prosthetic rehabilitation - Physiopedia (physio-pedia.com)

Text Books:

1. Duane Knudson, "Fundamentals of Biomechanics", 2nd edition, Springer publications, 2007

Reference Book:

- 1. Lee Waite, Jerry Fine, "Applied Bio fluid Mechanics", McGraw Hill publications, 2007 edition
- 2. Arthur T Johnson, "Biomechanics & exercise physiology", John Wiley & Sons publications
- 3. Dhanjoo N Ghista, "Applied Biomedical Engineering Mechanics", CRC Press, 2008 edition
- 4. Anthony Blazevich, "Sports Biomechanics Optimizing human performance", A & C Black Publications, 2007 edition
- 5. Donald R Peterson, Joseph D Bronzino, "Biomechanics-Principles & Applications", CRC press, 2008 edition

Course Outcomes (COs):

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

- 1. Recall the basic mechanical concepts and relate the same to human physiology (PO-12 &PSO-1)
- 2. Interpret the biomechanical concepts involved with exercise physiology and its importance in healthcare (PO2, 5, 12&PSO2)
- 3. Understand and apply the basics of biomechanics to illustrate the aerodynamics in sports (PO-1,3,4 & PSO-2)
- 4. Correlate the biomechanical aspects of human body to evaluate the hydrodynamics in swimming (PO-1,2,5,12 &PSO-2)
- 5. Comprehend the basics of biomechanics and apply the same to basics of gait (PO-1,2,4,12 & PSO-1)

Continuous Internal Evaluation (CIE): 50 Marks			
Assessment Tool	Marks	Course outcomes addressed	
Internal test-I	30	CO1, CO2	
Internal test-II	30	CO3, CO4, CO5	
Average of the two internal tests shall be taken for 30 marks.			
Other components			
Multiple choice questions	10	CO1, CO2	
Assignment	10	CO1, CO2, CO3, CO4, CO5	
Semester End Examination (SEE): 100 CO1, CO2, CO3, CO4, CO5			

MEDICAL DEVICE REGULATIONS

Course Code: MDE641

Credits: 3:0:0

Prerequisite: Nil

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Contact Hours: 42L

Course Coordinator: Dr. Tejaswini. S and Dr. Y S Sumathy

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=33VO6olowQg

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.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=XEwfaNKOqJ0

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.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=ibTu_-7o-wY

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=cBYonVA1ikU

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=KYsUlvtG8EI

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
- 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)
- 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)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE):	100	CO1, CO2, CO3, CO4, CO5

MEDICAL DEVICE DESIGN AND DEVELOPMENT

Course Code: MDE642

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Sweeti and Dr. N Sriraam

Course Contents

Unit I

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

- Pedagogy: Chalk board, power point presentations
- Links: https://bluemarbleuniversitymedicalschool.files.wordpress.com/2016/09/meddevices.pdf

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.

- Pedagogy: Chalk board, power point presentations
- Links:

https://bluemarbleuniversitymedicalschool.files.wordpress.com/2016/09/meddevices.pdf

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.

- Pedagogy: Chalk board, power point presentations
- Links:

https://bluemarbleuniversitymedicalschool.files.wordpress.com/2016/09/meddevices.pdf

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

- Pedagogy: Chalk board, power point presentations
- Links:

https://bluemarbleuniversitymedicalschool.files.wordpress.com/2016/09/meddevices.pdf

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.

- Pedagogy: Chalk board, power point presentations
- Links:

https://bluemarbleuniversitymedicalschool.files.wordpress.com/2016/09/meddevices.pdf

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
- Medical Devices (1st Edition) : Regulations, Standards and Practices, Seeram Ramakrishna Lingling Tian 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&PSO-1,2)
- 2. Demonstrate the implementing design procedures to develop a better product design specification. (PO-1,2,3,7&PSO1,2)
- 3. Apply the ideas and concepts for a quality design. (PO-1,2,5,8& PSO-1,2)
- 4. Analyze the design realization for a detailed design. (PO-1,2,3,9&PSO-1,2,3)
- 5. Apply the validation and verification for evaluation. (PO-2,6,7,8&PSO-2,3)

Continuous Internal Evaluation (CIE): 50 Marks			
Assessment Tool	Marks	Course outcomes addressed	
Internal test-I	30	CO1, CO2	
Internal test-II	30	CO3, CO4, CO5	
Average of the two internal tests shall be taken for 30 marks.			
Other components			
Multiple choice questions	10	CO1, CO2	
Assignment	10	CO1, CO2, CO3, CO4, CO5	
Semester-End Examination (SEE)100CO1, CO2, CO3, CO4, CO5			

PHYSIOLOGICAL SYSTEM MODELLING

Course Code: MDE643

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. N Sriraam and Dr. C K Narayanappa

Course Contents

Unit I

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

• Pedagogy: Chalk board, power point presentations

Unit II

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

• Pedagogy: Chalk board, power point presentations

Unit III

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

• Pedagogy: Chalk board, power point presentations

Unit IV

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

• Pedagogy: Chalk board, power point presentations

Unit V

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

• Pedagogy: Chalk board, power point presentations

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks			
Assessment Tool	Marks	Course outcomes addressed	
Internal test-I	30	CO1, CO2	
Internal test-II	30	CO3, CO4, CO5	
Average of the two internal tests shall be taken for 30 marks.			
Other components			
Multiple choice questions	10	CO1, CO2	
Assignment	10	CO1, CO2, CO3, CO4, CO5	
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5	

DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LAB

Course Code: MDL65

Credits: 0:0:1

Prerequisite: Nil

Contact Hours: 14P

Course Coordinator: Dr. Tejaswini S and Dr. Mahendra S J

Course Contents

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	20	CO1, CO2, CO3
Other components		
Quiz	10	CO1, CO2, CO3
Observation	10	CO1, CO2, CO3
Record	10	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

BIOMEDICAL IMAGE PROCESSING LAB

Course Code: MDL66

Credits: 0:0:1

Prerequisite: Nil

Contact Hours: 14P

Course Coordinator: Dr. Sweeti and Dr. Prabha Ravi

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 Books:

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):

By the end of the semester students are 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)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	20	CO1, CO2, CO3
Other components		
Quiz	10	CO1, CO2, CO3
Observation	10	CO1, CO2, CO3
Record	10	CO1, CO2, CO3
Semester End Examination (SEE)	50	CO1, CO2, CO3

OPEN ELECTIVES

INTRODUCTION TO MEDICAL ELECTRONICS

Course Code: MDOE01

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Basavaraj Hiremath and Dr. M. Lakshminarayana

Course Contents

Unit I

Bio Potential Electrodes: Origin of bio-potential and its propagation, Electrode-electrolyte interface, electrode-skin interface, half-cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=jGwM5gAHiDk https://www.youtube.com/watch?v=YcKFS0ke1Qg

Unit II

Electrode Configurations: Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12-lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode, EMG– unipolar and bipolar mode.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=BKJfB9KyQxc https://www.youtube.com/watch?v=BEUiz2oICXE

Unit III

Bio Amplifier: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier.

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=fyqvdRv3o6s https://www.youtube.com/watch?v=UFALTA2SfMU

Unit IV

Measurement of Non-Electrical Parameters: Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=278zZwh-49Y https://www.youtube.com/watch?v=s_Mnz4e1np8

Unit V

Imaging Systems and Patient Safety: X-Ray Physics, Fluoroscopy and Radiography, Ultrasonic Scanner, computed Tomography, Magnetic Resonance Imaging, **Patient Safety**: Electric Shock, Electric Shock Hazards in Hospital Environment, Safety Education and Precautions.

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=qokg3JEV4hg&list=PLWfaNqiSdtzUq9aIY24Dez XppHBq0Ch2C, https://www.youtube.com/watch?v=FSy6koShg9I

Text Books:

- 1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons,2004.
- 2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 2003.
- 3. Ajithkumar G. Patil, R. K. Jha and R. Hariharan, "Medical Electronics", ISTE, Excel Books Publications, 1st edition, 2003.

Reference Books:

- 1. Leslie Cromwell, "Biomedical Instrumentation and measurement", PHI, 2007.
- Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGrawHill,2003. Joseph J. Carr & John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

Course Outcomes (COs):

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

- 1. Reminisce the basics of instrumentation and relate the same to medical equipment used in healthcare (PO-1,2,4,6,12, &PSO-1,2,3)
- 2. Explore the features involved with the generation and applications of bioelectric potentials (PO-2,3 &PSO-1)
- 3. Accent the working and uses of biotelemetry in hospitals (PO-1,3,5,12 &PSO-1,2,3)
- 4. Quote the fundamentals of instrumentation and comprehend the features of electrical safety in medical equipments(PO-2,3,5 &PSO-1,2)
- 5. Emphasize on the recent trends in computers and their applications in healthcare (PO-1,4,5,6,12 & PSO1,2,3)

Continuous Internal Evaluation (CIE): 50 Marks				
Assessment Tool	Marks	Course outcomes addressed		
Internal test-I	30	CO1, CO2, CO3		
Internal test-II	30	CO3, CO4, CO5		
Average of the two internal tests shall be taken for 30 marks.				
Other components				
Multiple choice questions	10	CO1, CO2		
Assignment	10	CO1, CO2, CO3, CO4, CO5		
Semester End Examination (SEE)100CO1, CO2, CO3, CO4, CO5				

MECHATRONICS IN MEDICINE

Course Code: MDOE02

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Uma Arun and Dr. Prabha Ravi

Course Contents

Unit I

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=-qdiHCmWi1U

Unit II

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

- Pedagogy: Chalk board, power point presentations
- Links:https://www.youtube.com/watch?v=zxYeJW9v6OU&list=PLwymdQ84KI-w5DwDzqO_4hWsB2Jc4_eBy

Unit III

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=-2nwLvDYnaw

Unit IV

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=zx3gHPJiSJc

Unit V

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

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=zIOsisUC06Q

Text Books:

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

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks			
Assessment Tool	Marks	Course outcomes addressed	
Internal test-I	30	CO1, CO2	
Internal test-II	30	CO3, CO4, CO5	
Average of the two internal tests shall be taken for 30 marks.			
Other components			
Multiple choice questions	10	CO1, CO2	
Assignment	10	CO1, CO2, CO3, CO4, CO5	
Semester End Examination (SEE)100CO1, CO2, CO3, CO4, CO5			

HOSPITAL MANAGEMENT

Course Code: MDOE03

Credits: 3:0:0

Prerequisite: Nil

Contact Hours: 42L

Course Coordinator: Dr. Uma Arun and Dr. Tejaswini S

Course Contents

Unit I

Introduction To Hospital Management & Administration: Introduction, definition, classification, nature and scope of a hospital, difference between a hospital and an industry, functions of a hospital, hospital ethics, leadership, challenges in hospital administration, administrative conditions in hospitals, branding emotions, succession planning, feedback in planning, branded benefits

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=Uycn1kvSpZs

Unit II

Human Resource Management In Hospitals: Introduction, nature/characteristics & assumptions, fundamental principles, utilization factors, outsourcing, retention of top performers, characteristics of HR management, development & personal management, functions and importance of HR management, machines v/s human resources in hospitals, causes for poor HR management, good HR practices

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=VdKehUxhtpw

Unit III

Man Power Planning: Introduction, nature & scope of man power planning, need for man power planning, Benefits of manpower planning, objectives of manpower planning, manpower planning steps, work load ratio

Recruitment: introduction, recruitment, selection, induction, confirmation, probation & termination

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=wilqUFJmHW4 https://www.youtube.com/watch?v=-J5rHlCDkto

Unit IV

Organizational Development & Management By Objectives (MBO): nature & scope, goals and characteristics, phases and limitations, definition & need for MBO, establishment of objectives, appraisal interview, practice, limitations and advantages of MBO

Communication In Hospitals: Introduction, nature and scope, purpose, barriers, planning communication, effective communication, directions, styles and modes of communication

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=K57rvR2nGu0 https://www.youtube.com/watch?v=VIVqdPzpfEI

Unit V

Counseling In Hospitals: Introduction, nature and scope, role of listening, counseling service, effective listening, types, techniques and functions of counseling

Health Care Waste and Biomedical Waste Management

Definition, Classification, Biomedical Waste Management steps involved, segregation, colour coding, waste collection, transportation, Record keeping and updating

- Pedagogy: Chalk board, power point presentations
- Links: https://www.youtube.com/watch?v=CICQFABLjy0 •

Text Books:

- 1. D K Sharma & R C Goyal, Hospital Administration & Human Resource Management, PHI 5th edition (2013)
- 2. A V Srinivasan, Managing A Modern Hospital, SAGE publications, 2nd edition (2008)
- 3. Guidelines for Management of Healthcare Waste as per Biomedical Waste Management Rules. 2016

Reference Books:

1. Robert Carroll, Risk Management for Healthcare Organizations, Wiley Publications, 2009 edition

Course Outcomes (COs):

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

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

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	Marks	Course outcomes addressed
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other components		
Multiple choice questions	10	CO1, CO2
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Course Assessment and Evaluation:

MINI PROJECT	
Course Code: MDP67	Credits: 0:0:3
Prerequisite: Nil	Contact Hours: 42P
Course Coordinator: Dr. Uma Arun and Dr. Tejaswini S	

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

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

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

Course Outcomes (COs):

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

- 1. Understand and demonstrate the process of implementing the engineering concepts in real time application (PO: 1,2,4,9, PSO: 1,2)
- 2. Clearly identify and justify the problem statement with purpose (PO: 2,3,4,5,8,9, PSO: 2,3)
- 3. Works with a group thereby able to practice professional values (PO: 2,3,4,5, PSO: 2,3)

INNOVATION/SOCIETAL/ENTREPRENEURSHIP BASED INTERNSHIP

Course Code: INT68

Credits: 0:0:2

Prerequisite: Nil

Contact Hours: -

Course Coordinator: Dr. S J Mahendra & Dr. C K Narayanappa

Course Contents

Students are required to carry out training in a medical electronics industry or research organization or with a start-up firm or super specialty hospital for not less than four weeks after 4th or during 5th semester. The internship addresses innovation/societal contributions or should evolve a student's entrepreneurial skill sets. Students are required to submit a report on the same in the format provided by the internship committee at the department. The students will be evaluated by the training committee based on the rubrics informed to students by the committee.

Course Outcomes (COs):

On successful completion of this course, students will be able to

- Analyze the functional aspects of biomedical systems/blocks (PO-2,4,7,11,12, PSO-1,2,3)
- Enhance the communication to work • skills in interdisciplinary teams in industry/organization. (PO-9, 10, PSO-2,3)
- Realize the professional and ethical responsibility. (PO-6, 7, 8, PSO-2, 3) •