SEMESTER VII

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	BM16701	Human Assist Devices	3	0	0	3
2	PC	BM16702	Medical Image Processing	3	0	0	3
3	PC	BM16703	Biocontrol Systems	3	2	0	4
4	PE	BM1635*	Professional Elective III	3	0	0	3
5	PE	BM1645*	Professional Elective IV	3	0	0	3
6	OE	BM169**	Open Elective II	3	0	0	3
Practical							
7	PC	BM16704	Medical Image Processing Laboratory	0	0	4	2
8	EE	BM16705	Hospital Internship Training*	0	0	2	1
9	EE	BM16706	Project Work Phase I	0	0	4	2
			TOTAL	**18**	**2**	**10**	**24**
			Cumulative Total				**170**

(*Two weeks of continuous Summer Internship Training at Hospital)

SEMESTER VIII

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	BM16801	Healthcare and Hospital Management	3	0	0	3
2	PE	BM1655*	Professional Elective V	3	0	0	3
3	PE	BM1665*	Professional Elective VI	3	0	0	3
Practical							
4	EE	BM16802	Project Work Phase II	0	0	12	6
			TOTAL	**9**	**0**	**12**	**15**
			Cumulative Total				**185**

19	PC	BM16603	Medical Imaging Techniques	3	0	0	3
19	PC	BM16604	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2
20	PC	BM16701	Human Assist Devices	3	0	0	3
21	PC	BM16702	Biocontrol Systems	3	2	0	4
22	PC	BM16703	Medical Image Processing	3	0	0	3
23	PC	BM16704	Medical Image Processing Laboratory	0	0	4	2
24	PC	BM16801	Healthcare and Hospital Management	3	0	0	3

PROFESSIONAL ELECTIVES (PE)

S.No.	Category	Course Code	Course Title	L	T	P	C
Professional Elective I							
1	PE	BM16151	Biomedical Informatics	3	0	0	3
2	PE	BM16152	Virtual Bioinstrumentation	3	0	0	3
3	PE	BM16153	BioMEMS	3	0	0	3
4	PE	BM16154	Medical Optics	3	0	0	3
Professional Elective II							
1	PE	BM16251	Telemedicine and PACS	3	0	0	3
2	PE	BM16252	Biomedical Laser Instruments	3	0	0	3
3	PE	BM16253	Pattern Recognition and Neural Networks	3	0	0	3
4	PE	BM16254	Advanced Bioanalytical and Therapeutic Techniques	3	0	0	3
Professional Elective III							
1	PE	BM16351	Tissue Engineering	3	0	0	3
2	PE	BM16352	Rehabilitation Engineering	3	0	0	3
3	PE	BM16353	Design and Development of Medical Devices	3	0	0	3
4	PE	BM16354	Medical Ethics Standards and Safety	3	0	0	3
Professional Elective IV							
1	PE	BM16451	Biometric Systems	3	0	0	3
2	PE	BM16452	Fundamentals of Biomedical Nanotechnology	3	0	0	3
3	PE	BM16453	Digital Health Care	3	0	0	3
4	PE	BM16454	Advanced Medical Imaging Systems	3	0	0	3

Professional Elective V							
1	PE	BM16551	Artificial Organs and Implants	3	0	0	3
2	PE	BM16552	Embedded Systems and IoT in Healthcare	3	0	0	3
3	PE	BM16553	Physiological Modeling	3	0	0	3
4	PE	BM16554	Robotics and Automation in Medicine	3	0	0	3
Professional Elective VI							
1	PE	BM16651	Virtual Reality in Medicine	3	0	0	3
2	PE	BM16652	Wearable Devices	3	0	0	3
3	PE	BM16653	Quality Control in Biomedical Engineering	3	0	0	3
4	PE	BM16654	Medical Radiation Safety	3	0	0	3

OPEN ELECTIVE - I (OE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	OE	BM16901	Industrial Nanotechnology	3	0	0	3
2	OE	BM16902	Biomedical Waste Management	3	0	0	3

OPEN ELECTIVE - II (OE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	OE	BM16903	Introduction to Data science and Bioinformatics	3	0	0	3
2	OE	BM16904	Hospital Management	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Category	Course Code	Course Title	L	T	P	C
1	EE	GE16501	Career Development Laboratory - I	0	0	2	1
2	EE	GE16601	Career Development Laboratory - II	0	0	2	1
3	EE	BM16605	Mini Project	0	0	4	2
4	EE	BM16705	Hospital Internship Training	0	0	2	1
5	EE	BM16707	Project Work Phase I	0	0	4	2
6	EE	BM16802	Project Work Phase II	0	0	12	6

SEMESTER VII

BM16701 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 to compensate for the loss.
- 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 which will restore normal functional ability of particular organ that is defective temporarily or permanently.
- 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.

Co – Po Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1			3		3	2			2			2		3
CO 2		2	3	2	2		2		2					2
CO 3		2	2	2	3	3		2		3			2	
CO 4	2	2	3	2	3	3	1					3	3	
CO 5	2	3	3	2	3			2		2				2

BM16702 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

Pixels and voxels – Algebraic image operations, 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 – 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 BOOKS

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, "Bio signal 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:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3	2	2	2								3	3
CO 2	3	3	2	2	2								3	3
CO 3	3	3	3	2	2	3	2						3	3
CO 4	3	3	2	2	2	3							3	3
CO 5	3	3	2	2	2	3	3						3	3

BM16703 **BIO CONTROL SYSTEMS** **3 2 0 4**

COURSE OBJECTIVES

To enable the students to

- learn bio control systems modeling technique.
- learn the analysis of given system in time domain.
- study the stability analysis of the given system.
- learn the analysis of given system in time frequency domain.
- study the concept of physiological control system.

UNIT I MODELING OF SYSTEMS **15**

Basic structure of control system - Positive and Negative feedback, Transfer functions, Modeling of electrical systems; Block diagram and signal flow graph representation of systems - Conversion of block diagram to signal flow graph, Reduction of block diagram and signal flow graph.

UNIT II TIME RESPONSE ANALYSIS **15**

Step responses of first order and second order systems; Determination of time domain specifications of first and second order systems from its output responses; Definition of steady state error constants and its computations.

UNIT III STABILITY ANALYSIS **15**

Definition of stability - Routh- Hurwitz criteria of stability, Root locus technique; Construction of root locus and study of stability - Definition of dominant poles and relative stability.

UNIT IV FREQUENCY RESPONSE ANALYSIS **15**

Frequency response - Nyquist stability criterion, Nyquist plot and determination of closed loop stability; Definition of gain margin and phase margin, Bode plot, Determination of gain margin and phase margin using Bode plot.

UNIT V PHYSIOLOGICAL CONTROL SYSTEM **15**

Example of physiological control system - Difference between engineering and physiological control systems, Degeneralized system properties; Models with combination of system elements - Linear models respiratory mechanism and muscle mechanism, Model of regulation of cardiac output.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- represent the system in various forms.
- interpret the response of the system in time domain.
- examine the stability of the system.
- analyze simple system in frequency domain.

- compute the mathematical model of Physiological systems.

TEXTBOOKS

1. M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002 (Units I, II, III & IV).
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001 (Unit V).

REFERENCES

1. Benjamin C. Kuo, Farid Gol Naraghi, "Automatic Control Systems",10th edition, Mc Graw - Hill Education, 21 February 2017.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004.

CO-PO Mapping:

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3	3	3	3						3	3	3	3
CO 2	3	3	3	3	3						3	3	3	3
CO 3	3	3	3	3	3						3	3	3	3
CO 4	3	3	3	3	3						3	3	3	3
CO 5	3	3	3	3	3						3	3	3	3

BM16351 TISSUE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study cell cycle and differentiation.
- learn basics about stem cells and its applications.
- describe different synthetic and natural biomaterials in tissue replacements.
- know the cell growth and differentiation, cell and tissue mechanism.
- study the cell adhesion, cell migration, cell aggregation and tissue equivalent.

UNIT I FUNDAMENTALS OF TISSUE ENGINEERING 9

Tissue Exchange and Tissue Development - Objectives of Tissue engineering; Element of Tissue development. Signal expression in Engineered Tissue.

UNIT II STEM CELLS AND GENE THERAPY 9

Embryonic stem cells - Liver stem cells, Adult epithelial tissue stem cells, Mesenchymal stem cells; Strategies of gene therapy - Ex vivo Vs in vivo gene therapy, Gene transfer vector; Cell - specific targeting strategies, Combining gene transfer with stem cell strategies; Challenges to gene therapy for tissue engineering.

UNIT III TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT 9

Cell delivery and recirculation - Delivery molecular agents in tissue engineering; Control releaser agents in time and space; Vascularization of Engineered Tissues.

UNIT IV MATERIALS IN TISSUE ENGINEERING 9

Biological materials – Degradable and non-degradable, Extra cellular matrix-decellularization; Polymers: synthetic and natural, Cell interaction with polymers, Applications of polymer; Ceramics and Metals; Engineered Protein Biomaterials - Nano biomaterials for Tissue Engineering.

UNIT V APPLICATION OF TISSUE ENGINEERING 9

Artificial organs - Synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin and nerve regeneration; Dental and Craniofacial Bioengineering; Basics of Bone Engineering and Neural Engineering.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- understand the basic concept of tissue engineering.
- represent the concept of stem cell and gene therapy.

- apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies.
- design and develop different biomaterial in tissue engineering application.
- outline the research or clinical application on tissue repair/ engineering.

TEXTBOOKS

1. John P. Fisher, Antonios G. Mikos, Joseph D. Bronzino, "Tissue Engineering: Principles and Practices"- illustrated, CRC Press, 2012.
2. Gary E. Wnek, Gary L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc, New York, 2008.

REFERENCES

1. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue", Oxford University Press Inc New York, 2004.
2. Robert P lanza, Robert Langer and Joseph Vacanti, "Principles of tissue engineering", Academic Press, California, 2007.

CO-PO Mapping:

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CO 1			3	3	3	3	3	3	3				3	
CO 2			2	2	2	2	2	2	2				3	
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16352 **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- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
4. 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.

CO-PO Mapping:

Course Outcomes (CO's)	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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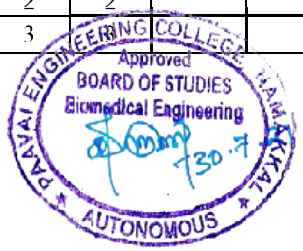
CO 1			3	3	3	3	3	3	3				3	
CO 2			2	2	2	2	2	2	2				3	
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3					3	



BM16353 DESIGN AND DEVELOPMENT OF MEDICAL DEVICES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- students will be able to know about the medical product design and development.
- knowledge in documentation and development of devices.
- patient safety and regulatory aspects followed in hospitals.
- understand scaling principles of medical devices.
- professional ethics to be followed by Biomedical Engineers.

UNIT I INTRODUCTION TO MEDICAL PRODUCT DESIGN 9

Definition - History and Modern Practice; Designs - Design and Product Life Cycle, Design Process, Understanding the innovation cycle, Good Design Practice, Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements; Concept Generation – Innovation Survey Questionnaire, Morphological Matrix, QFD, Concept Analysis and validation, Concept Modelling, Concept Screening & Validation.

UNIT II PRODUCT DEVELOPMENT 9

Breakthrough Products, Platform Products, Front End of Innovations / Fuzzy Front End, Generic Product Development Process, Variants of Development Processes; Good Documentation Practice and Prototyping Specifications, Prototyping; Medical Device standards, Quality management systems (ISO 13485), Medical Device Classification, Design of Clinical Trials.

UNIT III REGULATORY SCHEMES 9

Design Control & Regulatory Requirements, Documentation in Medical Devices, Regulatory pathways; Biomedical Evaluation of Medical Devices -ISO Medical Devices – Applications of Risk Management to Medical Devices (ISO 14971), Electrical Safety Standard - IEC60601-1, IEC60601-2, IEC60601-6, Protection of Electrical and Electronic Parts, Assemblies and Equipment's (ESD S20.20-2014).

UNIT IV SCALABLE PRODUCT DEVELOPMENT 9

Design for manufacturing, Design for assembly, Design for Serviceability, Design for usability, Medical Device Verification & Validation; Product Testing & Regulatory compliance, Clinical trial & validation, Device Certification.

UNIT V PRACTICAL CHALLENGES ON MEDICAL DEVICE DEVELOPMENT 9

Product life cycle –Challenges in Practicing International Regulatory Requirements – Risk Management: Integration of Risk Management into the supporting QMS; Use of Codes to Identify Medical Devices,

Application of Risk Management throughout product life cycle.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- understand the basics for the medical product design
- represent the methodologies for Product development.
- assess the regulatory schemes in medical device design.
- outline the scalable product development for medical device design.
- compare and contrast the practical challenges occur during medical device design.

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation: Application and Design", 5th Edition, June 2020.
2. Peter J. Ogrodnik, "Medical Device Design: Innovation from Concept to Market", Academic Press is an imprint of Elsevier, 1st edition 2013.

REFERENCES

1. Paul H. King, Richard C. Fries, Arthur T. Johnson, "Design of Biomedical Devices and Systems", CRC Press, Tailor and Francis Group, 3rd Edition, 2015.
2. Andrés D. Lantada, "Handbook on Advanced Design and Manufacturing Technologies forBiomedical Devices", Springer London 2013.
3. 3. Paul G. Yock, Stefanos Zenios, Joshua Makower, Todd J. Brinton, Uday N. Kumar, F. T. Jay Watkins, Lyn Denend, Thomas M. Krummel, Christine Kurihara, "Biodesign: The Process of Innovating Medical Technologies", Cambridge University Press; 2 edition, 2 February 2015.

CO-PO Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
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CO 1			3	3	3	3	3	3	3				3	
CO 2			2	2	2	2	2	2	2				3	
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16354 MEDICAL ETHICS STANDARDS AND SAFETY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know about the legal and ethical principles in health care settings.
- gain knowledge about the medical standards that to be followed in hospitals.
- understand the medical safety protocols.
- professional ethics to be followed by Biomedical Engineers.
- patient safety and regulatory aspects followed in hospitals.

UNIT I INTRODUCTION TO MEDICAL ETHICS 9

Definition of Medical ethics, Scope of ethics in medicine, International code of Ethics for occupational health professionals; Ethical Theories --Deontology & Utilitarianism, Casuist theory, Virtue theory, Right Theory; Role of ethics in healthcare workplace – Autonomy, Non- Malfeasance, Beneficence, Veracity, Justice, OSHA, Decision Model for Healthcare Dilemmas, Applications of Plus decision-making model.

UNIT II CODE OF ETHICS FOR BIOMEDICAL ENGINEERS 9

Bioethics - The principle of Double effect, Code of Hammurabi, Engineering Competence; Ethical Issues in biomedical research - Cloning and stem cell research, Neuro ethics, Organ Transplantation, Hypothetico-deductive method, Research Conflict of Interest; Medical device failure- Five failure types, Bio-terrorism, Sustainable Bioethics-Life cycles and Concurrent Engineering; Environmental Health – Case studies.

UNIT III MEDICAL DEVICE SAFETY 9

General requirements for basic safety & essential performance of medical equipment; WHO – International Health Regulations (IHR), Stages of regulatory control of medical devices; Ethics committee- its members and functions, Global Harmonization Task Force (GHTF); Quality systems requirement – ISO, Voluntary and mandatory standards, Collateral Standards; EMC radiation protection & Programmable medical device system, Particular Standards,Type of medical device.

UNIT IV REGULATORY STANDARDS FOR MEDICAL DEVICE MAINTENANCE 9

International Standards- Medical Device Directive 93/42/EEC, Medical Electrical Equipment ISO 60601, Safety Testing of Medical Devices ISO 62353, 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 V HOSPITAL ACCREDITATION AND SAFETY STANDARDS 9

Accreditation - JCI Accreditation & its Policies; Life Safety Standards- Protecting Occupants, Protecting the Hospital and Individuals from Fire, Smoke, and Heat. Managing Hazardous Medical Material and

Waste, Laboratory and Radiation safety, Health and safety hazards of shift work; Patient Safety – Human factors, Reliability, Evidence based Medicine, Root cause Analysis.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of this course the student should be able to

- understand legal and professional guidelines for the health professions.
- develop social responsibility in healthcare systems.
- understand bioethics and engineer's role.
- comprehend medical device maintenance.
- understand safety aspects.

TEXTBOOKS

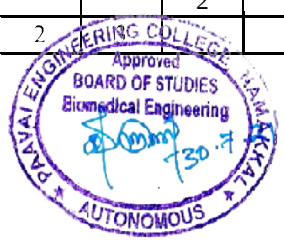
1. William Charney, "Handbook of Modern Hospital Safety'', CRC Press, 2nd Edition, 2009.
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, Zijad Dzemic, "Inspection of Medical Devices: For Regulatory Purposes", Springer Nature, 2018.

REFERENCES

1. Eileen E. Morrison, "Ethics in Health Administration: A Practical Approach for Decision Makers' 'Jonnes and Bartletts' Publication, 2nd Edition, 2011.
2. Robert M Veatch, "Basics of Bio Ethics'', Prentice- Hall, Inc., 2nd Edition, 2003.
3. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HC Pro, Inc., 2010.
4. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003.

CO-PO Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3				2		3				2	3	
CO 2		3				2	2	3		2		2	3	
CO 3		3				2	2	3	2	2		2	3	
CO 4	3	3	3		2	2			2		2	2	3	
CO 5	3	3			2		2					2	3	



BM16451 BIOMETRIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of biometrics.
- understand the technologies of fingerprint, iris, face and speech recognition.
- understand the general principles of design of biometric systems and the underlying trade-offs.
- recognize personal privacy and security implications of biometrics-based identification technology.
- identify issues in the realistic evaluation of biometrics-based systems.

UNIT I INTRODUCTION TO BIOMETRICS 9

Introduction and background – Biometric technologies, Passive biometrics, Active biometrics, Biometric characteristics, Biometric applications; Biometric Authentication systems- Taxonomy of Application Environment; Accuracy in Biometric Systems- False match rate, False non match rate, Failure to enroll rate, Derived Metrics,Biometrics and Privacy.

UNIT II FINGERPRINT TECHNOLOGY 9

History of fingerprint pattern recognition - General description of fingerprints, Fingerprint sensors, Fingerprint enhancement; Feature Extraction- Ridge orientation, Ridge frequency; Fingerprint matching techniques- Correlation based, Minutiae based, Ridge feature based, Fingerprint classification, Applications of fingerprints; Finger scan- Strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT III FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition - Face recognition using PCA, LDA, Face recognition using shape and texture, Face detection in color images; 3D model-based face recognition in video images, Neural networks for face recognition, Hand geometry – Scanning, Feature Extraction, Classification.

UNIT IV IRIS RECOGNITION 9

Introduction - Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization; Daugman and Wilde ‘s approach, Iris matching, Iris scan strengths and Weaknesses, System performance, Future directions.

UNIT V VOICE SCAN AND MULTIMODAL BIOMETRICS 9

Voice scan - Speaker features, Short term spectral feature extraction, Mel frequency cepstral coefficients, Speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program; Introduction to multimodal biometric system – Integration strategies, Architecture, level of fusion, Combination strategy, Examples of multimodal biometric systems; Securing and trusting a biometric transaction –

matching location, Local host, Authentication server, Match On Card (MOC).

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate the principles of biometric systems.
- develop fingerprint recognition technique.
- design face recognition and hand geometry system.
- design iris recognition system.
- develop speech recognition and multimodal biometric systems.

TEXTBOOKS

1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation" SPRINGER (SIE), 1st Edition, 2011.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.

REFERENCES

1. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system'', Springer, 2003.
2. L C Jain, I Hayashi, S B Lee, U Halici, " The Biometric Computing: Recognition and Registration" Taylor & Francis Group, 19 Nov 2019.
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003.

CO-PO Mapping:

Course Outcomes (CO's)	**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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CO 1		3		3				3	2	2		2	3	3
CO 2				3	2			3	2	2		2	3	2
CO 3				3	2			3	2	2		2	3	2
CO 4				3	2			3	2	2		2	3	2
CO 5				3	2			3	2	2		2	3	2

BM16452 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 Microorganism- 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, Nano sensors in Diagnosis, Drug delivery.

TOTAL PERIODS 45

COURSE OUTCOMES

After the 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.
- implement microcontroller-based systems in biomedical domain.

TEXTBOOKS

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

REFERENCES

1. Emily S. Day, Sarah Hurst Petrosko , "Biomedical Nanotechnology Methods and Protocols", Springer New York , 9 June 2018 .
2. Chris Binns, "Introduction to Nanoscience and Nanotechnology", Wiley ,16 June 2010.

CO-PO Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
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CO 1		3		3				3	2	2		2	3	3
CO 2				3	2			3	2	2		2	3	2
CO 3				3	2			3	2	2		2	3	2
CO 4				3	2			3	2	2		2	3	2
CO 5				3	2			3	2	2		2	3	

BM16453 DIGITAL HEALTH CARE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- expose the needs for wearable devices and the technology.
- learn the concepts in digital health care and digital hospitals.
- apply the tools in design, testing and developing digital health care equipment.
- gain knowledge about E-health.
- impart the Laws and regulations in Digital health.

UNIT I WEARABLE DEVICES AND M-HEALTH CARE 9

Introduction to mobile health care - Devices, Economy, Average length of stay in hospital, Outpatient care, Health care costs; Mobile phones - 4G, Smart devices, Wearable devices, Uptake of e-health and m-health technologies, Standards, System, Design and Case study.

UNIT II DIGITAL RADIOLOGY 9

Digital radiology for digital hospital - Picture archiving and communication, System integration; Digital history of radiology - Medical image archives, Storage and networks.

UNIT III E-HEALTH 9

Health care networking - Medical reporting using speech recognition; Physiological tests and functional diagnosis with digital methods, Tele-consultation in medicine and radiology.

UNIT IV MODALITY AND DIGITAL HEALTH 9

Multimodality registration in daily clinical practice - Mobile healthcare, Case study; Requirements and best practices - Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT V STANDARDS FOR INTER-OPERABILITY 9

Selection and Implementation in e-Health project, Design of medical equipments based on user needs; Security and privacy in digital health care.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the available technology for wearable healthcare devices.
- interpret the need for digital methods of handling medical records.

- modify the tools and methods for workflow.
- compare various standards for inter-operability of devices.
- formulate advanced strategies for innovation to societal needs.

TEXTBOOKS

1. Walter Hruby, "Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006.
2. Khandpur,R.S, "Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003.

REFERENCES

1. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015.
2. Rick Krohn (Editor), David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.

CO-PO Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
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CO 1			3	3	3	3	3	3	3				3	
CO 2			2	2	2	2	2	2	2				3	
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16454 **ADVANCED MEDICAL IMAGING SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- study the Fluoroscopic imaging.
- learn functional MRI.
- understand the Microwave Imaging.
- understand the Nuclear Medicine.
- develop the knowledge in Infrared imaging.

UNIT I FLUOROSCOPY **9**

Fluoroscopic imaging chain components – Characteristics of Image intensifier performance; Modes of operation – Image quality, Radiation dose, Fluoroscopic suites, Peripheral equipment, Optical coupling, Video cameras.

UNIT II FMRI **9**

Introduction to fMRI – Basics of MRI Signal, Tissue contrast and spatial localization, Neuronal activity and Hemo dynamics; BOLD fMRI, SNR in fMRI Experimental design, fMRI statistics land 2 – Advanced fMRI.

UNIT III MICROWAVE IMAGING AND ULTRASOUND CAPTURING **9**

Introduction - Electromagnetic scattering, Electromagnetic inverse scattering problem, Imaging configuration, Model approximations; Qualitative reconstruction methods -Microwave imaging apparatus; Digital ultrasound and its scanning techniques, Biological Effects of Ultrasound.

UNIT IV NUCLEAR MEDICINE **9**

Historical Overview - Fundamentals of Radioactivity, Nuclear Activity and its Units, Half Life, Interaction of Nuclear Particles and Matter, Attenuation of Gamma Radiation; Radionuclides, Radiopharmaceuticals, Common Radioisotopes; Generation and Detection of Nuclear Emission - Radionuclide Generators, Cyclotrons, Nuclear Radiation Detectors, Rectilinear Scanners, Scintillation Camera. Acquisition of NMRI.

UNIT V INFRARED IMAGING AND ISOTOPE IMAGING **9**

Thermography – Clinical applications of thermography, Liquid crystal thermography; Radio isotope Rectilinear Scanners, Gamma Camera, Multi Crystal Gamma Camera; Emission Computed Tomography – PET, SPECT.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- study about fluoroscopic imaging techniques and components.
- understand the basics and advancement in fMRI.
- acquire the knowledge about microwave and infrared medical imaging modalities.

- understand the concepts of radioisotope and nuclear imaging.
- acquire the knowledge about infrared medical imaging modalities.

TEXT BOOKS

1. Khandpur R S, "Hand-book of Biomedical Instrumentation", Tata McGraw Hill, 2nd Edition, 2003.
2. William Hendee R, Russell Ritenour E, "Medical imaging physics", Fourth Edition, 2002.

REFERENCES

1. Stephan Ulmer, Olav Jansen, "FMRI: Basics and Clinical Applications", Springer, First Edition, 2010.
2. Matteo Pastorin , "Microwave imaging", John Wiley and Sons first edition , 2010.
3. Khandpur R.S, "Hand-book of Biomedical Instrumentation", Tata McGraw Hill, 3rd Edition, 2015.

CO-PO Mapping:

Course Outcomes (CO's)	**Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**													
	Programme Outcomes (PO's)												**Programme Specific Outcomes (PSO's)**	
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CO 1	3	3	3	3									3	3
CO 2	3	3	3	2									3	3
CO 3	3	3	3	2		3	3						3	3
CO 4	3	3	3	2		3							3	3
CO 5	3	3	3	3		3	3						3	3

BM16704 MEDICAL IMAGE PROCESSING LABORATORY 0 0 4 2

COURSE OBJECTIVES

To provide practice to

- analyze the basic image processing techniques.
- compute magnitude and phasor representation of images.
- understand the concepts of image restoration and segmentation.
- 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 nonlinear 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 analyze the characteristics of the image.
- perform enhancing operations and segmentation operations on the image using spatial filters and frequency domain filters.
- estimate the efficiency of the compression technique on the images develop image processing algorithms for different image processing.
- apply image processing technique to solve real health care problems.

CO-PO Mapping:

Course Outcomes (CO's)	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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CO 1	1	3	3	3		3	3				3	3	3	3
CO 2	1	3	3	3		3	3				3	3	3	3
CO 3	1	3	3	3									3	3
CO 4	1	3	3	3							3	3	3	3

BM16705 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 2 weeks. After the completion of Internship training, they will have to submit the 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 jointly by the 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

- advocate a patient-centered approach in healthcare.
- communicate with other health professionals under various departments in a respectful and responsible manner.
- propose a patient-centered inter-professional health improvement record plan based upon the patient ‘s perceived needs.
- use the knowledge of one ‘s own role in a hospital and those of other professions to address the healthcare needs of populations and patients served.

CO-PO Mapping:

Course Outcomes (CO's)	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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CO 1	3	3	3					3	3	3		2	3	3
CO 2	3	3	3	3	3	2	2		2	3		3	3	2
CO 3	3	3	3	3	3	3	2		2	3		3	2	3
CO 4	3	3	3				2	3	3	3	2	3	2	2

BM16706 **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 4 members and work under a project supervisor. The prototype/simulation may be decided in consultation with the supervisor. A Project 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 Phase I report is examined jointly by external and internal examiners constituted by the Controller of Examinations. 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.
- explain the acquired knowledge through preparation of report and oral presentations.

CO-PO Mapping:

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CO 2	3	3	3	3	3	2	2		2			3	3	2
CO 3	3		3	3	3	3	2		2	2		3	2	3
CO 4	3	3	3				2	3	3	3	2	3	2	2
CO 5	3		3						2	3	3	2	2	2

SEMESTER VIII

BM16801 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. San Deigo 2017 – Fourth Edition.
2. Human Resource in Hospital Management, Erickson Thomas, 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, Zijad Dzemic, "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:

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CO 2			2	2	2	2	2	2	2				3	
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16551 **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 device;, 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. Nadey S. Hakim, Artificial Organs, Springer London, 28 Oct 2010.
2. Park J.B., ―Biomaterials Science and Engineering‖, Springer US, 23 Jan 2014.

REFERENCES

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.
3. Roderic S. Lakes, Joon B Park, Biomaterials – An Introduction, Springer US , 28 Nov 2012.
4. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, ―Clinical Engineering‖, CRC Press, 1st edition,2010.

CO-PO Mapping:

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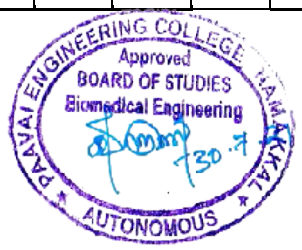
CO 1		3										3	3	3
CO 2		3	3	3	3	3	3	3	3			3	3	3
CO 3					3	3	3	3	3	3		3	2	3
CO 4								3			3	3	2	3
CO 5												3	2	3



BM16552 EMBEDDED SYSTEMS AND IOT IN HEALTH CARE 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 INFRASTRUCTURE 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.

TEXTBOOKS

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:

Course Outcomes (CO's)	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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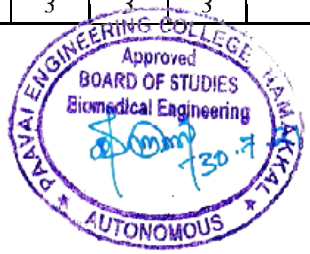
CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	



BM16553 **PHYSIOLOGICAL MODELING** **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 to compensate for the loss.
- know the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- understand electrical stimulation techniques used in clinical applications.

UNIT I SYSTEM CONCEPT **9**

Introduction to Physiological control systems, Purpose of physiological modeling and signal analysis, Difference between engineering and physiological control systems; System variables and properties - Resistance, Static and Dynamic, Compliance and combination of resistance and compliance; Resistance and compliance models – Respiratory system, Aortic segments, Lumped model of physiological thermal system, Step response of resistance, Compliance system, Dye dilution study of circulation.

UNIT II SYSTEM ANALYSIS **9**

Review of transfer function, Transfer function of coupled system; Impedance based transfer function – Flexible tube feeding a single port compliant model, Development of a lung model; Periodic signals: Sinusoidal analysis of second order system, Analysis of respiratory system based on sinusoidal excitation, Pendelluft.

UNIT III TRANSIENTAND FEEDBACK **9**

Review of transient and stability analysis - Homeostasis, Representation, Finger tracking; Characterization of Physiological Feedback systems - Hypophysis adrenal systems; Nonlinear systems and linearization – Transfer function analysis of pupillary control system as a closed loop and method of opening the closed loop, Pupillary hippus.

UNIT IV MODELING OF CARDIOPULMONARY SYSTEM **9**

Model of cardiac output regulation – Starling's law, Physical Significance of under damped responses of post systolic operations in aortic arch, Model of circadian rhythms; Chemical regulation of ventilation, Cheyne-Stoke breathing, Biot breathing.

UNIT V OTHER PHYSIOLOGICAL MODELS AND SIMULATION **9**

Steady state analysis of regulation of glucose, Hodgin-Huxley model; Thermal system – Model and Simulation; Modeling of eye movement- Types of eye movement, Saccade model, Model of occulo-motor control; Introduction to digital control system.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain application of Physiological models.
- model dynamically varying physiological system.
- analyze and synthesize dynamic models of physiological system.
- develop differential equations to describe the dynamic models, simulate and visualize.
- implement physiological models using software to get dynamic responses.

TEXTBOOKS

1. Alexandru Mihai Grumezescu, "Nano architectonics in Biomedicine", Elsevier Science, 20 March 2019.
2. Micheal C.K.Khoo ,"Physiological Control System Analysis, Simulation and Estimation", Prentice Hall of India , New Delhi ,2001.

REFERENCES

1. Robert B. Northrop, " Signals and Systems Analysis In Biomedical Engineering, Second Edition" Taylor & Francis, 26 Mar 2010.
2. Jacob Kline ·, "Hand Book of Biomedical Engineering" , Elsevier Science, 2012.
3. Olfa Boubaker (ed.,), "Control Theory in Biomedical Engineering - Applications in Physiology and Medical Robotics ", Elsevier Science, 30 June 2020.
3. Joseph D,Bronzino, "'The Biomedical Engineering Handbook'', CRC Press,3 rd Edition, 2006.
4. F.C. Hoppensteadt and C.S.Peskin, "Modeling and Simulation in Medicine and the Life Sciences" Springer, 2nd Edition, 2002.

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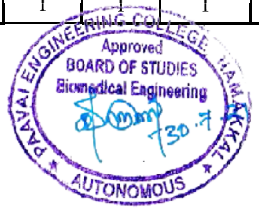
CO 2					3	3	2	1	1					3
CO 3			3	2	2	1	1	1	2	2			3	
CO 4					3	2	1	1	2					2
CO 5					3	1	2	1	1	1			2	



BM16554 ROBOTICS AND AUTOMATION IN MEDICINE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of Robotics, Kinematics.
- understand the basics of Inverse Kinematics.
- gain Knowledge about robotic vision.
- explore various kinematic motion planning solutions for various Robotic configurations.
- acquire knowledge on applications of Robots in Medicine.

UNIT I INTRODUCTION 9

Introduction Automation and Robots - Classification, Application, Specification, Notations, Direct Kinematics, Dot and cross products; Coordinate frames, Rotations, Homogeneous coordinates, Link coordination; Arm equation – Five-axis robot, Four-axis robot, Six-axis robot.

UNIT II KINEMATICS 9

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three- Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples; Workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION 9

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation, Thresholding; Region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING 9

Task Planning, Task level programming, Uncertainty, Configuration, Space, Gross motion; Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS IN MEDICINE 9

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering; Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical Gynecology, Orthopedics, Neurosurgery.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the basics of robotic systems.
- design basic Robotics system and formulate Kinematics.

- implement the robotic vision robotic systems.
- construct Inverse Kinematic motion planning solutions for various Robotic configurations.
- elucidate the Robotic systems for medical application.

TEXTBOOKS

1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
2. J.J.Craig, "Introduction to Robotics", Pearson Education, 2005.

REFERENCES

1. Francis X. Govers " Artificial Intelligence for Robotics - Build Intelligent Robots that Perform Human Tasks Using AI Techniques", Packt Publishing, 2018.
2. A.K. Gupta, S.K. Arora, Jean Riescher Westcott ·, "Industrial Automation and Robotics - An Introduction",Mercury Learning & Information, 2016.
3. Maki K. Habib, " Handbook of Research on Advanced Mechatronic Systems and Intelligent Robotics ", IGI Global ,26 July 2019.
4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Wiley, 2020.

CO-PO Mapping:

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CO 2	3		2	3	3	2	2						3	3
CO 3	3		2	3	3	2	2						3	3
CO 4	3		2	3	3	2	2						3	3
CO 5	3		3	3	3	2	2						3	3

BM16651 VIRTUAL REALITY IN MEDICINE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce the VR components basics and feedback concepts.
- learn the various modelling techniques in VR technology.
- impart the fundamental aspects, principles of virtual reality technology.
- learn how to program for virtual reality using Java 3D.
- gain knowledge about applications of virtual reality.

UNIT I INTRODUCTION 9

The three I's of virtual reality - Commercial VR technology and the five classic components of a VR system – Input Devices (Trackers, Navigation, and Gesture Interfaces); Three-dimensional position trackers, Navigation and Manipulation-interfaces and Gesture interfaces, Output Devices; Graphics displays - Sound displays & Haptic feedback.

UNIT II MODELING 9

Geometric modeling, Kinematics modeling, Physical modeling, Behavior modeling ,Model management.

UNIT III HUMAN FACTORS 9

Methodology and terminology - User performance studies, VR health and safety issues, Usability of virtual reality system; Cyber sickness - Side effects of exposures to virtual reality environment.

UNIT IV VR PROGRAMMING 9

Introducing Java 3D - Loading and manipulating external models using a lathe to make shapes; 3D Sprites - Animated 3D sprites, Particle systems.

UNIT V APPLICATIONS 9

Medical applications–Robotics applications; Advanced Real time Tracking - Other applications; Games, Movies, Simulations, Therapy.

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.

- understand the basic concepts of Virtual reality.
- expose the concept of Virtual Reality Programming with toolkits
- design of various modeling concepts.
- develop the Virtual Reality applications in different areas.

TEXTBOOKS

1. C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Andrew Davison, "Killer Game Programming in Java", Oreilly SPD, 2005.

REFERENCES

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag Ltd., 2004.
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design", The Morgan Kaufmann Series, 2003.

CO-PO Mapping:

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CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16652 **WEARABLE DEVICES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the fundamentals of sensors.
- understand signal processing association in wearable systems.
- evaluate various energy needs in wearables.
- learn the analysis of wearable systems.
- analyze the applications of wearables.

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.

TEXTBOOKS

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

CO-PO Mapping:

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CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM**16653** **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

Upon the completion of the 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.

TEXTBOOKS

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, New Delhi – 5th edition Reprint 2007.
4. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI–4th Edition,2006.

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CO 3			3	3	3	3	3	3	3				3	
CO 4			2	2	2	2	2	2	2				3	
CO 5			3	3	3	3	3	3	3				3	

BM16654 **MEDICAL RADIATION SAFETY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- enhance knowledge on radiation.
- understand the importance of detecting radiation levels.
- be aware of nuclear medicine and its precautions.
- understand safety measures on laser and UV.
- evaluate the need of dosimetry.

UNIT I INTRODUCTION TO RF AND MICROWAVE RADIATION 9

Sources of radio frequency radiation- Effects of radio frequency radiation; Development of standards for human safety- Calculation of RF field quantities, RF radiation measuring instruments and methods.

UNIT II RADIATION DETECTION AND MEASUREMENT 9

Fundamentals of radiation detection - Conducting radiation measurements and surveys, Gas detectors, Designing to reduce radiation hazards, Radio frequency radiation safety management and training; Scintillation detectors, Statistics of counting, Minimum detectable activity, Quality assurance of radiation counters; International Commission on Radiation Protection (ICRP), Nuclear Regulatory Commission (NRC).

UNIT III RADIATION SAFETY IN NUCLEAR MEDICINE AND RADIOTHERAPY 9

Design and description of NM department- Radiation protection in nuclear industry, Guidelines for radiation protection, Molecular medicine and radiation safety program; Procedures for safe operation of radiation equipment - Radiation protection in external beam radiotherapy, Radiation protection in brachytherapy Radioactive wastes.

UNIT IV LASER AND ULTRAVIOLET RADIATION SAFETY 9

Classification of UV radiation -Sources of UV, Biological effects of UV, Hazards associated with UV radiation, UV control measures, Safety management of UV; Classifications of LASER and its radiation hazards- Control measures, Emergencies and incident procedures, The ALARA Policy; Radiation Safety Practices – RSO, RSC,RSP,QMP.

UNIT V MONITORING AND INTERNAL DOSIMETRY 9

Monitoring methods-Personal radiation monitoring, Records of personal dosimetry, ICRP method, MIRD method, Internal doses from radiopharmaceuticals, Bioassay of radioactivity; Hazard and risk in radiation protection- Radiological incidents and emergencies, Regulation to radiation protection; Recommended Dose Limits – Occupational, General Public Dose Limits.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- provide an insight to the basics of radiation physics.
- enable them to understand the guidelines of radiation protection and radiation detectors.
- understand the nuclear medicine protocols.
- provide information on safety measures related to UV, laser and nuclear medicine.
- understand the needs of dosimetry.

TEXTBOOKS

1. Jamie V, Trapp, Thomas Kron, "An introduction to radiation protection in medicine", CRC press Taylor &Francis group, 2008.
2. Alan Martin, Samuel Harbison, Karen Beach, Peter Cole, Hodder Arnold, "An Introduction to radiation protection", 6th edition 2012.

REFERENCES

1. Max Hlombardi, "Radiation safety in nuclear medicine", CRC Press Taylor & Francis group, 2nd edition, 2007.
2. Aruna Kaushik, Anupam Mondal, Dwarakanath B.S, Tripathi R P, "Radiation protection manual", INMAS, DRDO, 2010.
3. Ronald kitchen, "RF and microwave radiation safety", Newness publishers, 2nd edition, 2001.

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CO 2	3				3					3	3	3		3
CO 3					3					3	3	3	3	
CO 4						3				3	3	3		3
CO 5	3					3			3	3	3	3		3

BM16903 INTRODUCTION OF DATA SCIENCE AND BIOINFORMATICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the introduction of data science.
- gain the knowledge about data science using python.
- explore the biological information in data acquisition.
- understand the bioinformatics data processing.
- know the methods of analysis in bioinformatics.

UNIT I INTRODUCTION OF DATA SCIENCE 9

Data Science – Fundamentals and Components, Data Scientist; Terminologies Used in Big Data Environments – Types of Digital Data ,Classification of Digital Data, Introduction to Big Data, Characteristics of Data, Evolution of Big Data; Big Data Analytics -Classification of Analytics, Top Challenges Facing Big Data, Importance of Big Data Analytics, Data Analytics Tools.

UNIT II DATA SCIENCE USING PYTHON 9

Introduction to Essential Data Science Packages: Numpy, Scipy, Jupyter, Stats models and Pandas Package; Data Munging: Introduction to Data Munging, Data Pipeline and Machine Learning in Python – Data Visualization Using Matplot lib; Interactive Visualization with Advanced Data Learning Representation in Python.

UNIT III BIOLOGICAL DATA ACQUISITION 9

Biological information - Retrieval methods for DNA sequence; Protein sequence and protein structure information.

UNIT IV DATA PROCESSING 9

Data – Access, Retrieval and Submission, Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data, Sequence Similarity Searches: Local versus global; Distance metrics, Similarity and homology, Scoring matrices.

UNIT V METHODS OF ANALYSIS 9

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman; Heuristic Methods of sequence alignment, FASTA and PSI BLAST; Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the process of bioinformatics data.
- explain the methods of analysis in bioinformatics.

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- understand the process of bioinformatics data.

TEXTBOOKS

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.

REFERENCES

1. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
2. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, OReilley Media
3. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.
4. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by Durbin, S.Eddy, A.Krogh, G.Mitchison.

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CO 5				2	2	2				2	2	2	3	

BM19904 HOSPITAL MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals of hospital administration and management.
- know the market related research process.
- explore various information management systems.
- learn the quality and safety aspects in hospital.
- explore relative supportive services.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration; Hospital Planning, Equipment Planning, Functional Planning.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM, Profile of HRD Manager; Human Resource Inventory – Manpower Planning.

UNIT III RECRUITMENT AND TRAINING 9

Different Departments of Hospital, Recruitment, Selection; Training Guidelines – Methods of Training, Evaluation of Training, Leadership grooming and Training, Promotion, Transfer.

UNIT IV SUPPORTIVE SERVICES 9

Medical Records Department – Central Sterilization and Supply Department, Pharmacy, Food Services, Laundry Services.

UNIT V COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL 9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV; Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the principles of Hospital administration.
- identify the importance of Human resource management.
- list various marketing research techniques.
- identify Information management systems and its uses.
- understand safety procedures followed in hospitals.

TEXTBOOKS

1. R.C.Goyal, Hospital Administration and Human Resource Management, PHI – Fourth Edition, 2006.

2. G.D.Kunders, Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint ,2007.

REFERENCES

1. Arnold D. Kalcizony and Stephen M. Shortell, Health Care Management, 6th Edition Cengage Learning, 2011.
2. Blane, David, Brunner, Health and SOCIAL Organization: Towards a Health Policy for the 21st Century, Eric Calrendon Press 2002.

Co – Po Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		3										2	3	3
CO 2		3	3	3	2	2	2	2	2			2	3	2
CO 3					3	3	2	2	2	2		2	2	3
CO 4								3			2	2	2	2
CO 5												2	2	2

BM16802 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 upto 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 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 Phase II Report is examined jointly by external and internal examiners constituted by the Controller of Examinations. 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.
- explain the acquired knowledge through preparation of report and oral presentations.

Co – Po Mapping:

Course Outcomes (CO's)	Mapping of course objectives with PO's and PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (PO's)												Programme Specific Outcomes (PSO's)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3					3	3			2	3	3
CO 2	3	3	3	3	3	2	2		2			3	3	2
CO 3	3		3	3	3	3	2		2	2		3	2	3
CO 4	3	3	3				2	3	3	3	2	3	2	2
CO 5	3		3						2	3	3	2	2	2