SEMESTER VII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MD16701	Human Assist Devices	3	0	0	3
2	PC	MD16702	Medical Image Processing	3	0	0	3
3	PC	MD16703	Healthcare and Hospital Management	3	0	0	3
4	PE	MD1635*	Professional Elective-III	3	0	0	3
5	PE	*******	Professional Elective-IV	3	0	0	3
6	OE	MD169**	Open Elective-II	3	0	0	3
Practicals							
7	PC	MD16704	Medical Image Processing Laboratory	0	0	4	2
8	EE	MD16705	Hospital Internship Training	0	0	2	1
9	EE	MD16706	Project Work Phase I	0	0	4	2
			Total	**18**	**0**	**12**	**23**

(Hospital Internship will be 2 weeks continuous training which carries one credit)

SEMESTER VIII

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	MD1655*	Professional Elective V	3	0	0	3
2	PE	MD1665*	Professional Elective VI	3	0	0	3
3	EE	MD16801	Project Work Phase II	0	0	12	6
			Total	**6**	**0**	**12**	**12**
			Cumulative Total	**132**	**14**	**80**	**180**

PROFESSIONAL ELECTIVE COURSES (PE)

S.No.	Category	Course Code	Course Title	L	T	P	C
Professional Elective-I							
1	PE	MD16151	Robotics and Automation	3	0	0	3
2	PE	MD16152	Neural Networks and its applications	3	0	0	3
3	PE	MD16153	Bio MEMS	3	0	0	3
4	PE	MD16154	Nano Technology and its applications	3	0	0	3
Professional Elective-II							
5	PE	MD16251	VLSI Design	3	0	0	3
6	PE	MD16252	Pattern Recognition	3	0	0	3
7	PE	MD16253	Medical Expert Systems	3	0	0	3
8	PE	MD16254	Introduction to Cloud Computing	3	0	0	3
Professional Elective-III							
9	PE	MD16351	Medical Devices Regulations	3	0	0	3
10	PE	MD16352	Rehabilitation Engineering	3	0	0	3
11	PE	MD16353	Fundamentals of Nano science	3	0	0	3
12	PE	MD16354	Medical Ethics and Safety	3	0	0	3
Professional Elective-IV							
13	PE	MD16451	Smart Wearable Systems	3	0	0	3
14	PE	MD16452	Fundamentals of Biomedical Nanotechnology	3	0	0	3
15	PE	MD16453	Advanced Medical Instrumentation Technology	3	0	0	3
16	PE	IT16454	Introduction to Mobile App Development	3	0	0	3
Professional Elective-V							
17	PE	MD16551	Artificial Organs and Implants	3	0	0	3
18	PE	MD16552	Embedded Systems and IOT in Healthcare	3	0	0	3
19	PE	MD16553	Body Area Networks	3	0	0	3
20	PE	MD16554	Telehealth Technology	3	0	0	3
Professional Elective-VI							
21	PE	MD16651	Virtual Bio Instrumentation	3	0	0	3
22	PE	MD16652	Digital Video Processing	3	0	0	3
23	PE	MD16653	Quality Control in Biomedical Engineering	3	0	0	3
24	PE	MD16654	Brain Computer Interface and its Applications	3	0	0	3
			Total	**18**	**0**	**0**	**18**

OPEN ELECTIVE COURSES (OE)

S.No.	Category	Course Code	Course Title	L	T	P	C
OPEN ELECTIVE COURSE -I							
1	OE	MD16901	Biomedical Equipments	3	0	0	3
2	OE	MD16902	Basics of Bioinformatics	3	0	0	3
OPEN ELECTIVE COURSE –II							
3	OE	MD16903	Product design and development	3	0	0	3
4	OE	MD16904	Analytical Methods and Instrumentation	3	0	0	3
			Total	**12**	**0**	**0**	**12**

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	EE	EN16501	Carrier Development Laboratory I	0	0	2	1
2	EE	EN16601	Career Development Laboratory II	0	0	2	1
3	EE	MD16606	Mini Project	0	0	4	2
4	EE	MD16705	Project Work Phase I	0	0	4	2
5	EE	MD16706	Hospital Internship Training	0	0	0	1
6	EE	MD16801	Project Work Phase II	0	0	12	6
			Total	**0**	**0**	**24**	**13**

ONE CREDIT COURSES

S.No.	Category	Course Code	Course Title	L	T	P	C
1	OCC	MD16951	Embedded Programming using ARDUINO	0	0	2	1
2	OCC	MD16952	PC Hardware Assembling and Troubleshooting	0	0	2	1
3	OCC	MD16953	Basic Electronic Circuit Design using Multisim	0	0	1	1
4	OCC	MD16954	MATLAB Programming	0	0	2	1
5	OCC	MD16955	Labview Programming	0	0	2	1
6	OCC	MD16956	Open source programming using Linux	0	0	1	1
7	OCC	MD16957	PCB Design using KICAD EDA Tool	0	0	2	1
8	OCC	MD16958	VHDL Programming	0	0	1	1

MD16701 **HUMAN ASSIST DEVICES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- study various mechanical techniques that will help failing heart.
- learn the functioning of the unit which does the clearance of urea from the blood.
- understand the tests to assess the hearing loss and development of electronic devices
- know the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- understand electrical stimulation techniques used in clinical applications.

UNIT I CARDIAC ASSIST DEVICES **9**

Principle of External counter pulsation techniques, Intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, Prosthetic heart valves. Drug delivery systems for cardiovascular ailments. Implantable defibrillators.

UNIT II HEMODIALYSERS **9**

Artificial kidney, Dialysis action, Hemodialyzer unit, Membrane dialysis, Portable dialyzer monitoring and functional parameters, Automated insulin delivery systems for type 1 diabetes people. Orthopedic Prosthetics in Rehabilitation.

UNIT III HEARING AIDS **9**

Common tests – Audiograms, Air conduction, Bone conduction, Masking techniques, SISI, Hearing aids – principles, Drawbacks in the conventional unit, DSP based hearing aids. Augmentative and alternative communication.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES **9**

Hand and arm replacement – Different types of models, Externally powered limb prosthesis, Feedback in orthotic system, Hip & knee replacement, Spinal Orthoses,Ocular drug delivery,Sensory assist devices. Implantable stimulators for neuro muscular control, Measurement and analysis of Sensory – Motor performance.

UNIT V RECENT TRENDS **9**

Drug delivery systems in cancer therapy, Pain management – Chronic back pain ,3D-printed prosthetics and orthoses, Smart eyewear- Artificial iris, Regulation of software as a medical device.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- explain the functioning and usage of electromechanical units .
- analyze different types and uses of dialyzer units.
- discuss external devices that can work under supervision.
- outline the importance of patient safety against electrical hazard.
- describe the measurement techniques of sensory responses.

TEXTBOOKS

1. Albert M. Cook, Janice Miller Polgar, Pedro Encarnação, "Assistive Technologies - Principles and Practice ", Vol. I, II, IV, Elsevier - Health Sciences Division, 2019.
2. Tammy Gagne, "Artificial Organs", Focus Readers USA, May 2019.

REFERENCES

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.
2. Joseph D. Bronzino, Donald R. Peterson,"Medical devices and Human Engineering", Taylor & Francis Group, 30 Aug 2017.
3. Eric Chappel, "Drug Delivery Devices and Therapeutic Systems", Elsevier Science, 7 November 2020.
4. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2 nd Edition, Edition- 2003

CO-PO **Mapping**:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**
CO1			3		3	2			2			2		3
CO2		2	3	2	2		2		2					2
CO3		2	2	2	3	3		2		3			2	
CO4	2	2	3	2	3	3	1					3	3	
CO5	2	3	3	2	3			2		2				2

MD16702 MEDICAL IMAGE PROCESSING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the basic concept of image fundamentals.
- Identify the designing concept of post processing.
- familiarize medical image representation.
- acquire knowledge on medical image analysis.
- infer knowledge on image compression, recognition

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Introduction – Origin, Steps in Digital Image Processing, Components; Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationships between pixels; color models.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Spatial domain methods - point processing, intensity transformations, histogram processing, image subtraction, image averaging Spatial filtering, smoothening filters and sharpening filters Frequency domain methods LPF, HPF, Homomorphic filtering; Image Restoration - degradation model, Unconstrained and constrained restoration, Inverse filtering, Wiener filtering

UNIT III MEDICAL IMAGE REPRESENTATION 9

Medical Image Representation - Pixels and voxels, algebraic image operation, gray scale and color representation, depth, color and look up tables; Image file formats- DICOM, other formats, Analyze 7.5, NIF TI and Interfile; Image quality and the signal to noise ratio hectic;

UNIT IV MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation; Image representation and analysis; Feature extraction and representation - Statistical, Shape, Texture, feature and image classification; Classification Techniques- Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, feature based registration, Elastic deformation-based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze different domain of digital images.
- develop post processing techniques.
- apply image processing concepts for medical images.
- design and implement image processing applications that incorporates different concepts of medical Image Processing
- explore the possibility of applying Image processing concepts in modern hospitals.

TEXT BOOK

1. Rafael C. Gonzalez, "Digital Image Processing", 4th Edition, 2018, Pearson Publication
2. Wolfgang Birkfellner, "Applied Medical Image Processing- A Basic course", CRC Press, 2011.

REFERENCES

1. Atam P.Dhawan, "Medical Image Analysis" Wiley Interscience Publication, NJ, USA 2003
2. John L. Semmlow, "Biosignal and Biomedical Image Processing MATLAB Based applications", Marcel Dekker Inc., New York, 2004.
3. Kavyan Najarian and Robert Splerstor, "Biomedical signals and Image processing", CRC – Taylor and Francis, New York,2006.
4. Jayaram, Kudupa and Gabor,T Herman, "3D imaging in medicine", 2nd Edition, CRC press, 2000.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

MD16703 HEALTHCARE AND HOSPITAL MANAGEMENT **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- expose the students for planning and operation of hospitals in a detailed manner.
- impart the facts of hospital planning activities.
- teach the regulatory requirements and its standards.
- introduce the equipment maintenance management skills.
- expose how to protect equipment from electromagnetic interferences.

UNIT I HEALTH SYSTEM IN A HOSPITAL **9**

Health organization of the country, the State, The Cities and the Region, Health Financing System, Organization of Technical Section. Different Departments of Hospital, Recruitment, Selection, Training Guidelines **–**Methods of Training **–** Evaluation of Training **–** Leadership grooming and Training, Promotion – Transfer.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT **9**

Management of Hospital Organization, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Teamwork, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEALTH CARE CODES **9**

FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.International Standards- Medical Device Directive 93/42/EEC, Medical Electrical Equipment ISO 60601, Medical Device Inspection ISO17020. Indian Standards – Biomedical Equipment Management and Maintenance Program (BMMP), ISO 9001-2008, AERB Compliance – Radiation protection AE(RP)R-2004, Safety Code AE/RF-MED/SC-3.

UNIT IV EQUIPMENT AND ASSET MAINTENANCE MANAGEMENT **9**

Organizing Maintenance Operations, Paperwork Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance. Hospital Planning – Equipment Planning- AMC – Functional Planning.

UNIT V TRAINED TECHNICAL PERSONNEL **9**

Function of Clinical Engineer, Role to be performed in Hospital, Manpower Market, Professional Registration, Structure in Hospital. Support Service Technical Information Systems – Medical Transcription.

TOTAL PERIODS **45**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- expert in understanding the various health policies.
- planning activities at health care centers.

- equipment installation, service & calibration needs.
- organizing maintenance operations.
- function of a clinical engineer in a hospital.

TEXTBOOKS

1. Jacob Kline, "Handbook of Bio Medical Engineering", Academic Press Inc. SanDeigo 2017 – Fourth Edition.
2. Erickson Thomas, "Human Resource in Hospital Management", Global Vision Publishing House, 2019 Edition.

REFERENCES

1. Edda Weimann, Peter Weimann, "High Performance in Hospital Management - A Guideline for Developing and Developed Countries", Springer Berlin Heidelberg,22 May 2017.
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, ZijadDzemic, "Inspection of Medical Devices: For Regulatory Purposes", Springer Nature, 2018.
3. Cesar A.Caceres, "The Practice of Clinical Engineering", Elsevier Science, 2 December 2012.
4. "Joint Commission Accreditation Standards for Hospitals", 2nd Edition, 2003.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

MD16704 **MEDICAL IMAGE PROCESSING LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To provide practice to

- practice the basic image processing techniques.
- compute magnitude and phasor representation of images.
- understand the concepts of image restoration and segmentation.
- explore the applications of image processing techniques.
- study the various characteristics of analysis of bio-signals.

LIST OF EXPERIMENTS

1. Display of color and grayscale Images.
2. Histogram Equalization.
3. Spatial filtering and non linear filtering
4. Edge detection using operators
5. 2D DFT and DCT
6. Filtering in frequency domain
7. DWT of images
8. Steganography
9. Feature extraction of medical images
10. Medical Image Compression techniques
11. Medical Image fusion
12. Study of Dicom standards

TOTAL PERIODS 60

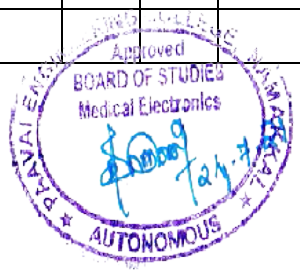
COURSE OUTCOMES

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

- Use transforms and analyse the characteristics of the image.
- Perform enhancing operations on the image using spatial filters and frequency domain filters.
- Perform segmentation operations in the images.
- Perform compression for images using various algorithms
- Apply image processing technique to solve real health care problems.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3



MD16705 HOSPITAL INTERNSHIP TRAINING 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- improve the skills by visiting the hospitals
- understand the working principle of various biomedical equipments
- able to work on the equipments through internship
- able to design the equipment prototype model

GUIDELINE FOR HOSPITAL INTERNSHIP AND TRAINING

The students may be grouped into 2 to 4 members by internship coordinator. The students will be allowed for hospital internship training for continuous 2 weeks. After the completion of Internship training, they will have to submit certificate and report to the Coordinator and Head of the Department. At the end of the semester examination, the Hospital Training report is evaluated based on oral presentation and is examined by department committee constituted by the Head of the Department.

TOTAL PERIODS 30

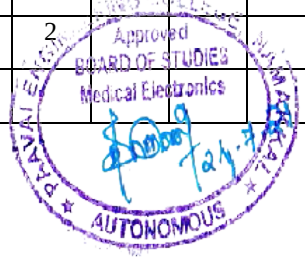
COURSE OUTCOMES

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

- formulate the real world problem, identify the requirement and develop the design
- identify the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques that contribute to obtain the solution of the
- analyze and validate through conformance of the developed prototype and analysis the
- explain the acquired knowledge through preparation of report and oral presentations.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3



MD16706 PROJECT WORK PHASE I 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- improve the skills to formulate a technical project.
- explain the various tasks of the project and standard procedures.
- teach the use of new tools, algorithms and techniques required to carry out the projects
- analyze the various procedures for validation of the product and analyze the cost effectiveness
- examine the technical report of the project

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped upto maximum of 4 members and work under a project supervisor. The prototype/simulation may be decided in consultation with the supervisor. A Project Work Phase I Report to be submitted by the group and the prototype model, which will be reviewed and evaluated for internal assessment by a Committee Constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the Project Work Phase I report is examined jointly by external and internal examiners constituted by the Controller of Examination. It is highly desirable to publish their Project Idea in State/ National level conferences or Symposiums.

TOTAL PERIODS 60

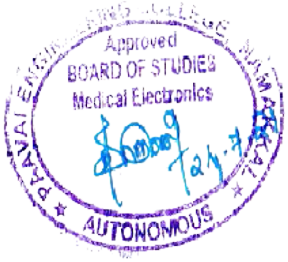
COURSE OUTCOMES

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

- formulate the real world problem, identify the requirement and develop the design solutions.
- identify the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques that contribute to obtain the solution of the project
- analyze and validate through conformance of the developed prototype and analysis the cost effectiveness
- explain the acquired knowledge through preparation of report and oral presentations.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16801 PROJECT WORK PHASE II 0 0 12 6

COURSE OBJECTIVES

To enable the students to

- improve the skills to formulate a technical project.
- explain the various tasks of the project and standard procedures.
- teach the use of new tools, algorithms and techniques required to carry out the projects
- analyze the various procedures for validation of the product and analyze the cost effectiveness
- examine the technical report of the project

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into maximum of 4 members and work under a project supervisor. The process of fabrication has to be completed and submitted to the supervisor. The device/system/component to be prototype based; may be decided in consultation with the supervisor. A Project work Phase II Report to be submitted by the group and the prototype model, which will be reviewed and evaluated for internal assessment by a Committee Constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the Project Work Phase II Report is examined jointly by external and internal examiners constituted by the Controller of Examination. It is highly desirable to publish their Project in state/ national level conferences or Symposiums

TOTAL PERIODS 180

COURSE OUTCOMES

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

- formulate the real world problem, identify the requirement and develop the design solutions.
- identify the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques that contribute to obtain the solution of the project
- analyze and validate through conformance of the developed prototype and analysis the cost effectiveness
- explain the acquired knowledge through preparation of report and oral presentations.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

PROFESSIONAL ELECTIVE III

MD16351 MEDICAL DEVICES REGULATIONS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- define the basic concepts of medical device regulations
- discuss the global policies on medical device regulations
- analyze implications of the regulations
- analyze the way design concepts are imbibed in practical scenarios.
- teach the concept about medical device quality assurance

UNIT I INTRODUCTION OF MEDICAL DEVICE AS AN ENTITY 9

The medical device as an entity - Medical Device definition, the product definition process, QFD process, the business proposal reliability: Definition, types of reliability, reliability's effects on medical devices; Concept of failure - causes of failure, practical aspects of failure, failure rates, hardware failure, software failure, failure due to the human errors, failure from the customer point of view, safety and risk management, effectiveness/ performance of medical devices, phases in the life span of a medical device, the risk management processes, tool for risk estimation, shared responsibility for medical device safety and performance.

UNIT II GLOBAL HARMONIZATION TASK FORCE 9

Global Harmonization Task Force (GHTF)- Objectives, Scope of the four GHTF study groups, Benefits of the GHTF, Final documents from the GHTF, Global Medical Device Nomenclature (GMDN); Food and Drug Administration- History of device regulation, Device classification, Registration and listing, The 510 (k) Process, Declaration of conformance to a recognized standard, The PMA application, Investigational Device Exemptions (IDEs), Good Laboratory Practices (GLPs), Good Manufacturing Practices(GMPs), Human Factors, Design Control, The FDA and Software, Software classification, The FDA Inspection.

UNIT III GLOBAL POLICIES ON MEDICAL DEVICE REGULATIONS 9

The European Union: European Directives, European Standardization Bodies, European Standards Development Process, Other European Standards Considerations, Conformity Assessment and Testing, European Organization for Testing and Certification, the NVCASE Program; Medical Devices Directive- Medical Devices Directives process, Identifying the applicable essential requirements, Identification of harmonized standards, Classification of the medical devices, identification and choice of a notified body.

UNIT IV STANDARDS AND REGULATIONS BACKGROUND 9

Standards and Regulations background: standards: what are standards? Voluntary and mandatory standards, standards development process, conformity assessment with standards, national and international of standards systems, identification of standards, current trends in the use of standards in medical device regulations. The ISO 9000 series of standards

UNIT V SOFTWARE AND QUALITY SYSTEM REGULATION 9

Software and Quality system regulation: Software as a Technology, Domestic Software Regulations, Domestic Software Standards, International Software Regulations, International Software Standards, The Move Toward One Software Standard History of the quality system regulations, Scope, General provisions, Quality system, Design controls, Document controls, Purchasing controls, Identification and traceability, Production and process controls, Acceptance activities, Non-conforming product, Corrective and preventive action

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- define and explain the basic concepts of medical device regulations
- illustrate the global policies on medical device regulations
- understand the design of concepts are imbibed in practical scenarios
- explain the regulations of medical devices
- interpret the software and quality system regulation

TEXT BOOKS

1. Reliable Design of Medical Devices, Second Edition by Richard Fries, CRC Press, 2006
2. Medical Device Quality Assurance and Regulatory Compliance by Richard C Fries, CRC Press, 1998.

REFERENCES

1. Michael Cheng , "Medical device regulations: global overview and guiding principles", World Health Organization
2. Aseem Sahu, "Regulatory requirements for medical devices including in vitro diagnostics in INDIA", NPTEL Textbooks
3. Product Safety in the European Union by GaborCzitan, Attila Gutassy, Ralf Wilde, TUVR he inland Akademia, 2008.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

Approved BOARD OF STUDIES Medical Electronics
PRAVAI AUTONOMOUS

MD16352 **REHABILITATION ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- explain the need for medical aids.
- understand the sensory rehabilitation systems.
- learn the use of the orthopedic prosthetics and orthotics in rehabilitation.
- understand the virtual reality.
- have an understanding of rehabilitation medicine and advocacy.

UNIT I INTRODUCTION **9**

Definition - Impairments, Disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – Members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT II ENGINEERING CONCEPTS IN SENSORY REHABILITATION ENGINEERING **9**

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, Cochlear implants, Visual auditory substitution, Tactual auditory substitution. Tactual system-Tactual augmentation, Tactual substitution, Computerized wheelchairs – Ergonomics of wheelchair propulsion.

UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS IN REHABILITATION **9**

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, Externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation Systems-Restoration of hand function, Restoration of standing and walking, Hybrid Assistive Systems (HAS), MARCUS intelligent hand prosthesis.

UNIT IV VIRTUAL REALITY IN REHABILITATION **9**

Introduction to virtual reality, Virtual reality-based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V REHABILITATION MEDICINE AND ADVOCACY **9**

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Trends in the rehabilitation of the long-term ill and severely disabled, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

TOTAL PERIOD 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- understand the key terminologies used by the rehabilitation team.
- devise new concepts for future development and applications.
- design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation.
- understand the need of virtual reality tools for different aids.
- appreciate the legal aspects for building rehabilitation aids for the needed people.

TEXTBOOKS

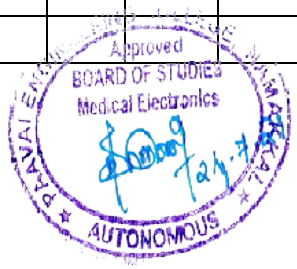
1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press,2000.
2. Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006.

REFERENCES

1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- NocholaiTeodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
4. Rory A Cooper (Editor), HisaichiOhnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering" CRC Press, 2006.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16353 **FUNDAMENTALS OF NANO SCIENCE** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- explain the basic principles of Nanotechnology .
- learn the aspects based on bimolecular synthesis of nanomaterials.
- learn about the advantages of nanomaterials in medicine.
- familiarize about biosensors and its application in nanotechnology
- acquire knowledge on applications of future technological advancements and increasing role of nanotechnology in biomedical industries.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenge of nanoscience and nanotechnology, influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. Methods of production of nanoparticles.

UNIT II NANOTECHNOLOGY AND BIOMOLECULES 9

DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications.

UNIT III NONMATERIAL IN MEDICINE 9

Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing. PRODUCTION OF NANOPARTICLES 10 hrs. Physical, chemical, biological methods, fabrication technology, characterization, micro fluidic- concepts, nano mechanics

UNIT IV NANOTECHNOLOGY AND BIOSENSOR 9

Principles, DNA and nucleotide-based biosensors, Protein-based biosensors, Materials for biosensor applications, Fabrication of biosensor devices, Detection in Biosensors – fluorescence, absorption, electrochemical methods, Techniques used for microfabrication, Future direction in biosensor research.

UNIT V NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

Nanoparticles and Micro–organism. Biochips- Integrated nanosensor networks for detection and response. Natural nanocomposite systems - spider silk, bones, shells . Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis. Tissue Engineering – Neuroscience -Neuro-electronic Interfaces .Nanorobotics– Photodynamic Therapy - Protein Engineering . Nanosensors in Diagnosis–Drug delivery.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- relate any architecture and assembly language for a processor.
- comprehend the architectural and pipelining concepts for microprocessors.
- design and deploy the interfacing peripherals in real time scenario.
- design, develop and trouble shoot microcontroller-based system.
- describe the measurement techniques of sensory responses

TEXT BOOKS:

1. Levine S.N. (ed), "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968
2. Kolff W.J, "Artificial Organs", John Wiley and sons, New York, 1976.

REFERENCES:

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010
2. Albert M.Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey,1982
3. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering CRC Press, 2006.
4. Warren E. Finn,Peter G. LoPresti; Handbook of Neuroprosthetic Methods CRC; edition 2002.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**
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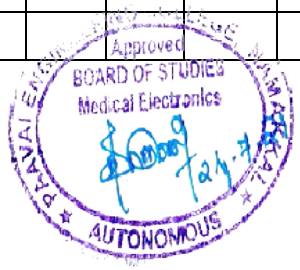
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16354 MEDICAL ETHICS AND SAFETY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on basic medical ethical codes
- know about Medical Standards and Regulations
- know about the legal and ethical principles and application of these principles in health care settings
- gain knowledge about the medical standards that to be followed in hospitals.
- learn about suitable principles of medical equipment safety standards in hospitals

UNIT I INTRODUCTION TO MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and the Patient, The Doctor and the Profession, Professional Independence, The Doctor and Society.

UNIT II ETHICAL THEORIES & MORAL PRINCIPLES 9

Theories-Deontology& Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles - Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research, Bioethical issues in Human Genetics & Reproductive Medicine.

UNIT III MEDICAL DEVICES STANDARDS 9

Medical Standards and Regulations – Device classification – Registration and listing – Declaration of conformance to a recognized standard – Investigational Device Exemptions – Institutional Review Boards – IDE format – Good laboratory practices – Good manufacturing practices.

UNIT IV MEDICAL DEVICES HANDLING, ENVIRONMENTAL SAFETY 9

Safe medical devices – Handling and operation – Medical Application safety – Usability – Clinical assessment – Environmental safety- General ethical issues.

UNIT V RELIABILITY AND ELECTRICAL SAFETY TESTING 9

Reliability – Types of reliability – Reliability optimization & assurance – Reliability's effect on medical devices – The concept of failure – Causes of failure – Types of Failures in Medical devices – Safety testing – Device specific safety goals, Failure assessment and Documentation, Electrical Safety – Biological aspect – Limitation of Voltages - Macroshock and Microshock – Earth and Protection – Leakage currents – Magnetic fields and compatibility

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- identify the scope of medical ethics
- illustrate the concepts of ethical theories and moral principles for the health professions
- explain the purpose of medical standards
- summarize the importance of hospital safety standards
- recommend the suitable principles of medical equipment safety standards in hospitals

TEXT BOOKS:

1. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada. 2009
2. Richard Fries, "Reliable Design of Medical Devices – Second Edition", CRC Press, Taylor & Francis Group, 2006.

REFERENCES:

1. Norbert Leitgeb "Safety of Electro-medical Devices Law – Risks – Opportunities" Springer Verlog, 2010.
2. Robert M Veatch, "Basics of Bio Ethics", Second Edition. Prentice- Hall, Inc. 2003
3. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003.
4. Physical Environment Online: A Guide to The Joint Commission"s Safety Standards is published by HCPro, Inc., 2010.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	3	3	2	2	2								3	3
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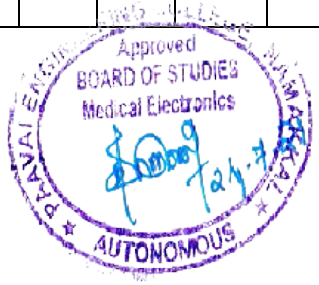
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



PROFESSIONAL ELECTIVE IV

MD16451 SMART WEARABLE SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the fundamentals of sensors
- learn the analysis of wearable systems
- understand the concept of wearing devices which consumes various energy harvesting techniques
- learn the various networks which is used in the wireless health systems
- understand the applications of wearable systems

UNIT I SENSORS 9

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS – Based Biosensors, E-Textiles, Bio compatibility

UNIT II SIGNAL PROCESSING 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Data mining

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES 9

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT IV WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics

TOTAL PERIODS 45

COURSE OUTCOMES

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

- familiarize with the principles of various types of sensors
- choose appropriate sensors and signal processing techniques for wearable systems
- assess the energy requirement for a wearable system
- evaluate the security issues related to wearable systems
- identify the application of wearable systems

TEXT BOOKS:

1. Annalisa Bonfiglio,Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.
1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety,Security, and Sustainability," Cambridge University Press, 2013.

REFERENCES:

2. Hang,Yuan-Ting,"wearable medical sensors and systems",Springer-2013
3. Mehmet R. Yuce,Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation and Applications",Pan Stanford Publishing Pvt.Ltd, Singapore, 2012
4. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer, 2006
5. Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
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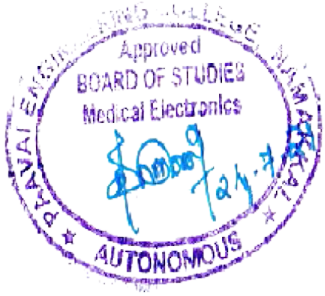
CO1	1	3	3	3		3	3				3	3	3	3
CO2	1	3	3	3		3	3				3	3	3	3
CO3	1	3	3	3									3	3
CO4	1	3	3	3							3	3	3	3
CO5	3	2	2			2		3		3		3	3	3



MD16452 FUNDAMENTALS OF BIOMEDICAL NANOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- explain the basic principles of Nanotechnology .
- learn the aspects based on bimolecular synthesis of nano materials.
- learn about the advantages of nano materials in medicine.
- familiarize about biosensors and its application in nanotechnology
- acquire knowledge on applications of future technological advancements and increasing role of nanotechnology in biomedical industries.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. Methods of production of nanoparticles.

UNIT II NANOTECHNOLOGY AND BIOMOLECULES 9

DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications.

UNIT III NONMATERIAL IN MEDICINE 9

Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing. Production of Nanoparticles: Physical, chemical, biological methods, fabrication technology, characterization, micro fluidic-concepts, nano mechanics

UNIT IV NANOTECHNOLOGY AND BIOSENSOR 9

Principles, DNA and nucleotide-based biosensors, Protein-based biosensors, Materials for biosensor applications, Fabrication of biosensor devices, Detection in Biosensors – fluorescence, absorption, electrochemical methods, Techniques used for microfabrication, Future direction in biosensor research.

UNIT V NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

Nanoparticles and Micro–organism. Biochips- Integrated nano sensor networks for detection and response. Natural nanocomposite systems - spider silk, bones, shells. Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis. Tissue Engineering – Neuroscience -Neuro-electronic Interfaces .Nanorobotics– Photodynamic Therapy - Protein Engineering . Nanosensors in Diagnosis–Drug delivery.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- acquire the knowledge on basic principles of Nanotechnology .
- apply the aspects based on bimolecular synthesis of nano materials.
- explore about the advantages of nano materials in medicine.
- familiarize about biosensors and its application in nanotechnology
- apply the knowledge on applications of future technological advancements and increasing role of nanotechnology in biomedical industries.

TEXT BOOK

1. Neelina H. Malsch, "Biomedical Nanotechnology", Taylor & Francis Group, 19 Sep 2019.
2. Mauro Ferrari, Sangeeta N. Bhatia, Tejal Desai , "BioMEMS and Biomedical NanotechnologyVolume III: Therapeutic Micro/Nanotechnology · Volume 3", Springer US,1st illustrated reprint edition , 23 November 2010 .

REFERENCES

1. Emily S. Day, Sarah Hurst Petrosko, "Biomedical NanotechnologyMethods and Protocols", Springer New York, 9 June 2018 .
2. Chris Binns, "Introduction to Nanoscience and Nanotechnology", Wiley,16 June 2010.
3. Pieterson, "Fundamentals of Biomedical Nanotechnology" Routledge publication, 2017
4. B.S.Murty, "Textbook of Nanoscience and Nanotechnology", Springer , 2015

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
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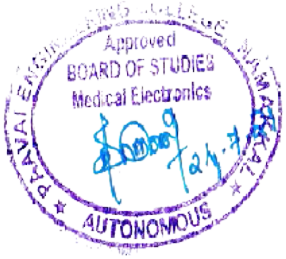
CO4	3	2	2	2	2								3	3
CO5	3	2	2	2	2	2	2						3	3



MD16453 ADVANCED MEDICAL INSTRUMENTATION TECHNOLOGY **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the advanced understanding of biomedical instrumentation.
- learn the various assistive devices systems and monitoring equipments
- learn the working principle of various radiography and diathermy equipments
- learn the ultrasonic and neonatal instruments
- understand the need of various biological safety instruments

UNIT I BIOMEDICAL SIGNALS & ELECTRODES **9**

Sources of biomedical signals, Basic medical instrumentation system, Medical surface electrodes and problems, Microelectrodes. Electrocardiograph-block diagram, ECG leads, Faults and troubleshooting, Phonocardiograph-origin of heart sounds, microphones and amplifiers for PCG, Operating Rooms

UNIT II ASSISTIVE DEVICES CARDIAC SYSTEM AND MONITORS **9**

Cardiac Pacemekers, Heart lung machine. Different types of Oxygenators, Pumps, Monitoring Process. Hemodialyser- Principle of Hemodialysis, Membranes, Dialyasate, Different types of heamodialysers, Wearable Artificial Kidney, Implantable Type. Defibrillators, Implantable defibrillators, Functional electrical stimulator (FES)

UNIT III RADIOLOGICAL, SURGICAL SCOPY AND DIATHERMY EQUIPMENTS **9**

Digital radiography, Digital Fluroscopy, Mammography, Angiography, Bone densitometry, Endoscopy, Laparoscopy Bronchoscopy, Gastroscopy, Physiological effects of HF radiation, Depth of Penetration, Short wave, Ultrasonic and microwave diathermy, Surgical diathermy,

UNIT IV ULTRASONIC AND NEONATAL INSTRUMENTS **9**

Basic principles of Echo technique, display techniques A, B, M modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynecology. Infusion Pumps. Baby incubator, Phototherapy, Radiant warmer - Working principle, block diagram, description, and function of basic blocks, Construction of bio signals using Python,

UNIT V BIOTELEMETRY, TELEMEDICINE AND SAFETY MEASUREMENTS **9**

Elements of Biotelemetry system, Design of a biotelemetry system, Implantable Units-Problems, Application of Telemetry in Patient Care. Fundamentals of Telemedicine, Block diagram of Telemedicine, Scope & Benefits and Limitation of Telemedicine. Applications –Teleradiography, Telecardiology, Telesurgery. Electric shock hazards – Gross shock, Effects on human body, Micro and macro electric shock, Leakage current and types, Testing of Biomedical Equipments.

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- familiarize with the principles of various types of biomedical signals and electrodes.
- choose appropriate assistive devices cardiac system and monitor.
- assess the radiological, surgical scopy and diathermy equipments
- assess the Ultrasonic and neonatal instrument
- identify the application of biotelemetry and telemedicine

TEXT BOOKS:

1. Joseph J Carr and John M Brown, "Introduction to Biomedical equipment Technology" Pearson Education 4th edition New Delhi 2001.
2. Webster J G ,"Medical Instrumentation Application and Design" Prentice Hall Nee York 2009

REFERENCES:

1. Jacobson B and Webster J G, "Medical and Clinical Engineering", Prentice Hall of India New Delhi 1999
2. Leslie Cromwell, Fred J.Weibell and Erich A.P.Feiffer, "Biomedical Instrumentation", Prentice Hall New Delhi 2000
3. Khandpur R.S, "Hand Book of Biomedical Instrumentation", Tata McGraw Hill publication , New Delhi 2nd edition 2003
4. Anthony Y. K. Chan, "Biomedical Device Technology: Principles and Designs", Pearson Publication , 2009

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Cos	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**
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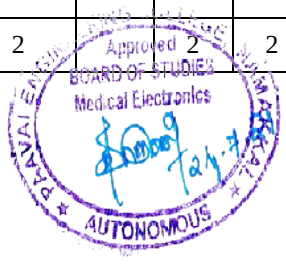
CO2	1	3	3	3		3	3				3	3	3	3
CO3	1	3	3	3									3	3
CO4	1	3	3	3							3	3	3	3
CO5	3	3	2	3		2		2	2	2	3	3	3	3



IT16454 INTRODUCTION TO MOBILE APP DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand system requirements for mobile applications.
- generate suitable design using specific mobile development frameworks.
- generate mobile application design.
- implement the design using specific mobile development frameworks
- deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION 9

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile application.

UNIT II BASIC DESIGN 9

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – user interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN 9

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV TECHNOLOGY I - ANDROID 9

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V TECHNOLOGY II – IOS 9

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the requirements for mobile applications.
- explain the challenges in mobile application design and development.
- develop design for mobile applications for specific requirements.

- implement the design using Android SDK.
- implement the design using Objective C and iOS.

TEXT BOOK

1. Jeff Mc Wherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, Dream Tech, 2012

REFERENCES

1. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013
3. Jeff McWherter and Scott Gowell , “Professional Mobile Application Development”, Phi, 2012
4. Kamal Kant Hiran,“Mobile Applications Development: with Python in Kivy Framework”, Gruyer Publication, 2017

CO-PO Mapping:

Mapping of course objectives with PO’s and PSO’s (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	3										3	3
CO2	3	3	2										3	3
CO3	3	3	3			2	2						3	3
CO4	3	3	2										3	3
CO5	3	3	2			2	2						3	3

PROFESSIONAL ELECTIVE V

MD16551 **ARTIFICIAL ORGANS AND IMPLANTS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- have an overview of artificial organs & transplants
- describe the principles of implant design with a case study
- explain the implant design parameters and solution in use
- study about various blood interfacing implants
- study about soft tissue replacement and hard tissue replacement

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS 9

Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN 9

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS 9

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS 9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, students will be able to

- gain adequate knowledge about artificial organs & transplants
- get clear idea about implant design and its parameters and solution
- have in-depth knowledge about blood interfacing implants
- explain different types of soft tissue replacement and hard tissue replacement
- undergo the applications of implantable medical devices and organs

TEXT BOOKS

1. J D Bronzino, Biomedical Engineering Handbook, Fourth Edition, (CRC Press), 3 Oct 2018.
2. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 16 June 2014.

REFERENCES

1. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
2. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003
3. Joon B Park, Biomaterials – An Introduction, Plenum press, New York, 1992.
4. Yannas, I. V, —Tissue and Organ Regeneration in Adults‖, New York, NY: Springer, 2001. ISBN: 9780387952147.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Cos	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

MD16552 EMBEDDED SYSTEMS AND IOT IN HEALTHCARE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- teach the internet concepts and design methodology
- teach fundamentals of embedded system
- teach importance of embedded and iot in health care.
- learn the ethical issues involved in the healthcare
- gain knowledge about applications of iot in healthcare

UNIT I INTERNET CONCEPTS AND INFRA STRUCTURE 9

Broad Band Transmission facilities, Open Interconnection standards, Local Area Networks, Wide Area Networks, Network management, Network Security, Cluster computers. Internet concepts, Capabilities and limitations of the internet. Interfacing Internet server applications to corporate databases HTML and XML Web page design through programming and the use of active components.

UNIT II DESIGN METHODOLOGY AND PROTOCOLS 9

Introduction, Characteristics, Physical design, Protocols, Logical design, Enabling technologies, IoT Levels, Domain Specific IoTs, IoT vs M2M. IOT design methodology, IoT systems management, IoT Design Methodology Specifications Integration and Application Development.

UNIT III EMBEDDED SYSTEMS 9

Generic Embedded Systems Structure- Components of Embedded Systems- Sensors and Actuators- importance of Analog/Digital Conversion- Embedded system based physiological monitoring system- Health care innovations using embedded system. Evolution of digital health- challenges and opportunities of digital health- importance of digital health.

UNIT IV ETHICAL ISSUES IN HEALTH CARE 9

Ethical implications of digital health technologies- privacy, confidentiality and security of personal health data-ethical framework and guidelines in digital health, principles of biomedical ethics..

UNIT V IOT IN HEALTH CARE APPLICATIONS 9

IoT based health care- physiological parameter monitoring system- future challenges in health care- health care echo system with IoT- IoT for personalized health care- wearable device characteristics- analysis of power aware protocols.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- acquire the knowledge & concepts of IoT.
- explain the basic concepts of IoT protocols.
- illustrate the concepts of embedded system for health care applications.
- criticize the ethical issues in health care.
- develop an application based on IoT in health care.

TEXT BOOKS

1. Eugene C. Nelson, Paul B. Batalden, Marjorie M. Godfrey, "Quality By Design: A Clinical Microsystems Approach" John Wiley & sons 2007.
2. Samuel A. Fricker, Christoph Thuemmler, Anastasius Gavras, "Requirements Engineering for Digital Health", Springer 2015.

REFERENCES

1. Klaus Pohl, Harald Honninger, Reinhold Achatz, Manfred Broy, "Model-Based Engineering of Embedded Systems: The SPES 2020 Methodology", Springer 2012
2. Adrian Mc Ewen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013.
3. Andrew S Tanenbaum, "Computer Networks", Pearson Education Pvt Ltd, New Delhi, 4th Edition, 2012.
4. Stallings, William, "Data and computer communications", Pearson Education Pvt Ltd, New Delhi, 2007

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
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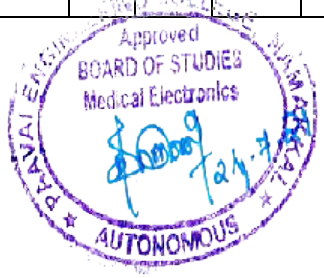
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16553 BODY AREA NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce the basic concepts of BAN
- know the hardware requirement of BAN
- understand the communication and security aspects in the BAN
- explore the coexistence issues with BAN
- know the applications of BAN in the field of medicine

UNIT I INTRODUCTION 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna- Flexible PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

UNIT IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN USING IoT 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- comprehend and appreciate the significance and role of this course in the present contemporary world.
- design a BAN for appropriate application in medicine.
- assess the efficiency of communication and the security parameters.

- understand the need for medical device regulation and regulations followed in various regions.
- extend the concepts of BAN for medical applications.

TEXT BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013.

REFERENCES:

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006.
3. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012.
4. Huan-Bang Li, NICT, Kamya Yekeh Yazdandoost, NICT, Bin Zhen, NICT , "Wireless Body Area Networks", River Publishers, 2010

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
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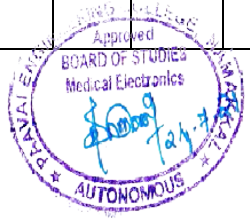
CO5	3	3	2	2	2	3	3						3	3



MD16554 TELEHEALTH TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the Series History and Evolution of telemedicine
- teach the functional diagram of telemedicine system
- teach the concept about telemedical data security and standards
- know about the Social and legal issues, Safety and regulatory issues and Advances in Telemedicine.
- gain knowledge about the health education and self care services

UNIT I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing.clinical data–local and centralized

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- learn objectives of Tele health, Telecare and Organs of telemedicine.
- learn the Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications.
- learn Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN).
- learn Basic parts of teleradiology system.
- work on the application of robotics surgery, tele surgery, Tele cardiology and Teleoncology.

TEXT BOOKS

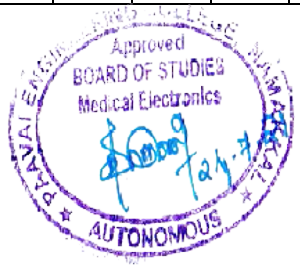
1. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), "Handbook of Telemedicine". IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
2. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). "Handbook of Medical Informatics". Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

REFERENCES

1. Norris, A.C. "Essentials of Telemedicine and Telecare". Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems",. Springer (ISBN 0-387-95474-0), 2003
4. Bernard Fong, "Telemedicine Technologies", Information Technologies and Health, Wiley, 2010

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



PROFESSIONAL ELECTIVE VI

MD16651 **VIRTUAL BIO INSTRUMENTATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- review background information required for studying virtual instrumentation
- study the basic building blocks of virtual instrumentation.
- study the various techniques of interfacing of external instruments of PC.
- make the student become competent in using state of the art VI tools.
- study a few applications in virtual instrumentation.

UNIT I INTRODUCTION **9**

History of Virtual Instrumentation(VI), advantages, block diagram and architecture of a virtual instrument, Programming paradigms – Virtual Instrumentation – LabVIEW software – LabVIEW basics – LabVIEW environment.

UNIT II VI USING LABVIEW **9**

Creating, Editing and debugging a VI in LabVIEW – Creating a sub VI – Loops and charts – Case and sequence structures – File I/O – VI customization –Applications of LabVIEW in displaying and monitoring vital parameters

UNIT III DATA ACQUISITION AND CONTROL IN VI **9**

Virtual Instrumentation Software Architecture (VISA), instrument drivers, serial and parallel interfaces: RS232, USB, fire wire, controller area network (CAN), GPIB, and Industrial Ethernet. Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems.

UNIT IV VI TOOL SETS **9**

Use of Analysis tools: Digital Filter Design Toolkit, Control System Design Toolkit, Communication System Design Toolkit, Power Measurement Suite, Virtual Laboratory, Web-based Laboratory

UNIT V APPLICATION OF VI IN BIOMEDICAL ENGINEERING **9**

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, SDR application, Robotics Application, IoT Application using LabVIEW.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- comprehend and appreciate the significance and role of this course in the present contemporary world.
- identify salient traits of a virtual instrument.
- understand the use of VI for data acquisition.
- experiment, analyze and document different types of interfaces.
- apply the virtual instrumentation technologies for medical applications.

TEXT BOOKS

1. Gary Johnson, "LABVIEW Graphical Programming", McGraw Hill, 2nd Edition,1997.
2. Lisa K. Wells and Jeffrey Travis, "LABVIEW for Everyone", PHI,1997.

REFERENCES

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes,2000.
2. S. Gupta, J.P. Gupta," PC Interfacing for Data Acquisition and Process Control", ISA,2nd Edition,1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical and Healthcare Applications in LabVIEW" Pearson Education,2001.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Cos	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
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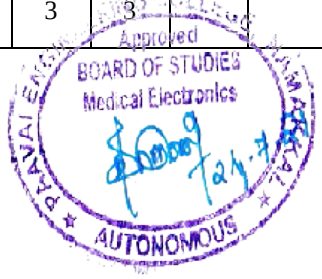
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16652 DIGITAL VIDEO PROCESSING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide an introduction to the fundamental principles and techniques in Video processing.
- offer an overview of video enhancement and restoration algorithms
- deliver details about video Tracking.
- Incorporate processing with artificial intelligence.
- review latest trends and future technologies in video computing.

UNIT I FUNDAMENTALS OF VIDEO PROCESSING 9

Video Formation, Perception and Representation – Video Capture and Display – Principles of Color Video – Video Cameras – Video Display and Composite versus Component Models and Gamma Correction – Analog Video Raster – Progressive vs Interlaced scans - – Digital Video – Notation – ITU– R.BT.601Digital Video Format and Other Digital Video Formats and Applications.

UNIT II DIGITAL VIDEO ENHANCEMENT AND SEGMENTATION 9

Video Sampling – Basics of the Lattice Theory – Sampling of Video Signals over Lattices –Filtering Operations in Cameras and Display Devices – Video Segmentation Algorithms – Median Cut, Graph Cut and EM Algorithms – Active Contour models.

UNIT III VIDEO ANALYSIS AND TRACKING 9

Typical Tracker – Localization – Optical Flow – Object Tracking and analysis – Ka lman Filtering – Video Tracking – Bayesian Approach – Particle Filter – Trackers – Evaluation – Video In painting – restoration –Video Mining – Video Search Engines and retrieval – Visual Event Detection – Video Surveillance and Security.

UNIT IV MOTION ESTIMATION 9

Two-Dimensional Motion Estimation – Optical Flow. General Methodologies – Motion Representation, Motion Estimation Criteria, Optimization Methods. Pixel-Based Motion Estimation – Block-Matching Algorithm – Exhaustive Block-Matching Algorithm – Phase Correlation Method and Multi resolution Motion Estimation

UNIT V VIDEO CLASSIFICATION AND RECOGITION 9

Video Classification – Classification and Clustering models – Video Annotation – Video Summarization – Action Recognition – Visual Event Detection

TOTAL PERIODS 45

COURSE OUTCOMES

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

- implement basic algorithms related to digital video.
- familiarize with the MATLAB and its equivalent open source tools for processing video .
- design and implement some basic video related applications in domains like biometrics, object .

- traction and in Industrial environment .
- critically analyze the role of video in modern technologies.

TEXT BOOK

1. A. Murat Tekalp ,"Digital Video Processing", Pearson, 2010.
2. Oge Marques „Practical Image and Video processing using MATLAB", IEEE Press, 2011.

REFERENCES

1. Maggio E., Cavallaro A., Video Tracking, Wiley , 2011.
2. Michael A. Smith, Takeo Kanade, Multimodal Video Characterization and Summarization, The Kluwer International Series in Video Computing, 2005.
3. Niels Haering, Niels Da Vitoria Lobo, Visual Event Detection, The International Series in Video Computing, Springer US, 2001.
4. Alan Bovik C "The Essential Guide to Video Processing", Academic Press Inc, 2009.

CO-PO Mapping:

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CO3	3	3	2	2	3	2	3						3	3
CO4	3	3	2	2	3								3	3
CO5	3	3	2	2	3	2	3			3	3	3	3	3

MD16653 QUALITY CONTROL IN BIOMEDICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn overview of various methodologies used for management in health care.
- understand the various Quality standards and regulations used for health care
- gain the knowledge about management methodologies in medical Engineering
- achieve the various tools
- gain knowledge in regulatory bodies

UNIT I INTRODUCTION 9

Philosophy of Quality Management, Customer Focus, Top Management Commitment, Teamwork, Quality control Tools, Problem solving methodologies, New Management Tools, work habits, Strategic Quality planning.

UNIT II DEVELOPMENT SYSTEM IN QUALITY 9

Quality policy development, quality function development, designing for Quality, Manufacturing for Quality. Environment Management Systems.

UNIT III QUALITY STANDARDS 9

Need for standardization, Regional, National, International standardization, classification of equipment, methods of Testing standardization, Maintenance of standardization & Recalibration. Quality system – Elements, implementation of quality system, Documentation, Quality auditing,

UNIT IV QUALITY REGULATION 9

FDA Regulations, Joint Commission, Accreditation of hospitals, other Regulatory codes. NABA, JCI, NABL, NABH.

UNIT V REGULATORY BODIES 9

International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485. Need for ISO 9000 System, Advantages, clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality Auditing, Case studies.

Total Periods 45

COURSE OUTCOMES

At the end this course, students will be able to

- know the overview of various methodologies used for management in health care.
- apply the quality development in medical field.
- gain the knowledge about quality standards.
- gain the knowledge about management methodologies in medical Engineering.
- understand the knowledge in regulatory bodies.

TEXT BOOKS

1. Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla ·, "Total Quality Management (TQM) Principles, Methods, and Applications ", CRC Press., 2020.
2. Ernesto Iadanza, "Clinical Engineering Handbook", Elsevier Science, 2019.

REFERENCES

1. Walter A. Shewhart, "Economic Control of Quality of Manufactured Product", Martino Publishing, 2015.
2. Paul Ganney, Richard Axell ·, "Clinical Engineering – A Handbook for Clinical and Biomedical Engineers", Elsevier Science, 2019.
3. G.D.Kunders, "Hospitals–Facilities Planning and Management",TMH, NewDelhi–5th edition Reprint2007.
4. R.C.Goyal, "Hospital Administration and Human Resource Management",PHI–4thEdition,2006.

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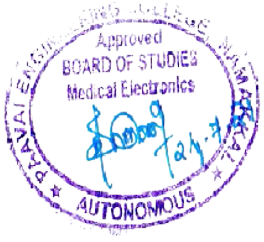

MD16654 BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts of Brain Computer Interface
- study the various signal acquisition methods
- study the signal processing methods used in BCI
- learn the various types of feature translation methods
- learn the various applications of BCI

UNIT I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition – Signal Preprocessing – Artifacts removal.

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 – Visual Evoked Potential – Activity of Neural Cells – Multiple Neuro mechanisms.

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features.

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines – Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis – Functional Electrical Stimulation, Visual Feedback and control – External device control, Case study: Brain actuated control of mobile Robot.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe BCI system and its potential applications.
- analyze event related potentials and sensory motor rhythms.
- compute features suitable for BCI.
- design classifier for a BCI system.
- implement BCI for various applications.

TEXT BOOKS

1. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.

REFERENCES

1. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
2. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
3. Guido Dornhege, "Toward brain-computer interfacing", MIT Press, First Edition, 2007.
4. Theodre Berger W, John k Chapin et all, "Brain computer interfaces, An International assessment of research and developmental trends", Springer, First Edition, 2008.

CO-PO Mapping:

Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Cos	**Programme Outcomes (Pos)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2	2								3	3
CO2	3	3	2	2	2								3	3
CO3	3	3	3	2	2	3	2						3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3

OPEN ELECTIVE-II

MD16903 PRODUCT DESIGN AND DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the importance of product development
- learn the concept generation and selection systematically
- understand the concept of product architecture
- learn the various tools involved in Industrial design
- know the design cost and manufacturing cost

UNIT I INTRODUCTION 9

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the importance of product development
- analyse the concept generation and selection systematically
- apply the concept of product architecture in real time development
- apply the knowledge on various tools involved in Industrial design
- implement the product based on the design cost and manufacturing cost

TEXT BOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill, International Edns. 1999.
2. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY., 2014

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4, .
3. Anup Goel, Shaikh Ubaid, Palaskar Ravikiran D. Siddu S, "Product Design and Development", Technical Publications, 2015

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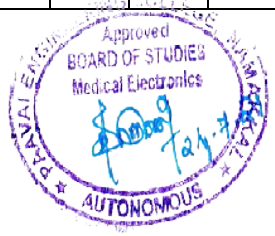
COs	**Programme Outcomes (POs)**													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	3	3	2	2	2						3		3	3
CO2	3	3	2	2	2						3		3	3
CO3	3	3	3	2	2	3	2				2		3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3



MD16904 ANALYTICAL METHODS AND INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the basic concepts involved in spectrometry
- learn the concept molecular spectroscopy
- understand the concept of magnetic resonance spectroscopy and mass spectrometry
- learn the separation methods in chromatography
- understand the basic concept of electro analysis and surface microscopy

UNIT I INTRODUCTION TO SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- illustrate the basic concepts involved in spectrometry
- acquire the knowledge on molecular spectroscopy
- apply the concept of magnetic resonance spectroscopy and mass spectrometry in practical purpose
- acquire the knowledge on separation methods in chromatography
- know the basic concept of electro analysis and surface microscopy

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". Cengage Learning , 2007
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". VII Edition, CBS, 1986

REFERENCES:

1. Braun, Robert D. "Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
2. Haven, Mary C., etal., "Laboratory Instrumentation ". IV Edition, John Wiley, 1995.
3. Sharma, B.K. "Instrumental Methods of Chemical Analysis: Analytical Chemistry" Goel Publishing House, 1972.

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CO2	3	3	2	2	2						3		3	3
CO3	3	3	3	2	2	3	2				2		3	3
CO4	3	3	2	2	2	3							3	3
CO5	3	3	2	2	2	3	3						3	3