PG Diploma

in

HEALTHCARE TECHNOLOGY

CURRICULUM

(For students admitted in 2026-2027)

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI– 620 015
TAMIL NADU, INDIA

CURRICULUM

The total minimum credits for completing the PG DIPLOMA programme in HEALTHCARE TECHNOLOGY is 40.

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CREDITS
1	PC-1	HUMAN PHYSIOLOGY FOR ENGINEERS	3
2	PC-2	BIOMEDICAL INSTRUMENTATION	3
3	PE	ELECTIVE 1	3
4	PE	ELECTIVE 2	3
5	MC	MICRO CREDIT 1	1
6	MC	MICRO CREDIT 2	1
7	PC-5	MEDICAL INSTRUMENTATION AND MEASUREMENTS LABORATORY	2
8	PC-6	MINI PROJECT	2
9		INTERNSHIP	2
Total			**20**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CREDITS
1	PC-3	DIGITAL HEALTHCARE	3
2	PC-4	IOT AND WEARABLE TECHNOLOGIES IN HEALTHCARE	3
3	PE	ELECTIVE 3	3
4	PE	ELECTIVE 4	3
5	MC	MICRO CREDIT 3	1
6	MC	MICRO CREDIT 4	1
7	PC-7	PROJECT	6
Total			**20**

LIST OF ELECTIVE COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CREDITS
1.	PE-1	BIOSIGNAL AND IMAGE ANALYSIS	3
2.	PE-2	AI FOR HEALTHCARE	3
3.	PE-3	BIG DATA ANALYTICS IN HEALTHCARE	3
4.	PE-4	MEDICAL DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	3
5.	PE-5	ETHICAL CHALLENGES IN HEALTHCARE **(ICMR Online course)**	3
6.	PE-6	MEDICAL DEVICE REGULATIONS, AND STANDARDS	3
7.	PE-7	TESTING AND CALIBRATION OF MEDICAL DEVICE	3
8.	PE-8	SPORTS BIOMECHANICS	3
9	PE-9	REHABILITATIVE AND ASSISTIVE TECHNOLOGY IN HEALTHCARE	3
10	PE-10	INTRODUCTION TO BIOINFORMATICS	3
11	PE-11	HUMAN-COMPUTER INTERACTION	3
12	PE-12	BIOMEDICAL DATA VISUALIZATION	3
13	PE-13	AUTOMATION IN HEALTHCARE INDUSTRY	3

LIST OF MICRO CREDIT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CREDITS
1	MC-1	IMAGING TECHNIQUES X-RAY, MRI, FUNCTIONAL MRI, PET etc	1
2	MC-2	PRECISION MEDICINE	1
3	MC-3	MEDICAL ROBOTICS	1
4	MC-4	STATISTICS AND PROBABILITY	1
5	MC-5	PYTHON FOR HEALTHCARE	1
6	MC-6	MATLAB FOR BIOMEDICAL ENGINEERING	1
7	MC-7	CYBER SECURITY IN HEALTHCARE	1
8	MC-8	INTRODUCTION TO MEDICAL SOFTWARE	1

Course Code	:	ICXXX
Course Title	:	**Human Physiology for Engineers**
Type of Course	:	PC-1
Prerequisites	:	--
No. of Credits	:	3 credits
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To introduce the structure and organization of the various organs of the human body
CLO2	To teach the fundamental concepts and principle of cell physiology
CLO3	To teach the physiology of cardiovascular, respiratory, digestive, renal, endocrine and nervous system
CLO4	To introduce the biomechanics concepts and their application in prosthetics, and assistive devices

Course Content

Overview of human physiology, Cellular and molecular basis of human physiology, Physiology of cells - structure, function, action and Resting Potential, and communication mechanism

Cardiovascular physiology: structure and functions of heart - Cardiovascular regulatory mechanics; Blood and hemodynamics, Electrical activity of the heart, blood flow, pressure, and resistance, along with engineering approaches.

Neuro anatomy and physiology - Electrical activity of brain, functional connectivity, sleep-wake states; different wave patterns; Control of posture and movement, Physiology of senses including touch, vision, and hearing.

Respiratory physiology: Pulmonary function; Principles of gas exchange; Gas transport in blood & tissue fluids; Regulation of respiration.

Digestive system, Renal system, Endocrine system – Introduction, Glands and Hormones, Endocrine disorders.

Musculoskeletal system – Bone and Joints structure and physiology principles of biomechanics and their application in designing prosthetics and orthotics

Textbooks:

1.	Guyton & Hall, Textbook of Medical Physiology, Elsevier, 14th Edition, 2020.
2.	KE Barett, SM Barman, S Boitano, HL Brooks, Ganong's Review of Medical Physiology, McGraw Hill Medical, 23rd Edition 2010.
3.	Rangaraj M. Rangayyan, Sridhar Krishnan, John Wiley & Sons, Inc. 2024.

References:

1.	Linda S. Costanzo, BRS Physiology, Wolters Kluwer India Pvt. Ltd, 8th Edition, 2022.
2.	Leonard R. Johnson, Essential Medical Physiology, Academic press, 3rd Edition 2003.
3.	Bruce M Koeppen, Bruce A Stanton, Berne & Levy Physiology, Elsevier, 7th Edition, 2017.
4.	Stefan Silbernagl, Florian Lang, Color Atlas of Pathophysiology, TPS, 2nd Edition, 2009.
5.	Walter F. Boron, Emile L. Boulpaep, Medical physiology, Elsevier, 3rd Edition, 2016.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To understand cell physiology to develop the measurement systems
CO2	To describe the electrical activity and functions of cardiovascular, nervous and respiratory systems
CO3	To explain the functions of Digestive system, Renal system, and Endocrine system
CO4	To understand working of the suitable prosthetics and assistive devices

Course Code	**:**	ICXXX
Course Title	**:**	**Biomedical Instrumentation**
Type of Course	**:**	PC-2
Prerequisites	**:**	-------
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To provide students with an understanding of electronic circuit analysis, biomedical sensors, transducers, and electronic medical devices and design principles, and their biomedical applications.
CLO2	To enable the students to acquire, analyse, and interpret physiological signals while eliminating potential artefacts.
CLO3	To create awareness of medical device standards in hospitals and electrical safety protocols.
CLO4	To equip students with knowledge of electrical safety principles in hospital environments,.

Course Content

Sensors and transducers in medical devices, Electrodes, electrode–tissue interface, and motion artefacts in biopotential measurements.

Signal conditioning techniques for biomedical signals - circuit analysis techniques, op-amps applications - filters design, power supplies, and microcontrollers.

Communication modules – Parallel and serial peripheral interfaces, Network interfaces

Electronic medical equipment working principle, list of medical devices, common issues in medical devices and diagnosis, Calibration of medical devices.

Electrical Safety and standards in Hospitals: Grounding, leakage currents, protection circuits, medical device standards.

Textbooks

1.	William H. Hayt, Jr., Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill Publications, 8th Edition, 2013
2.	Boylestead L R and Nashelsky L, "Electronic Devices and Circuit theory", Pearson Education India, New Delhi, 11th Edition, 2013.
3.	Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, Oxford, 7th Edition, 2015
4.	John G. Webster, Amit J. Nimunkar, Medical Instrumentation Application & Design, John Wiley & Sons, New York, 5th Edition, 2020
5.	Arthur Guyton, John E. Hall, Textbook of Medical Physiology, Elsevier Saunders, 12th Edition, 2011.
6.	Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2nd Edition 2014.

References

1.	Onkar N. Pandey and Rakesh Kumar, Bio-Medical Electronics and Instrumentation, Katson Books, 2011
2.	Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson publishing, 4th Edition, 2000.
3.	R.S. Khandpur, Hand Book of Biomedical Instrumentation, McGraw Hill Education (India) Private Limited, 3rd edition, 2014.
4.	Andrew G. Webb, Principles of Biomedical Instrumentation, Cambridge University Press, 2018.
5.	Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Cengage Learning, 2010.

Course Outcomes (CO)

At the end of the course students will be able to

CO1	Apply circuit analysis techniques to design and evaluate electronic systems, including diodes, filters, power supplies, op-amps, and microcontrollers, for biomedical applications.
CO2	Acquire and analyze physiological signals while addressing challenges such as electrode-tissue interactions, motion artifacts, and signal conditioning.
CO3	Understand the functionality of electronic medical devices, diagnose common operational issues, and implement troubleshooting strategies.
CO4	Ensure electrical safety in healthcare environments by implementing proper grounding, leakage current protection, and compliance with medical device regulations.

Course Code	**:**	ICXXX
Course Title	**:**	**Digital Healthcare**
Type of Course	**:**	PC-3
Prerequisites	**:**	-
No. of Credits	**:**	3 credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the significance of digital transformation in healthcare and its key enabling technologies.
CLO2	Analyze the role of Electronic Health Records (EHR), telemedicine, and mobile health applications.
CLO3	Explore the impact of AI, automation, and robotics in smart hospitals and digital therapeutics.
CLO4	Evaluate cybersecurity, data privacy, and ethical considerations in digital healthcare.

Course Content

Introduction to Digital Healthcare
Evolution and significance of digital healthcare**,** Challenges in traditional healthcare and digital transformation

Electronic Health Records (EHR) and Interoperability
Structure and components of EHR, Health data standards: OHDSI, HL7 (Health Level 7) for standardized medical communication, FHIR (Fast Healthcare Interoperability Resources) for cloud-based health data sharing, DICOM (Digital Imaging and Communications in Medicine) for medical imaging, Brain imaging data structure – MRI, Infrared spectroscopy, Blockchain applications in healthcare data security

Telemedicine and Mobile Health (mHealth)
Basics of telemedicine and remote consultations, Telemedicine platforms and applications, Mobile health applications, Regulatory framework and challenges in telehealth

Smart Hospitals and Digital Therapeutics
Hospital management systems, hospital automation and smart ICUs, Robotics in surgeries, Virtual nursing assistants and chatbots for patient support, Role of digital therapeutics (DTx) in healthcare

Cybersecurity and Ethics in Digital Health
Healthcare cybersecurity threats and countermeasures, Data privacy laws: HIPAA (Health Insurance Portability and Accountability Act), UPDP, GDPR (General Data Protection Regulation), Ayushman Bharat Digital Mission, Ethical considerations in AI-based healthcare solutions, Future Trends & Case Studies in Digital Healthcare

Textbooks:

1.	Nilmini Wickramasinghe, Digital Health: A Primer (Analytics and AI for Healthcare), CRC press, 1st edition, 2024
2.	Homero Rivas, Katarzyna Wac, Digital Health: Scaling Healthcare to the World ((Health Informatics), Springer, 1st edition, 2018

3.	Joseph Tan, Phillip Olla, Digital Health Care: Perspectives, Applications, and Cases, Jones and Bartlett Publishers, Inc, 1st edition, 2022

References:

1.	Nilanjan Dey, Nabanita Das, Jyotismita Chaki, Digital Future of Healthcare, CRC press, 1st edition, 2022.
2	Helen Almond, Carey Mather, Digital Health: A Transformative Approach, Elsevier, 1st edition, 2023
3.	Jerome H. Carter, Electronic Health Records: A Guide for Clinicians and Administrators, American College of Physicians, 2008

Course Outcomes (CO)

At the end of the course students will be able

CO1	Explain the evolution and key technologies in digital healthcare.
CO2	Analyze the structure and implementation of EHR, telemedicine, and mobile health applications.
CO3	Apply AI, robotics, and automation techniques in smart hospitals and digital therapeutics.
CO4	Evaluate cybersecurity challenges, data privacy laws, and ethical concerns in digital healthcare.

Course Code	**:**	ICXX
Course Title	**:**	**IoT and Wearable Technologies in Healthcare**
Type of Course	**:**	PC-4
Prerequisites	**:**	--
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To teach the anatomy, architecture and design of IoT system
CLO2	To teach the fundamentals and principles of wearable technologies
CLO3	To apply wearable technologies and IoT in healthcare applications
CLO4	To explain data privacy and security in wearable IoT system

Course Content

Overview of Internet of Things, anatomy and functionalities of IoT modules, Architecture of IoT, Sensors and actuators interfaces, communication technologies, gateways, edges and clouds, IoT systems design and levels. Networking models – OSI, TCP/IP model, Network Protocols, topologies, Networking Design. Challenges associated with their implementation in healthcare.

Fundamental principles of wearable technology, Wearable sensors – Chemical and Biochemical sensors, haptic sensors, flexible electronics and energy harvesting techniques, one to one communication Technology, wearable technology in various applications in healthcare, Significance of IoT in Wearable Technology

IoT and Wearable Technology case studies – Cardiovascular diseases, Neurological diseases, Gastrointestinal diseases; Wearable and non-invasive assistive technologies: Assistive devices for individuals with severe paralysis, Real time Cardiac monitoring, Wearable tongue drive system.

Privacy and Data security in Wearable IoT, Future Trends and Innovations in Healthcare IoT, Challenges in IoT and wearable, Standards in IoT and wearable

Textbooks

1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.
2.	Samuel Greengard, The Internet of Things, The MIT Press, 2021
3.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, “Internet of Things: Architectures, Protocols and Standards,” Wiley, 2018.
4.	Haider Raad, Fundamentals of IoT and wearable technology design, Wiley, 2021.
5.	Fei Hu, “Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations,” CRC Press, 2016.

References

1.	Edward Sazonov, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2nd Edition, 2020.
2.	Ram K Gupta, Flexible and wearable Sensors: Materials, Technologies and Challenges, CRC Press, 1st Edition, 2023.
3.	Perry Lea, "Internet of things for architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt, 1st Edition, 2018.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To understand the architecture and functionalities of IoT based system
CO2	To understand the fundamental design concepts of wearable devices
CO3	To Apply IoT and wearable technology in healthcare applications
CO4	Able to discuss the data security and privacy on IoT in healthcare

PROGRAM ELECTIVES

Course Code	**:**	ICXXX
Course Title	**:**	Biosignal and Image Analysis
Type of Course	**:**	PE-1
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the basics of medical signals and images
CLO2	Apply Time and Frequency domain analysis
CLO3	Learn medical image processing and feature extraction techniques
CLO4	Implement segmentation and analysis techniques for clinical application

Course Content

Introduction to Biomedical Signals and Characteristics, Filtering techniques for Removal of artefacts: Statistical Preliminaries, Time domain filtering (Moving Average Filter to Integration, Derivative-based Operator) Frequency Domain Filtering (Notch Filter), Time and frequency features, Wavelet features

Image storage and display operation properties of digital image. Image enhancement and restoration techniques: statistical features of images and their application in image enhancement, histogram equalization

Correlation and convolution, and application of convolution for designing of smoothing filters, sharpening filters, gradient and Laplacian and zero crossing edge detectors Image Segmentation techniques: segmentation of image by threshold, Edge based and Region based techniques

Analysis of ID and 2D signals with applications and case studies: ECG, EMG, and EEG, X-ray and MR Images

Textbooks:

1. Rangaraj M. Rangayyan, Sridhar Krishnan, and Sridhar Krishnan. Biomedical signal analysis. John Wiley & Sons, 2024.
2. D.C.Reddy, “Biomedical Signal Processing: Principles and Techniques, Tata McGraw-Hill, 3rd reprint, 2007.
3. Geoff Dougherty, Digital image processing for medical applications, Cambridge University Press, 2009.
4. Suresh R. Devasahayam, Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing, 3rd edition, Springer, 2019.

Reference Books:

1. Najarian, Kayvan, and Robert Splinter, Biomedical signal and image processing, CRC Press, 2nd Edition, 2012.
2. John L. Semmlow, Biosignal and medical image processing. 2nd Edition, 2008, CRC press.
3. Al-Jumaily, Adel, Paolo Crippa, Ali Mansour, and Claudio Turchetti, Non-Invasive Health Systems Based on Advanced Biomedical Signal and Image Processing. CRC Press, 1st Edition, 2024.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Demonstrate the ability to filter and analyse and extract meaningful extraction.
CO2	Apply statistical and spectral methods to interpret bio signals accurately.
CO3	Enhance and restore medical image using transformation techniques.
CO4	Implement segmentation techniques to analyse and interpret CT and MRI images.

Course Code	**:**	ICXXX
Course Title	**:**	AI for Healthcare
Type of Course	**:**	PE-2
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand Healthcare Data and standards in AI applications
CLO2	Apply and develop the Machine Learning Techniques
CLO3	Implement Deep Learning models for healthcare analytics
CLO4	Understand advanced AI techniques for real world healthcare scenario

Course Content

Health Data, Information, and Knowledge
Understanding clinical data, Types of data, Coding systems, LOINC, NDC, ICD-10, SNOMED, Clinical Text -NLP, Medical Image, Physiological Time-series, Omics data, Risk stratification, Labels and evaluations, Introduction to mathematical tools. Data characterization, Introduction to Data visualization and normalization.

Machine Learning in healthcare
Supervised learning algorithms: Decision Trees, K-Nearest Neighbors, Support Vector Machines, Logistic Regression, Probabilistic Neural Network.

Deep Learning and Representative Learning
State-of-the-art neural networks architectures – Fundamentals of deep learning - Convolutional neural networks, Gradient descent learning, Backpropagation, Regularization, Loss functions, Optimisation techniques, and Types of CNN, LSTM Architecture. and Transformers, Transfer Learning Model, Foundation Model, Generative adversarial networks.

Advanced AI Technologies for Healthcare - Multimodal data and models, Explainable and Ethical AI,

AI application in Healthcare - Classification and segmentation, Copilot, ChatGPT, Large Language Model, Automating clinical workflows

References

1. Adam Bohr, Kaveh Memarzadeh, Artificial intelligence in healthcare. Academic Press, 1st Edition, 2020.
2. Richard O. Duda, Peter E. Hart, David G. Stork - Pattern classification, John Wiley & Sons, 2nd Edition, 2006.
3. Walid A. Zgallai, Biomedical Signal Processing and Artificial Intelligence in Healthcare. Academic Press; 2020.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Familiarize healthcare data standards for processing clinical images.
CO2	Design and evaluate the machine learning models for disease classification.
CO3	Implement deep learning frameworks for medical image and physiological signal processing.
CO4	Develop AI driven solutions for various applications like emotion recognition, epilepsy and clinical support.

Course Code	:	ICXXX
Course Title	:	Big Data Analytics in Healthcare
Type of Course	:	PE-3
No. of Credits	:	3 Credits
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the role of big data analytics in healthcare
CLO2	Gain knowledge of data processing and management
CLO3	Apply analytical techniques for healthcare insights
CLO4	Explore Big Data technologies for large scale healthcare analytics

Course Content

Introduction to Healthcare Data and Big Data Analytics:
Overview of Electronic Health Records (EHRs), claims data, genomic data, wearable device data, Characteristics of big data (volume, velocity, variety, veracity), Importance of data analytics in healthcare decision making

Data Management and Preprocessing In Healthcare
Data warehousing and data lakes in healthcare, Data cleaning, normalization, and transformation techniques, Data integration from diverse sources, Data quality assessment and validation

Statistical and Machine Learning Techniques for Health Analytics
Descriptive statistics for healthcare data, Regression analysis (linear, logistic) for prediction modelling, Classification algorithms (Decision Trees, Random Forests, Support Vector Machines), Clustering techniques for patient segmentation, Time series analysis for trend identification, Probabilistic Neural Network

Big Data Technologies and Tool in Healthcare
Hadoop Distributed File System (HDFS), Apache Spark for large-scale data processing, SQL and NoSQL databases for data storage, Data visualization tools (Tableau, Power BI), Programming languages (Python, R) for data analysis

Application of Big Data Analytics in Healthcare
Clinical Decision Support, Population Health Management, Healthcare Operation, Genomics and Personalized Medicine

Text Books

1. Langkafel, P. ed., 2015. Big data in medical science and healthcare management: Diagnosis, therapy, side effects. Walter de Gruyter GmbH & Co KG.
2. Guo, Chonghui, and Jingfeng Chen. "Big data analytics in healthcare." In Knowledge technology and systems: Toward establishing knowledge systems science, pp. 27-70. Singapore: Springer Nature Singapore, 2023.
3. El Morr Christo, and Hossam Ali-Hassan, Analytics in healthcare: a practical introduction. Springer, 2019.

Reference Books

1. Mowafa Househ, Andre W. Kushniruk, and Elizabeth M. Borycki, Big Data, Big Challenges: A Healthcare Perspective, Springer Nature Switzerland AG, 2019.
2. Connie W. Delaney, Charlotte A. Weaver, Judith J. Warren, Thomas R. Clancy, and Roy L. Simpson. Big Data-Enabled Nursing Education, Research and Practice, Springer International Publishing AG, 2017.

3. Pantea Keikhosrokiani. Big data analytics for healthcare: datasets, techniques, life cycles, management, and applications. Academic Press,2022.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Demonstrate the effective data handling.
CO2	Apply advanced analytical skills to analyse healthcare data.
CO3	Develop the Big Data tools for scalable healthcare data processing.
CO4	Ensure the improves healthcare decision making for health management.

Course Code	**:**	ICXXX
Course Title	**:**	**Medical Diagnostic and Therapeutic Equipment**
Type of Course	**:**	PE-4
Prerequisites	**:**	-------
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To help students understand patient monitoring systems and telemedicine
CLO2	To familiarize students with various medical imaging systems for effective clinical applications
CLO3	To equip students with knowledge of extracorporeal devices used in critical care
CLO4	To introduce students to various physical therapy modalities

Course Content

Patient monitoring systems, Intensive cardiac care, bedside and central monitoring systems, Infusion pumps, Central consoling controls, telemedicine.

ECG, EMG, EEG, sLORETA, Pneumotachometer, Thoracic pressure measurements

Medical Imaging diagnostic system - X ray machine, Computer tomography, ultrasonic imaging system, magnetic resonance imaging system, thermal imaging system, positron emission tomography,

Therapeutic Equipment: Cardiovascular and Respiratory system - Cardiac Pacemaker, Defibrillator, Heart lung machine, Types of Ventilators, Humidifiers, Nebulizers, Inhalators, Hemo Dialyser unit, Incubators, Neuromodulation equipments – TMS, tES, ECT, tDCS.

IR, UV lamp and LASER application, Diathermy, Electro surgery machine, Lithotripsy, cryogenic technique and application, Endoscopy, Laparoscopy, Otoscopes.

Textbooks

1.	William H. Hayt, Jr., Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill Publications, 8th Edition, 2013
2.	Boylestead L R and Nashelsky L, "Electronic Devices and Circuit theory", Pearson Education India, New Delhi, 11th Edition, 2013.
3.	Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, Oxford, 7th Edition, 2015
4.	John G. Webster, Amit J. Nimunkar, Medical Instrumentation Application & Design, John Wiley & Sons, New York, 5th Edition, 2020
5.	Arthur Guyton, John E. Hall, Textbook of Medical Physiology, Elsevier Saunders, 12th Edition, 2011.
6.	Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall of India, New Delhi, 2nd Edition, 2014.

References

1.	Onkar N. Pandey and Rakesh Kumar, Bio-Medical Electronics and Instrumentation, Katson Books, 2011
2.	Thomas S. Curry, James E. Dowdey, Robert E. Murry, Christensen's Physics of Diagnostic Radiology, 4th Edition, Lea & Febiger,U.S, 1990.
2.	Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson publishing, 4th Edition, 2000
3.	R.S. Khandpur, HandBook of Biomedical Instrumentation, McGraw Hill Education (India) Private Limited, 3rd edition, 2014.
4.	Andrew G. Webb, Principles of Biomedical Instrumentation, Cambridge University Press, 2018.
5.	Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Cengage Learning, 2010.

Course Outcomes (CO)

At the end of the course students will be able to

CO1	Understand the working of patient monitoring systems
CO2	Familiar with various imaging techniques used for diagnosis
CO3	Discuss extracorporeal devices used in hospital
CO4	Explain phototherapy, diathermy and other physical therapy modalities

Course Code	:	ICXXX
Course Title	:	Ethical Challenges in Healthcare
Type of Course	:	PE-5
No. of Credits	:	3
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand ethical principles and their application in healthcare decision-making
CLO2	Analyze ethical dilemmas in medical practice, research, and public health
CLO3	Explore the role of laws, policies, and professional codes in guiding ethical conduct
CLO4	Examine emerging ethical challenges in digital health, AI, and biomedical innovations

Course Content

Foundations of Healthcare Ethics
Introduction to bioethics and medical ethics - Ethical theories and principles (autonomy, beneficence, non-maleficence, justice) - The role of ethics in clinical practice and healthcare policy - Ethical decision-making models - Professional codes of ethics (AMA, WHO, NMC, etc.)

Patient Rights, Confidentiality, and Informed Consent
Patient autonomy and shared decision-making - Informed consent: legal and ethical aspects - Confidentiality and data privacy in healthcare - HIPAA and GDPR regulations on patient data protection - Ethical issues in genetic testing and counselling

Ethical Dilemmas in Clinical Practice and Research
End-of-life care, euthanasia, and physician-assisted dying - Organ donation and transplantation ethics - Ethical considerations in reproductive healthcare (abortion, surrogacy, IVF) - Clinical trials, human subjects research, and informed consent in research - Medical errors, whistleblowing, and professional accountability

Healthcare Equity, AI, and Digital Ethics
Ethical challenges in access to healthcare and disparities - AI and machine learning in healthcare: bias, transparency, and accountability - Telemedicine and remote patient monitoring: privacy and consent issues - Big data and predictive analytics in healthcare decision-making - Ethical concerns in biotechnology and personalized medicine

Public Health Ethics and Global Healthcare Challenges
Ethics in pandemic response and vaccination policies - Resource allocation and triage during health crises - Ethical implications of global health initiatives and policies - The role of government and organizations in shaping healthcare ethics - Future ethical challenges in healthcare innovation and technology

Textbooks

1. Tom L. Beauchamp and James F. Childress, *Principles of Biomedical Ethics*. Oxford University Press, 8th Edition, 2019
2. Jonsen AR, Siegler M, Winslade WJ. eds. Clinical Ethics: A Practical Approach to Ethical Decisions in Clinical Medicine, McGraw-Hill Education, 9th Edition, 2022

References

1. Ezekiel J. Emanuel, *Which Country Has the World's Best Health Care?* PublicAffairs, 2020.
2. Vicki D. Lachman, *Ethical Challenges in Health Care: Developing Your Moral Compass*, Springer Publishing Co Inc, 2009

Course Outcomes (CO)

At the end of the course students will be able

CO1	Apply ethical principles to real-world healthcare challenges
CO2	Analyze ethical dilemmas in patient care, medical research, and public health policies
CO3	Develop ethical reasoning skills to navigate complex decision-making in healthcare
CO4	Assess the impact of digital innovations on healthcare ethics

Course Code	**:**	ICXXX
Course Title	**:**	Medical Device Regulations and Standards
Type of Course	**:**	PE-6
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the medical device regulation and the regulatory requirements
CLO2	Identify and apply medical device design principles
CLO3	Analyse the requirements of the clinical trial and risk management
CLO4	Interpret Regulatory Standards and case studies

Course Content

Clinical Trials and Evaluation
Definition and designing clinical trials for medical devices, industry, Medical Device Design Principles: User-centered design, Ergonomics and human factors, Design for manufacturability, Overview of regulatory requirements for clinical trials, Post-market surveillance and reporting

Regulatory Frameworks and Standards
Overview of FDA regulations, Introduction to ISO standards (ISO 13485, ISO 14971), CE marking and European regulations, Various other standards - FDA, international and Indian standards.

Standards of Therapeutics and Diagnostic Equipments - Introduction to Risk management process (ISO 14971), Quality management systems (ISO 13485), Good Manufacturing Practice (GMP), IEC 62304 software as medical device, CDSCO, IEC 60601-1 & 1-2, Bureau of Indian Standards.

Case Studies and Real-world Applications

Text Books

1. Peter J. Ogrodnik, Medical Device Design: Innovation from Concept to Market, Academic Press, 1st Edition, 2013.
2. John J. Tobin, Gary Walsh, Medical product regulatory affairs: pharmaceuticals, diagnostics, medical devices, Wiley-Blackwell, 2nd Edition, 2023.
3. Douglas J. Pisano and David S. Mantus, FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics, CRC Press, 2nd Edition, 2008.

Reference Books

1. Aakash Deep. Medical Device Regulations: A Complete Guide. Academic Press, 1st Edition, 2022.
2. Elijah Wreh. Medical Device Regulation: FDA-CDRH Manufacturing, Policies and Regulation Handbook. Academic Press, 1st Edition, 2023.
3. Ilkka Juuso, Ilpo Pöyhönen. Medical-Grade Software Development: How to Build Medical-Device Products That Meet the Requirements of IEC 62304 and ISO 13485. CRC Press, 1st Edition, 2023.

Course Outcomes (CO)

At the end of the course student will be able

CO1	Demonstrate knowledge of medical device classification and regulations
CO2	Apply principles for effective medical device design and manufacturing
CO3	Design and evaluate appropriate clinical trials with regulatory compliance
CO4	Apply risk assessment techniques and quality management principles to improve performance

Course Code	**:**	ICXXX
Course Title	**:**	Testing and Calibration of Medical Device
Type of Course	**:**	PE-7
Prerequisites	**:**	
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the importance of testing and calibration in maintaining the accuracy and safety of medical devices.
CLO2	Identify and apply appropriate testing and calibration procedures for various medical equipment.
CLO3	Interpret and adhere to national and international standards related to medical device calibration.
CLO4	Develop and implement maintenance strategies to ensure the longevity and reliability of medical devices.

Course Content

Introduction to Medical Device Testing and Calibration
Fundamentals of medical devices, definition and classification of medical devices, importance of accuracy and reliability in healthcare, and the need for testing and calibration. Regulatory requirements including FDA (U.S.), CE Marking (Europe), and CDSCO (India), Bureau of Indian Standards (BIS) regulations. Good Manufacturing Practice (GMP) and QMS standard - ISO 13485. Overview of the calibration process, including definitions of precision, accuracy, uncertainty, and traceability. Introduction to calibration methods and tools.

Standards and Quality Management Systems
International standards for medical devices, including ISO 17025, for calibration and testing laboratories, IEC 60601 for medical electrical equipment safety, and ISO 15189 for medical laboratories. Quality control and assurance in medical devices, validation and verification processes, and metrology and measurement traceability. Documentation and record-keeping, including calibration certificates, compliance reports, and electronic documentation and data logging.

Mechanical Testing of Medical Devices
Introduction to mechanical testing, mechanical properties including elasticity, plasticity, hardness, tensile strength, fatigue, and endurance testing. Testing of medical implants and instruments, load testing of orthopedic implants, and durability testing of catheters and stents. Use of testing equipment including Universal Testing Machine (UTM), Dynamic Mechanical Analyzer (DMA), and biomechanical simulators for prosthetic testing.

Calibration of Medical Electronic Devices
Principles of electronic device calibration, methods including direct comparison, substitution, and zero-based calibration. Instrument calibration versus system calibration. Calibration of diagnostic and monitoring devices including ECG and EEG machines, patient monitors for blood pressure, SpO_2, and temperature sensors, and defibrillators for output energy testing. Calibration of therapeutic devices including infusion pumps for flow rate and

volume accuracy and ventilators for pressure, volume, and flow calibration, Calibration of imaging devices.

Textbooks

1. Joseph J. Carr & John M. Brown *Introduction to Biomedical Equipment Technology,* Pearson Education, 4th Edition, 2000.
2. John G. Webster, *Medical Instrumentation: Application and Design*. John Wiley & Sons, 3rd Edition 2007.

References

1. Joseph D. Bronzino, *Biomedical Engineering and Instrumentation: Basic Concepts and Applications,* PWS, 2010.
2. Joseph D. Bronzino, The Biomedical Engineering Handbook- Four Volume Set, CRC Press, 4th edition, 2015.

Course Outcomes (CO)

At the end of the course students will be able

CO1	Demonstrate proficiency in testing and calibrating a range of medical devices.
CO2	Apply international standards for medical device safety and performance.
CO3	Develop maintenance schedules and troubleshoot common medical device issues.
CO4	Ensure compliance with regulatory requirements in healthcare settings.

Course Code	:	ICXXX
Course Title	:	Human Biomechanics
Type of Course	:	PE-8
Prerequisites	:	--
No. of Credits	:	3 Credits
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	Understand the principles of biomechanics as applied to sports
CLO2	Analyze human movement using biomechanical techniques
CLO3	Assess the mechanical properties of tissues and their response to forces
CLO4	Apply biomechanical principles to improve athletic performance and prevent injuries

Course Content

Introduction to Biomechanics
Definition and scope of biomechanics - Importance of biomechanics - Basic concepts of kinematics and kinetics in human movement - Planes and axes of motion - Types of motion: linear, angular, and general - Introduction to forces acting on the human body

Biomechanical Analysis of Human Motion
Kinematic analysis: displacement, velocity, and acceleration - Kinetic analysis of forces in sports activities - Newton's laws of motion and their application in sports - Impulse-momentum relationship - Work, power, and energy in sports - Free-body diagrams and force vectors in sports movements

Musculoskeletal Model
Biomechanical properties of bones, muscles, tendons, and ligaments - Response of biological tissues to stress and strain - Factors influencing injury mechanisms in sports - Overuse and acute injuries in athletes- Biomechanics of rehabilitation and recovery - Preventive measures and training modifications for injury reduction

Motion Analysis and Measurement Techniques
Introduction to motion capture systems and video analysis - Use of force plates, electromyography (EMG), IMU, and pressure sensors for movement analysis

Applications of Biomechanics - Sports biomechanics and Rehabilitation biomechanics

Textbooks

1. Roger Bartlett, Introduction to Sports Biomechanics: Analysing Human Movement Patterns. Routledge, 2nd Edition, 2007.
2. Prof. Anthony J. Blazevich, Sports Biomechanics - The Basics: Optimising Human Performance, Bloomsbury Publishing, 3rd edition, 2017.

References

1. Duane Knudson, *Fundamentals of Biomechanics*. Springer, 2nd edition, 2007
2. Vladimir Zatsiorsky, Biomechanics in Sport: Performance Enhancement and Injury Prevention. Wiley-Blackwell, 2008.
3. Peter M. McGinnis, Biomechanics of Sport and Exercise, Human Kinetics Publishers, 3rd Edition, 2013.

Course Outcomes (CO)

At the end of the course students will be able

CO1	Apply biomechanical principles to analyze and improve sports performance
CO2	Evaluate the role of sports equipment and technology in biomechanics
CO3	Utilize biomechanical measurement tools for motion analysis
CO4	Evaluate the role of sports equipment and technology in biomechanics

Course Code	**:**	ICXXX
Course Title	**:**	**Rehabilitative and Assistive Technology in Healthcare**
Type of Course	**:**	PE-9
No. of Credits	**:**	3
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives:

CLO1	To understand the basic principles and concepts of rehabilitation and assistive devices
CLO2	To learn the role of rehabilitation devices in restoring the lost movements
CLO3	To understand the functionalities and components of upper and lower limb prostheses
CLO4	To study various assist devices for visually and auditory impaired

Syllabus

Basic Principles: Principles of Assistive and Rehabilitation Technology, Design considerations, standards and key approaches to rehabilitation and Assistive Technology, Anatomy and Physiology of Musculoskeletal system model.

Rehabilitative Technology for Upper Limb Prostheses: Anatomy of upper extremities, Classification of amputation types - Components of upper limb prosthesis, Body powered prosthetics- Myoelectric controlled prosthetics and Externally powered limb prosthetics. Lower Limb Prostheses: Anatomy of lower extremities, Components of upper and lower limb prosthesis, Myoelectric controlled prosthetics and Externally powered limb prosthetics Special purpose wheelchairs -Manual wheelchairs –Electric power wheelchairs -Power assisted wheelchairs

Assistive Devices for Patients with Heart Disease: - Anatomy of Heart and circulatory system, Heart Assist Technology, Engineering Heart and Circulatory problem, Prosthetic Heart Valves.

Assistive Devices for Persons with Visual and Hearing Impairments - Anatomy of eye, Categories of visual impairment – Cortical and retinal implants, Blind mobility aids – reading writing - graphics access and Braille Reader, Orientation and navigation Aids –Ultra sonic canes and laser canes. Anatomy of ear -hearing functional assessment, Types of deafness, Hearing aids- Cochlear implants

Workplace design - Ergonomics

Text Books

1. Albert M. Cook and Janice M. Polgar, Assistive Technologies Principles and Practice, Elsevier, 4th Edition, 2015.
2. Rory A Cooper, Hisaichi Ohnabe, and Douglas A. Hobson, An Introduction to Rehabilitation Engineering, CRC Press, 1st Edition, 2006.

3. Joseph D. Bronzino, Handbook of Biomedical Engineering- Two Volume Set, 2nd Edition –Volume II, CRC press, 2000
4. Ashok Muzumdar, Powered Upper Limb Prostheses – Control, Implementation and Clinical Application, 1st Edition, Springer, 2004.
5. Albert M. Cook, and Susan M. Hussey, Assistive Technologies: Principles and Practice, Mosby, USA, 1995.

Reference Books

1. Horia-Nicolai L Teodorescu, Lakhmi C. Jain., Intelligent systems and technologies in rehabilitation engineering, 1st edition, CRC Press, 2000.
2. Warren E. Finn, and Peter G. LoPresti, Handbook of Neuroprosthetic Methods, CRC Press; 1st Edition, 2002.
3. Marion A. Hersh, Michael A. Johnson, Assistive Technology for Visually impaired and blind people", Springer Publications, 1st Edition, 2008.
4. Albert M. Cook and Janice M. Polgar, Essentials of Assistive Technologies, Elsevier,1st Edition, 2012.
5. Roberto Manduchi, Sri Kurniawan, Assistive Technology for Blindness and Low Vision, 1st Edition, CRC Press, 2013.

Course Outcomes

At the end of the course student will be able

CO1	Gain adequate knowledge on basic principles and concepts of rehabilitation and assistive devices and its future development
CO2	Familirize with the conventional and current trends in the development of upper and lower limb prostheses
CO3	Gain in-depth knowledge about various assistive technologies for vision and hearing.
CO4	Select the appropriate rehabilitation devices for various disabilities.

Course Code	**:**	ICXX
Course Title	**:**	**Introduction to Bioinformatics**
Type of Course	**:**	PE-10
Prerequisites	**:**	--
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To teach the basics of molecular biology to work on bioinformatics
CLO2	To teach various databases used to store and organize the biological information
CLO3	To explain various sequential alignment techniques for analysis and anatomical visualization of biological data
CLO4	To explore the applications and case studies using bioinformatics

Course Content

Introduction to Bioinformatics – Principles, significance and applications in modern biological research, Molecular biology - DNA, RNA, and protein structure and function, central dogma of molecular biology, Data generation.

Biological databases – Nucleic acid database - GenBank, EMBL, and Protein Data Bank (PDB), DNA database of Japan. Protein database – Primary, secondary and composite, Genome database – SGD, TIGR and ACeDB, Structure database - CATH, SCOP, and PDBsum, Role of databases in storing and organizing biological information, Data storage, retrieval and interoperability.

Sequence alignment techniques – Genomic sequence Processing Techniques, pairwise and multiple sequence alignment – BLAST, FASTA and ClustalW algorithm, local and global alignment, gene prediction, phylogenetic analysis, Anatomical visualization, Viewers – sequence and 3D viewers.

Applications – Drug delivery, personalised medicine, evolutional biology, Prediction of protein structure, Discovery of new drugs in medicine, Storage and retrieval of biological data.

Textbooks

1.	Jack J. Pasternak, An introduction to human molecular genetics:

	Mechanisms of inherited diseases, Wiley-Liss, 2nd Edition, 2005.
2.	David. W. Mount, Bioinformatics Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 1st Edition, 2001.
4.	Shio Kumar Singh, Database Systems: Concepts, Design and Applications, Pearson, 2nd Edition, 2011.
5.	Jeremy O. Baum and Marketa J. Zvelebil. Understanding Bioinformatics, Garland Science, 1st Edition, 2007.
6.	Andreas D. Baxevanis and B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley Publishers, 2nd Edition,2004.
7.	David. W. Mount, Bioinformatics Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 1st Edition, 2001.

References

1.	Stuart M. Brown, Next-Generation DNA Sequencing Informatics, Cold Spring Harbor Laboratory Press, 2nd Edition, 2015.
2.	Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems, 6th Edition, 2011.
3.	Xinkun Wang, Next Generation Sequencing Data Analysis, CRC Press, 1st Edition, 2016.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To describe various form of biological data used in bioinformatics research
CO2	To explain various databases to store and organize biological data
CO3	To apply sequential techniques to analyze and organize the biological data
CO4	To explore and develop healthcare solutions utilizing the biological data

Course Code	**:**	ICXXX
Course Title	**:**	**Human Machine Interaction**
Type of Course	**:**	PE-11
Prerequisites	**:**	--
No. of Credits	**:**	3 Credits
Course Assessment Methods	**:**	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To teach the importance and principles of Human Machine Interface
CLO2	To teach techniques for evaluating the usability of HMI
CLO3	To provide knowledge on cognitive and physiological factors influence HMI
CLO4	To introduce advances and trends in HMI

Course Content

Introduction - history and evolution of HMI, importance of designing user-friendly interfaces. principles of user-centered design, emphasizing the importance of understanding users' needs and behaviors. Models in HMI, Task analysis and creating effective user interfaces, Measurement techniques for HMI.

Techniques for evaluating the usability of human-machine interfaces, Usability testing methods, heuristic evaluation, and user feedback analysis.,

Cognitive Aspects of HMI - psychological and cognitive factors that influence Human-Machine Interaction, Human perception, memory, attention, Decision-making processes, Impact on design and usability of interfaces.

Advanced HMI - Natural language processing, gesture recognition, virtual and augmented reality, and brain-computer interfaces; Privacy, security, accessibility, and the impact of HMI on society, Recent trends in HMI, Wearable and IoT in Healthcare, HMI - Digital Healthcare.

Textbooks

1.	Jenny Preece, Helen Sharp, and Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction", Wiley, 6th Edition, 2023.
2.	Jenifer Tidwell, Designing Interfaces: Patterns for Effective Interaction Design", O'Reilly Media, 1st Edition, 2005.
3.	Alan Dix, Janet Finlay, Gregory D. Abowd, and Russell Beale, "Human-Computer Interaction" , Pearson Education Limited, 3rd Edition, 2004.

References

1.	Guy A. Boy, "The Handbook of Human-Machine Interaction: A Human-Centered Design Approach", CRC Press, 1st Edition, 2011.
2.	Julie A. Jacko, Human Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, 3rd Edition, CRC Press, 2012.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To understand the principles, importance and user-friendly design of HMI
CO2	To apply techniques to evaluate the usability of HMI
CO3	To understand the physiological and cognitive behavior impact on HMI
CO4	To design the Human machine interface for healthcare applications

Course Code	:	ICXXX
Course Title	:	**Biomedical Data Visualization**
Type of Course	:	PE-12
Prerequisites	:	--
No. of Credits	:	3 Credits
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To teach sources and characteristics of different biomedical data
CLO2	To teach the use of various software tools to visualize the biomedical data
CLO3	To provide knowledge on ethical and data privacy policy on handling biomedical data
CLO4	To explain the real-time application of data visualization tools using case studies

Course Content

Introduction to Biomedical Data Visualization
Benefits of data visualization in the biomedical field, types of biomedical data, basic principles of creating effective visualizations, sources of biomedical data, characteristics of different data types, Principles of data visualization

Tools and Software for Biomedical Visualization
Popular data visualization tools and software used in the biomedical field, familiarisation of platforms like R, Python, and specialized biomedical visualization tools to create effective visualizations; Advanced visualization techniques, including interactive visualizations, 3D modeling, and the use of machine learning to enhance data interpretation, AR and VR models.

Ethics and Data Privacy in Biomedical Visualization
Learn about the ethical considerations and privacy concerns specific to visualizing biomedical data. Understand how to ensure compliance with data protection regulations and maintain patient confidentiality while creating visualizations, Deidentification techniques.

Case Studies in Biomedical Visualization
Examine real-world examples of biomedical data visualizations. Analyze successful case studies to understand the strategies and techniques used to convey complex biomedical information effectively.

Textbooks

1.	Kieran Healy, Data Visualization: A Practical Introduction, Princeton University Press, 2018.
2.	Winston Chang, R Graphics Cookbook: Practical Recipes for Visualizing Data, O'Reilly Media Inc, 1st Edition, 2013.
3.	Matthew O. Ward, Georges Grinstein, Daniel Keim "Interactive Data Visualization: Foundations, Techniques, and Applications", CRC Press; 2nd edition, 2015.
4.	Stephen Few, "Now you see it: Simple Visualization Techniques for Quantitative Analysis", Analytics Press, 1st Edition, 2009.

References

1.	Mario F Trialo, Mark M Trialo, and Jasan Roy, Biostatistics for the Biological and Health Sciences, Pearson, 3rd edition, 2024.
2.	Ira J. Kalet**,** Principles of Biomedical Informatics, Academic Press Inc, 1st Edition, 2009.
3.	Robert E. Hoyt and Ann K. Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Sixth Edition, 2014.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To describe different types and characteristics of biomedical data
CO2	To apply various software tools to the visualization and analysis of data
CO3	To understand ethical policies and data privacy in handling biomedical data
CO4	To apply various techniques and strategies to present complex biomedical information

Course Code	:	ICXXX
Course Title	:	**Automation in Healthcare Industry**
Type of Course	:	PE-13
Prerequisites	:	-------
No. of Credits	:	3 Credits
Course Assessment Methods	:	Continuous Assessment, Final Assessment

Course Learning Objectives (CLO)

CLO1	To understand and analyse the technologies and diverse applications of automation within healthcare sectors
CLO2	To evaluate the impact of automation on patient care, healthcare professionals, and healthcare systems
CLO3	To examine the ethical, social, legal, and regulatory considerations surrounding healthcare automation
CLO4	To assess and predict future trends and opportunities related to automation in healthcare

Course content:

Introduction to automation in healthcare, challenges, and ethical implications. Overview of robotics, AI, IoT, RFID, Data Analytics, and Cloud Computing.

Diagnostics and Therapeutics: Automation in disease detection, diagnosis, and treatment, automated lab testing, AI-powered image analysis, robotic surgery, and personalized medicine approaches.

Patient Care and Management: Patient care through telehealth, smart hospitals, and wearable devices. Automation in healthcare management, EHRs, billing, supply chain, and resource allocation.

Medicolegal implications in healthcare automation.

Emerging trends and future directions in healthcare automation. Case Studies and Use cases.

Textbooks

8.	Artificial Intelligence in Healthcare: A Practical Guide" – by Anthony Adam Bohr & Kaveh Memarzadeh- Covers AI applications in diagnostics, robotics, and personalized medicine, Academic Press (Elsevier), 1st Edition, 2020.
9.	Healthcare Robotics: Ethics, Design and Implementation" – by Aimee van Wynsberghe- Focuses on robotic surgery, patient care robots, and ethical challenges, Taylor & Francis, 1st Edition, 2016.
10.	IoT in Healthcare and Ambient Assisted Living" – by Gonçalo Marques & Akash Kumar Bhoi - Discusses IoT, wearables, smart hospitals, and remote monitoring, Springer, 1st Edition, 2021.
11.	Joe Biron& Jonathan Follett, Foundational Elements of an IoT Solution – The Edge, The Cloud and Application Development, Oreilly,1st Edition, 2016.

References

1.	The Future of Healthcare: Humans and Machines Partnering for Better Outcomes" – by Emmanuel Fombu &Sean Strong- Discusses human-AI collaboration in medicine, Emmanuel Fombu, 1st Edition, 2018.
2.	Encyclopedia of E-Health and Telemedicine " – by Isabel Maria Miranda, Maria Manuela Cruz-Cunha, & Ricardo - Covers telehealth automation and virtual care models, Routledge, IGI Global, 1st Edition, 2016.
3.	Data Science and Predictive Analytics in Healthcare" – by Ivo D. Dinov - Focuses on big data, automation in diagnostics, and predictive modelling, Springer, 2nd Edition, 2023.
4.	Robotic Surgery: Smart Materials, Robotic Structures, and Artificial Muscles" – by Mohsen Shahinpoor, CRC Press, 1st Edition, 2023.

Course Outcomes (CO)

At the end of the course students will be able to

CO1	Demonstrate a comprehensive understanding of healthcare automation technologies and their applications.
CO2	Analyse the effectiveness and challenges of automated systems in medical imaging, robotic surgery, telemedicine, and smart hospitals.
CO3	Evaluate the ethical, legal, and social implications of implementing automated systems in healthcare.
CO4	Understand the real-world healthcare applications by evaluating case studies and emerging technologies in AI, robotics, and IoT-enabled healthcare.

LABORATORY COURSE, PROJECT WORK & INTERNSHIP

Course Code	**:**	ICXXX
Course Title	**:**	Medical Instrumentation and Measurement Laboratory
Type of Course	**:**	PC-5
Prerequisites	**:**	--
No. of Credits	**:**	3
Course Assessment Methods	**:**	Continuous Assessment, End Assessment

Course Learning Objectives (CLO)

CLO1	To learn the working principles of sensors and transducers used in medical devices
CLO2	To design simple measurement systems that can be used to measure physiological parameters
CLO3	To acquire physiological data from biological systems and analyze it for medical applications.
CLO4	To develop an awareness of current and emerging technologies in the field of medical instrumentation and measurement

List of Experiments

1. Design of ECG Acquisition system using different lead configuration
2. Measurement and recording of peripheral blood flow using doppler
3. Measurement of oxygen saturation using PPG sensor
4. Measurement of Respiratory parameters using spirometry
5. Design of electronics system to acquire 2 channels EEG signals
6. Study of 19 channels EEG acquisition system and the brain activation patterns
7. Acquisition and study of EMG characteristics in Isometric condition
8. Study of EMG in Dynamic contraction
9. Study of data communication using parallel and serial communication protocols
10. Study of data communication using network protocols
11. Point of Care devices for glucose and Hemoglobin

References

1.	John G. Webster, Amit J. Nimunkar, Medical Instrumentation: Application and Design, 5th Edition, Wiley, 2020.
2.	Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall India, 1980.
3.	David Prutchi, Michael Norris, Design and development of medical electronic instrumentation, Wiley, 2005.
4.	John Enderle and Joseph Bronzino, Introduction to Biomedical Engineering,
5.	John G. Webster, Bioinstrumentation, John Wiley & Sons, 2004.
6.	Hand Book of Biomedical /Instrumentation, 3rd Edition, McGraw Hill Education (India), 2014.
7.	*Paul H. King, Richard C. Fries, Arthur T. Johnson*, Design of Biomedical Devices and Systems, 4th Edition, CRC Press, 2018.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To apply measurement techniques to real-world biological systems and health conditions using medical instrumentation.
CO2	To analyze and interpret biomedical signals acquired from instrumentation systems
CO3	To design biomedical measurement systems and critically evaluate their performance.
CO4	To demonstrate an awareness of emerging trends in medical instrumentation and measurement technologies

Course Code	**:**	ICXX
Course Title	**:**	**Mini project**
Type of Course	**:**	PC-6
Prerequisites	**:**	--
No. of Credits	**:**	2 credits
Course Assessment Methods	**:**	Reviews during and at the end of the semester

Course Learning Objectives (CLO)

CLO1	To apply technical knowledge in healthcare technologies to real-time problems
CLO2	To Identify a specific healthcare challenge or inefficiency that can be addressed using technology
CLO3	To conduct a small-scale review or research on existing healthcare technologies, evaluating their effectiveness, benefits, and limitations in addressing real-world healthcare challenges
CLO4	To develop a practical implementation plan for integrating a technological solution into an existing healthcare setting

Mini project work should be any practical implementation of healthcare technology related learning from the first semester PG diploma courses in a focused real-world problem. Students are expected to select a topic for project work from the list of given topics or any topic relevant to healthcare technology based on their interest. The primary objective of the mini project is to enhance student ability to recognize the problems and find the solution for such problems based on the scientific methods which they learned during the theory and laboratory courses. The progress of mini project shall be evaluated by the course coordinator in 2 intermittent reviews (1st, and 2nd reviews) during the semester and final review at the end of the semester. At the end of the semester each student should submit the project report to the course coordinator. The group of 3 or 4 students shall work under the guidance of one faculty from the department.

Course Outcomes (CO)

At the end of the course students will be able to

CO1	To develop and implement a practical healthcare technology solution (e.g., mobile app, digital platform, AI-based system) to address an identified healthcare challenge.
CO2	To plan and execute the mini-project effectively, managing resources, timelines, and deliverables to meet project objectives within the scope and constraints.
CO3	To prepare a comprehensive project report that documents the project objectives, methodology, findings, results, and recommendations for healthcare technology implementation
CO4	To collaborate effectively with team members, healthcare professionals, or stakeholders in the development and implementation of the healthcare technology project.

Course Code	:	ICXX
Course Title	:	**Project Work**
Type of Course	:	PC-7
Prerequisites	:	--
No. of Credits	:	6
Course Assessment Methods	:	Reviews during and at the end of the semester

Course Learning Objectives (CLO)

CLO1	To Develop the ability to identify problems, analyze them, and come up with creative and feasible solutions
CLO2	To Conduct independent research to gather relevant data and insights
CLO3	To Develop and implement a project plan, including setting timelines, goals, and deliverables
CLO4	To Develop an understanding of the ethical and social implications of the project's outcomes

Project Work Project should be any practical implementation of healthcare technology related learning from the PG diploma course in a healthcare industry/hospital. Students are expected to select a topic for project work from the list of given topics or any topic relevant to healthcare technology based on their experience and interest. Further the topic selected by the student shall be approved by the guide and project coordinator. The primary objective of the project is to enhance student ability to recognize the problems and find the solution for such problem based on the scientific methods which they learned during the theory and laboratory courses. Further detailed guidelines (the objective, rationale, sample list of topics, guides, methods of doing the project, relationship with guide, supervision, submission deadlines, evaluation, etc.) will be provided during the contact classes. The progress of project work shall be evaluated by the department project evaluation committee in 4 reviews (zeroth, 1st, 2nd and 3rd reviews) during the semester and final review at the end of the semester. At the end of the semester each student should submit the project report to the project evaluation committee. Each student shall work under two guides one from the faculty of the host institute and one from the industry/hospital work place as co guide.

Course Outcomes (CO)

At the end of the course students will be able

CO1	To demonstrate the ability to apply theoretical knowledge of healthcare systems, clinical practices, and management principles to address a specific healthcare project.
CO2	To develop and execute a research methodology to investigate a specific healthcare problem, leveraging data collection and analysis techniques to derive actionable insights.
CO3	To demonstrate project management skills by planning, organizing, and executing a healthcare-related project, and ensuring timely completion of project
CO4	To explore and integrate technological solutions or innovations in their projects, such as digital health tools, telemedicine, or data analytics, to enhance healthcare delivery.