



SCHOOL OF DIGITAL HEALTH SCIENCES & TECHNOLOGY

BACHELOR OF SCIENCE IN MEDICAL ROBOTICS

PROGRAM OUTCOMES (POs)

PO	Program Outcomes
PO-1	Knowledge in Robotics System Design for Healthcare Design and develop complete medical robotic systems, including hardware (robotic components, sensors, actuators) and software (AI, machine learning models) tailored to the healthcare sector.
PO-2	Understanding of Advanced Application of AI and Robotics in Healthcare Utilize AI and machine learning to create autonomous robotic systems capable of performing tasks like patient monitoring, rehabilitation, and diagnostics in real-time.
PO-3	Skill in Practical Application of Robotics in Clinical Healthcare Implement robotics for specific clinical applications such as patient mobility (exoskeletons), remote monitoring, emergency care robots, and surgical assistance.
PO-4	Knowledge in Robotics Simulation and Performance Optimization Use simulation tools to model, test, and optimize robotic systems for various healthcare environments, ensuring maximum safety, efficiency, and usability.
PO-5	Understanding of Managing in Medical Robotics Projects Lead and manage projects in the field of healthcare robotics, from initial design through prototyping and final implementation, ensuring successful deployment in clinical settings.
PO-6	Contribution to the Growth of the Healthcare Robotics Industry Apply entrepreneurial and business development skills to create new healthcare robotics startups or contribute to existing ones, focusing on improving healthcare systems through automation.

Minimum Credit requirements to award Degree under each category as per UGC

S.No	Broad Category of Course	Minimum Credit Requirement	
		3-Year UG	4-Year UG
1.	Major (Core)	60	80
2.	Minor Stream	24	32
3.	Multidisciplinary	09	09
4.	Ability Enhancement Courses (AEC)	08	08
5.	Skill Enhancement Courses (SEC)	09	09
6.	Value Added Courses common for all UG	06-08	06-08
7.	Summer Internship	02-04	02-04
8.	Research Project / Dissertation	-	12
9.	Total	120	160

MALLA REDDY VISHWAVIDYAPEETH
(Deemed to be University)
School of Digital Health Sciences and Technology

B.Sc. Medical Robotics

COURSE STRUCTURE AND SYLLABUS

Effective from Academic Year 2025-26 Admitted Batch

Category Code: Major Core (MC), Minor Stream (MS), Multidisciplinary (MD), Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Value Added Courses (VAC), Summer Internship (SI), Research Project / Dissertation (RP), Practical Lab (PL)

SEMESTER – I							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BDH0714101	Introduction to Human Anatomy	4	-	-	4
2		BDH0714102	Introduction to Human Physiology	4	-	-	4
3		BDH0714103	Introduction to Medical Biochemistry	4	-	-	4
4		BDH0714104	Sociology	2			2
5		BDH0714107	English & Communication Skills	1	-	2	2
6		BDH0714108	Basic Computers	1	-	2	2
8		BDH0714110	Practicals in Human Anatomy	-	-	4	2
9		BDH0714111	Practicals in Physiology	-	-	4	2
Total				16	0	12	22

SEMESTER – II							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914201	Microbiology	2	-	-	2
2		BMR0914202	Pathology	2	-	-	2
3		BMR0914203	Occupational health	2	-	-	2
4		BMR0914204	Languages for Coding	2	-	-	2
5		BMR0914205	Introduction to Github	1	-	-	1
6		BMR0914206	Essentials of Research Design & Literature Reviews	3	-	-	3
7		BMR0914207	Essential Biostatistics	2	-	-	2
8		BMR0914208	Digital Health Terminology	1	-	-	1
9		BMR0914209	Regulations and Ethics	1	-	-	1
10		BMR0914210	Practicals in Microbiology	-	-	2	1
11		BMR0914211	Practicals in Pathology	-	-	2	1
12		BMR0914212	Practicals in Coding	-	-	4	2
Total				16	0	8	20

SEMESTER – III							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914301	Advanced data analytics (R/ SPSS/ STATA/ SAS)	3	-	-	3
2		BMR0914302	Data Visualization and GIS	3	-	-	3
3		BMR0914303	Evidence based Medical Tools	2	-	-	2
4		BMR0914304	Health Algorithms to Application	2	-	-	2
5		BMR0914305	Mobile Apps & Web Apps	2	-	-	2
6		BMR0914306	Database Features	1	-	-	1
7		BMR0914307	API, Plug-in Integration	2	-	-	2
8		BMR0914308	Dashboards for Healthcare	1	-	2	2
9		BMR0914309	Practicals in Advanced data analytics	-	-	2	1
10		BMR0914310	Practicals in Data Visualization	-	-	2	1
11		BMR0914311	Practicals in Mobile Apps & Web Apps	-	-	2	1
Total				16	0	8	20

SEMESTER – IV							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914401	Introduction to electronics circuits & platforms	2	-	-	2
2		BMR0914402	Introduction to Sensors & Health Functions	2	-	-	2
3		BMR0914403	Introduction to Robotics components	3	-	-	3
4		BMR0914404	Sensing using ultrasonic LIDAR & RADAR	2	-	-	2
5		BMR0914405	AI/ML/Gen AI/ computer vision	3	-	-	3
6		BMR0914406	Rapid Prototyping and 3D Printing	-	-	4	2
7		BMR0914407	Digital Signal Processing	2	-	-	2
8		BMR0914408	Practicals in Robotics modelling	-	-	4	2
9		BMR0914409	Practicals in AI/ML/Gen AI	-	-	4	2
Total				16	0	12	20

SEMESTER – V							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914501	Autonomous Mobile Navigation for robotics	3	-	-	3
2		BMR0914502	Swarm Robotics	2	-	-	2
3		BMR0914503	AR/ VR/ MR for Health care	3	-	-	3
4		BMR0914504	Simulation of Robotics	2	-	-	2
5		BMR0914505	Market Research & Needs Assessment	2	-	-	2
6		BMR0914506	Practicals in AR/ VR/ MR for Health care	-	-	4	2
7		BMR0914507	Practicals in Simulation of Robotics	-	-	4	2
8		BMR0914508	Internship	-	-	-	4
Total				12	0	16	20

SEMESTER – VI							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914601	Digital Twins for Robotics	3	-	-	3
2		BMR0914602	Robotics for Bedside Patient Monitoring	2	-	-	2
3		BMR0914603	Robotics for Emergency and ICU Care	2	-	-	2
4		BMR0914604	Robotics for Home-based Healthcare	3	-	-	3
5		BMR0914605	Robotics for occupational well-being	2	-	-	2
6		BMR0914606	Robotics for Elderly care	2	-	-	2
7		BMR0914607	Robotics for Health care Logistics	2	-	-	2
8		BMR0914608	Healthcare E-commerce	2	-	-	4
9		BMR0914609	Robotics for Finance for Healthcare Settings	2	-	-	2
Total				12	0	16	20

SEMESTER – VII							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914701	Digital Transformation of Healthcare	3	-	-	3
2		BMR0914702	Digital Health Project Management	3	-	-	3
3		BMR0914703	Wearable diagnostics	2	-	-	2
4		BMR0914704	Exoskeletons & Humanoid for Health Care	2	-	-	2
5		BMR0914705	Drone & UAVs	2	-	-	2
6		BMR0914706	Sustainability & recycling	2	-	-	2
7		BMR0914707	Cyber Security for Health	2	-	-	2
8		BMR0914708	Research Project Design	4	-	-	4
Total				16	0	8	20

SEMESTER – VIII							
Sl. No	Category	Course code	Name of the Subject/Practical	Contact Hours/week			Credits
				L	T	P	
1		BMR0914801	Research Project	-	-	-	12
2		BMR0914802	Review of Topics/Electives	4	-	-	4
3		BMR0914803	Critical thinking	2	-	-	2
4		BMR0914804	Health Care Start up pathway	2	-	-	2
Total				8	0	0	20

- **1 Credit = 15 hours of Lecture/Tutorial or 30 hours of Practical**
- **Internship/Practical Training**
- **Dissertation/Project Work**
- **Seminar and Presentations**
- **Abbreviations: L-Lecture, T-Tutorial, P-Practical, C-Credit**
- **TOTAL CREDIT-160**

B.Sc. Medical Robotics

Course Description

The B.Sc. in Medical Robotics program combines robotics, engineering, and healthcare to prepare students for a career in the rapidly growing field of medical robotics. It covers topics such as robotic surgery, rehabilitation robotics, assistive devices, automation in healthcare, and the integration of artificial intelligence in medical technologies. Students gain practical skills in designing, programming, and testing robotic systems for applications in surgery, patient care, and rehabilitation. The program emphasizes the development of robots that enhance surgical precision, improve patient outcomes, and assist in tasks like physical therapy and elderly care. Graduates are equipped to work in hospitals, research institutions, medical device companies, and health-tech startups, where they contribute to advancing robotic technologies that are transforming the healthcare industry.

Course Objectives

The overall objective of this course is to provide an introduction, relate to settings linked use cases for application of the epidemiologic approach and principles. The students will be learning to apply the concepts of epidemiology that can lead to better analytics, in their professional engagements in health sector.

This course will also help the students in designing and analysis of case-control, cohort and randomized control studies and evaluation of health programmes

Course Pedagogy

The course will be covered by classroom lectures augmented by discussions, assignments, group work, and group presentations. Students are also given select pre-reads. The students are expected to read the reference books mentioned in the session plan and are also provided with sourced reference material for additional reading.

Course Requirement

Effective learning requires active participation of students in class, it is therefore desired that every student report to the class well prepared to present and defend his/her ideas. Preparation for the class calls for pre-reading of the topics/cases to be discussed later. Further, for meaningful discussion of the cases, the students are required to come ready with their case analysis identification and genesis of, and recommendations to resolve the problems.

SEMESTER I:**Course: Introduction to Human Anatomy**

S.No	Topics	COMMENTS
1	Integumentary • Lymphatic • Digestive • Respiratory • Urinary • Reproductive	
2	Skeletal • Bones and connective tissues	
3	Muscular • Skeletal • Smooth • Cardiac muscle	
4	Nervous • Brain • Spinal cord • Nerves • Sensory organs and cell	
5	Endocrine • Pituitary • Thyroid • Parathyroid • Adrenals glands • pancreas • ovaries • testes	
6	Cardiovascular • Heart • Blood vessels • Blood	
7	Lymphatic • Tonsils • Spleen • Thymus • Lymph nodes • Lymphatic vessels • Lymph	
8	Digestive • Mouth • Oesophagus • Stomach • Small and large intestines (alimentary canal), • Accessory organs (including salivary glands, • Pancreas • Liver • Gallbladder	

9	Respiratory • Nose and mouth • Pharynx • Larynx, • Trachea, bronchi, and lungs	
10	Urinary • Kidneys • Ureters • Bladder • Urethra	
11	Reproductive • Ovaries • Uterine tubes • Uterus and Vagina • Vulva in females • Testes • Seminal vesicles • Penis, Urethra • Prostate • Bulbourethral glands in males	

References

1. Anatomy and Physiology for Dummies
2. Manipal Manual of Anatomy for Allied Health Science Courses - 3rd edition
3. Textbook of Medical Physiology, D. Venkatesh, HH Sudhakar
4. Anatomy and Physiology for Paramedical students, Pinki Rajendra Wadiya
5. Ross and Wilson, Anatomy and physiology in health & illness
6. BD Chaurasia's Handbook of General Anatomy
7. Essentials of physiology for para medicals- K Sembulingam

SEMESTER I:**Course: Introduction to Human Physiology**

S.No	Topics	COMMENTS
1	Circulatory System • Heart • Blood vessels • Blood	
2	Respiratory System • Lungs • Diaphragm	
3	Digestive System • Mouth • Stomach and intestines • Liver and pancreas	
4	Nervous System • Brain • Spinal cord • Nerves	
5	Endocrine System • Pituitary gland • Thyroid • Pancreas • Adrenal glands	
6	Musculoskeletal System • Bones • Muscles • Joints	
7	Immune System • White blood cells • Lymph nodes • Antibodies	
8	Integumentary System • Skin • Hair and nails	
9	Excretory System • Kidneys • Bladder • Sweat glands	
10	Reproductive System • Male reproductive organs • Female reproductive organ	

References

1. Human Physiology: An Integrated Approach by Dee Unglaub Silverthorn
2. Principles of Physiology by David R. Roux

SEMESTER I:**Course: Introduction to Medical Biochemistry**

S.No	Topics	COMMENTS
1	A review of cell types and their structures • Prokaryotic Cells • Eukaryotic Cells	
2	The role of carbon in the study of life • Carbon's Bonding Ability • Carbon in Metabolism	
3	Properties of amino acids • Structure of Amino Acids • Essential vs. Non-Essential	
4	Structure levels of proteins • Primary Structure • Folding and Function	
5	The scoop on enzymes and catalysts • Enzyme Action • Factors Affecting Enzymes	
6	A primer on nucleic acids • DNA vs RNA • Replication and Transcription	
7	Hundreds of figures that illustrate biochemical structures • Molecular Structures • 3D Structures	
8	Real-world examples that connect biochem concepts to everyday life • Nutrition and Biochemistry • Medicine	

References

1. Essential of Biochemistry by Pankaja Naik, 2nd edition
2. Essential of Biochemistry by Satyanarayana

SEMESTER I:**Course: Sociology**

S.No	Topics	COMMENTS
1	Introduction - Meaning- Definition, Nature and Scope of Sociology - Methods of Sociological Investigations, Case Study, Social Survey, Questionnaire and Interview methods. - Importance of its study with special reference to Health Care Professionals.	
2	Social Factors in health and disease situations - Role of Social factors in health - Role of social factor in illness - Decision making in taking treatment	
3	Socialization - Definition and Meaning of Socialisation - Primary, Secondary and Anticipatory socialisation - Agencies of Socialisation	
4	Social Groups a. Definition and Features of Social Group b. Primary Social Group c. Secondary Social Group d. The role of Primary and Secondary Groups in Hospitals.	
5	Family - The family, meaning and definition - Functions of family - Changing family patterns - Influence of Family on the individuals health, the effects of sickness in the family.	
6	Community - Rural community: meaning and features- Health problems of rural community. - Urban community: meaning and features – Health problems in urbanities.	
7	Culture and Health - Concept of Health - Concept of Culture - Cultural factors affecting Health and Diseases	
8	Social Change - Meaning of social change - Factors of social change - Human adaptation and social change - Social planning and Health	
	Social Problems Population explosion	

	• Juvenile delinquency • Alcoholism • Unemployment • Poverty • Problems of women	
	Social Security • Social security and social legislation	

References

1. Principles of sociology.....C.N Shankar Rao
2. Sociology for physiotherapy students.....K.P Neeraja

SEMESTER I:**Course: English & Communication Skills**

S.No	Topics	COMMENTS
1	Fundamentals of Communication • Definition and importance of communication in healthcare and professional settings • Types of communication (verbal, non-verbal, written, digital) • Barriers to effective communication and overcoming them	
2	Scientific & Technical Writing in Healthcare • Structure and format of scientific documents • Writing research papers, abstracts, and summaries • Citation styles and plagiarism prevention	
3	Grant & Proposal Writing • Basics of proposal writing for research and funding • Structure of grant proposals and common funding source • Effective writing techniques for securing grants	
4	Communication for Healthcare Professionals • Effective patient communication and empathy in healthcare • Medical terminology and professional interactions • Ethical considerations in communication	
5	Presentation & Public Speaking Skills • Preparing and delivering impactful presentations • Body language, tone, and clarity in speech • Handling Q&A sessions confidently	

References

1. Communication in Healthcare: A Guide for Students and Practitioners by Julia Balzer Riley and Susan M. H. Kessler
2. The Communication Handbook for Health Care Professionals by Kerry L. McDonald

SEMESTER I:**Course: Computer Foundation**

S.No	Topics	COMMENTS
1	Definition of Computer - Characteristics of computer-Components of Computer Hardware – Input & Output devices-Memories– RAM and ROM– MB, GB their conversions - Software - Application Software and Systems software- Data and Information –Different computer languages- Number systems- Binary and decimal conversions.	
2	Typing text in MS Word - Manipulating text formatting text–using different font sizes, bold, italic– bullets and numbering –Pictures, - Aligning the text and justify–choosing paper size– adjusting margins– header and footer, - Inserting page no's in a doc– printing a file with options– using spell check and grammar– find and replace– mail merge – insert tables in a document.	
3	Creating - MS Excel-Cell editing, using formulas and functions, manipulating data with excel– using sort function to sort numbers and alphabets– drawing graphs and charts using data in excel. - MS PowerPoint slide transition and animation-slides with sounds– inserting clip arts– Pictures, tables and graphs.	
4	Introduction - Computer Network Devices(Hubs, Switches, Routers, Gateway, Bridge, Modems) - Wireless Access Points, Firewalls & NIC) - Types of computer Networks (LAN, MAN & WAN) - Network Topologies (Star, Ring, Mesh, Tree, Hybrid Topologies) - Internet-Based Applications - Advantages & Disadvantages of Computer Networks - E-Mail - Components of E-Mail, Attaching Files in E-mail, Different Search Engines	
5	AI - History of AI, Sub Areas of AI, - Applications of AI in Healthcare, - Benefits of AI in Health Care, - Challenges of AI in Healthcare, - Introduction to Machine Learning,	

	• Applications of Machine Learning, • Machine Learning Algorithms, • Real-world Machine Learning Use Cases.	
6	PRACTICALS • Peripherals of Computer • MS Word • MS Excel • MS PowerPoint • Network Devices	

References

1. Computer Fundamentals by Goel, Anita Pearson
2. Computer Fundamentals : Concepts, Systems & Applications- 8th Edition by Priti Sinha, Pradeep K., Sinha
3. MS-Office 2010 Training Guide by Prof. Satish Jain, M. Geetha
4. Computer Networks, Andrews S Tanenbaum, 5th Edition, Pearson Education
5. Artificial Intelligence : A modern Approach, Stuart J. Russell and Peter Norvig, Third Edition, Pearson Education
6. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurelien Geron- Oreilly, 2ndEdition.

SEMESTER II:**Course: Microbiology**

S.No	Topics	COMMENTS
1	Introduction to Microbiology - History of Microbiology - Scope of Microbiology - Branches of Microbiology	
2	Microbial Groups Bacteria, Fungi, Protozoa, Algae, Viruses	
3	Microscopy and Staining Technique - Types of Microscopes - Staining Techniques	
4	Bacterial Growth and Metabolism - Bacterial Growth - Bacterial reproduction - Bacterial Metabolism	
5	Culture Media and Technique - Types of Culture Media - Agar Plate Technique - Incubation and Maintenance	
6	Sterilization and Disinfection - Sterilization Methods - Disinfection and Antiseptics	
7	Immunology (Basic Concepts) - Immunity - Antigen-Antibody Interactions - Vaccination	
8	Microbial Pathogenesis and Disease - Pathogenic Mechanisms - Disease caused by Microorganism	
9	Antimicrobial Agents - Antibiotics - Antivirals, Antifungals and Antibiotic Resistance - Antibiotic Resistance	

References

1. Ananthanarayana & Paniker Medical Microbiology- University Press
2. Essentials of Medical Microbiology, Apurba Shankar Sastry.
3. CP Baveja, Textbook of Microbiology,
4. Chatterjee- Parasitology- Interpretation to Clinical Medicine

SEMESTER II:**Course: Pathology**

S.No	Topics	COMMENTS
1	Introduction to Pathology - History of Pathology - Scope of Microbiology - Branches of Microbiology	
2	Cell Injury and Adaptation - Cell Injury - Types of Necrosis - Cellular adaptations - Mechanisms of Injury	
3	Inflammation and Repair - Acute Inflammation - Chronic Inflammation - Healing and Tissue Repair	
4	Hemodynamic Disorders - Edema - Haemorrhage - Thrombosis - Embolism - Shock	
5	Neoplasia (Tumours and Cancer) - Benign vs Malignant tumours - Carcinogenesis - Tumour Grading and Staging, Spreading	
6	Infectious Diseases in Pathology - Bacterial Infection - Viral Infection - Fungal Infection - Parasitic Infections	
7	Systemic Pathology - Cardiovascular System - Respiratory System - Gastrointestinal System - Renal system - Endocrine System - Nervous System	
8	Forensic Pathology - Autopsy - Trauma - Forensic Toxicology	
9	Molecular Pathology - Genetic Basis of Disease - Molecular Techniques in Pathology	

References

1. Robbins Basic Pathology by Kumar, Abbas, and Aster

2. Basic Pathology by E. Robert S. Heidger

SEMESTER II:**Course: Occupational Health**

S.No	Topics	COMMENTS
1	Introduction to Occupational Health Covers the basics of occupational health, focusing on the relationship between work environments, health risks, and worker well-being	
2	Workplace Hazards and Risk Assessment Teaches students how to identify and assess physical, chemical, biological, and ergonomic hazards in the workplace and their impact on health	
3	Occupational Diseases and Injuries Focuses on common occupational diseases (e.g., respiratory illnesses, musculoskeletal disorders) and how they are diagnosed, prevented, and managed	
4	Health and Safety Regulations Explores international and national health and safety regulations, such as OSHA (Occupational Safety and Health Administration), and how they are applied in various industries.	
5	Digital Health in Occupational Safety Discusses how digital tools and technologies (wearables, health monitoring systems) can be applied to monitor and improve the health and safety of workers in different environments	

References

1. Book: *Introduction to Occupational Health and Safety* by S. D. Williams and W. G. Mathews
2. Book: *Occupational Health and Safety Management: A Practical Approach* by Charles D. Reese
3. Book: *Wearable Health Devices in Occupational Health* by Bernard J. Etienne

SEMESTER II:**Course: Languages for coding (Python)**

S.No	Topics	COMMENTS
1	Introduction to Python for Healthcare Teaches basic Python programming, focusing on its applications in analyzing and processing health data.	
2	Data Analysis with Python Covers using libraries like Pandas and NumPy to clean, manipulate, and analyze healthcare datasets, including patient records and clinical data.	
3	Data Visualization in Healthcare Focuses on creating healthcare-specific visualizations using libraries like Matplotlib and Seaborn to represent trends in health outcomes and disease data	
4	Machine Learning for Healthcare Introduces machine learning techniques with Python, using libraries like Scikit-learn to develop models for disease prediction and treatment recommendations.	
5	Healthcare Data Integration and Automation Teaches how to use Python to integrate healthcare data from different sources (e.g., EHRs, sensors) and automate workflows in health systems.	

References

1. Book: Python for Data Analysis by Wes McKinney
2. Online Resource: Python for Healthcare Applications by DataCamp
3. Book: Practical Data Science with Python by Nathan George

SEMESTER II:**Course: Languages for coding (C)**

S.No	Topics	COMMENTS
1	Introduction to C Programming for Healthcare Covers the fundamentals of C programming, including syntax, variables, and functions, with applications in healthcare systems	
2	Data Structures in Healthcare Focuses on implementing essential data structures (e.g., arrays, linked lists, stacks) in C to handle patient data, medical records, and health-related information	
3	C for Healthcare Application Development Teaches how to use C to develop simple healthcare applications, such as patient management systems or scheduling tools	
4	File Handling and Data Management in Healthcare Explores how to use C to manage healthcare data through file handling, including reading and writing patient data to files or databases	
5	System Integration and Optimization in Healthcare Focuses on integrating C programming with healthcare systems, optimizing performance, and ensuring efficient data processing in medical applications	

References

1. Book: C Programming for Beginners by Peter G. Aitken
2. Online Resource: Learn C Programming by GeeksforGeeks
3. Online Resource: C Programming: Data Structures and Algorithms (Available on platforms like Coursera or edX)

SEMESTER II:**Course: Introduction to GitHub**

S.No	Topics	COMMENTS
1	Introduction — what are Git and GitHub?	
2	Installing Git	
3	Getting started on GitHub	
4	Configuring Git	
5	Creating a Git repository	
6	Creating and editing files	
7	Adding files to your Git repository	
8	Finding out what's happening	
9	Making changes and tracking them	
10	Synchronizing your local Git repository with GitHub	
11	Deleting and renaming files	
12	Undoing changes	
13	Branching	
14	Tags and releases	
15	Downloading a repository	
16	Managing multiple copies of a repository	
17	Command summary	

References

1. <http://www.bioinf.org.uk/teaching/splats/git.pdf>

SEMESTER II:**Course: Essentials of Research Design & Literature Reviews**

S.No	Topics	COMMENTS
1	What is Research Design? • Definition • Purpose	
2	Types of Research Designs • Quantitative Research • Qualitative Research	
3	Key Components of Research Design • Research question • Sampling • Data Collection Methods • Analysis Plan	
4	Importance of a Literature Review • Definition • Purpose	
5	Conducting a Literature Review • Searching for sources • Evaluating Sources • Synthesizing Information	
6	Structure of a Literature Review • Introduction • Body • Conclusion	
7	Importance of a Good Literature Review in Research Design • Identifies Knowledge Gaps • Guides Research Questions • Establishes Framework	
8	Common Challenges in Research Design & Literature Reviews • Bias in Literature Selection • Choosing the Right Methodology • Access to Resources	
9	Best Practices in Research Design & Literature Reviews • Clear Research questions • Use of Reliable Sources • Comprehensive Review	

References

1. Doing a Literature Review: Releasing the Research Imagination by Chris Hart
2. The Literature Review: A Step-by-Step Guide for Students by Diana Ridley

SEMESTER II:**Course: Essential Biostatistics**

S.No	Topics	COMMENTS
1	Introduction to Biostatistics Foundation in basic statistical concepts, including types of data, measures of central tendency (mean, median, mode), and variability (range, variance, standard deviation).	
2	Probability and Distributions: Introduces probability theory and essential statistical distributions (e.g., normal, binomial), with applications in health data interpretation.	
3	Hypothesis Testing and Confidence Intervals: Teaches methods for testing research hypotheses (e.g., t-tests, chi-square tests) and calculating confidence intervals to assess statistical significance.	
4	Correlation and Regression Analysis: Covers how to analyze relationships between variables, focusing on linear regression, correlation, and prediction models used in health outcomes.	
5	Epidemiology and Survival Analysis: Key techniques in epidemiology, including survival analysis methods (e.g., Kaplan-Meier) to study patient outcomes and disease progression over time.	

References

1. Kirkwood BR (2003). Essentials of Medical Statistics. Blackwell Scientific Publications, Oxford
2. Leslie E. Daly, Geoffrey J. Bourke. (2000). Interpretation and Uses of Medical Statistics. Blackwell Publishers

SEMESTER II:**Course: Digital Health Terminology**

S.No	Topics	COMMENTS
1	Introduction to Digital Health Terminology: Covers the foundational terms and concepts used in digital health, including eHealth, mHealth, telemedicine, and telehealth.	
2	Health Information Systems and Standards: Introduces key terminology related to health information systems (e.g., EHR, EMR) and health data standards (e.g., HL7, FHIR).	
3	Clinical Informatics: Focuses on terminology related to the use of information technology in clinical settings, such as decision support systems, patient portals, and clinical workflows.	
4	Health Data and Analytics: Explains terms related to health data types (e.g., structured, unstructured) and analytical methods (e.g., predictive modeling, data mining).	
5	Regulations and Ethics in Digital Health: Provides terminology related to data privacy laws (e.g., HIPAA, GDPR) and ethical considerations in using digital health technologies	

References

1. Book: Digital Health: A Path to Validation by Homero Rivas and Katarzyna Wac
2. Book: Health Information Management: Concepts, Principles, and Practice by Kathleen M. LaTour and Shirley A. D. Thomas
3. Book: Clinical Informatics: A Practical Approach for Healthcare and Information Technology Professionals by Jon M. N. McCarthy and William L. Hersh

SEMESTER III:**Course: Regulations and Ethics**

S.No	Topics	COMMENTS
	Introduction to Healthcare Ethics: Covers foundational ethical principles in healthcare such as autonomy, beneficence, non-maleficence, and justice, with a focus on their application in digital health.	
	Data Privacy and Security: Focuses on regulations like HIPAA (Health Insurance Portability and Accountability Act) and GDPR (General Data Protection Regulation) that govern the handling of patient data.	
	Informed Consent and Patient Rights: Teaches the ethical principles behind obtaining informed consent, especially in digital health technologies and telemedicine.	
	Ethical Issues in AI and Digital Health: Examines ethical dilemmas related to AI, machine learning, and data analytics in healthcare, including bias, transparency, and accountability.	
	Regulatory Frameworks for Digital Health: Covers the legal and regulatory standards affecting digital health technologies, including FDA approval processes for health apps and devices.	

References

1. Book: Principles of Biomedical Ethics by Tom L. Beauchamp and James F. Childress
2. Book: Healthcare Information Security and Privacy by Sean P. Murphy
3. Book: Digital Health: Meeting the Promise of Personalized Medicine by Homero Rivas and Katarzyna Wac

SEMESTER III:**Course: Advanced data analytics (R)**

S.No	Topics	COMMENTS
1	Introduction to R Programming: Covers the basics of R, including installation, syntax, and using the RStudio interface for data analysis	
2	Data Import and Management in R: Focuses on importing datasets, cleaning data, and handling missing values using R functions and packages	
3	Descriptive Statistics in R: Teaches how to calculate and interpret descriptive statistics such as mean, median, variance, and standard deviation using R	
4	Basic Statistical Analysis with R: Introduces inferential statistics, including t-tests, chi-square tests, and simple linear regression for analyzing healthcare data	
5	Data Visualization in R: Covers how to create visualizations like histograms, scatter plots, and boxplots using R's ggplot2 package to represent healthcare data	

References

1. The Art of R Programming by Norman Matloff

SEMESTER III:**Course: Advanced data analytics (STATA)**

S.No	Topics	COMMENTS
1	Introduction to STATA Interface and Commands: Covers the basics of navigating STATA, understanding its interface, and using basic commands for data manipulation and analysis.	
2	Data Management in STATA: Focuses on importing, cleaning, and managing healthcare datasets, including handling missing values and variable transformations	
3	Descriptive Statistics in STATA: Teaches students how to compute and interpret summary statistics like means, frequencies, and standard deviations for healthcare data	
4	Basic Statistical Analysis with STATA: Introduces inferential statistics such as t-tests, chi-square tests, and simple regression analysis, applying them to healthcare data	
5	Data Visualization in STATA: Teaches how to create graphs and charts in STATA to effectively present findings from healthcare research and data analysis.	

References

1. "A Visual Guide to Stata Graphics" by Michael N. Mitchell

SEMESTER III:**Course: Advanced data analytics (SPSS)**

S.No	Topics	COMMENTS
1	Introduction to SPSS Software: Covers the basics of SPSS, including navigating the interface, data entry, and understanding data sets	
2	Data Management in SPSS: Teaches how to import, clean, and organize healthcare data, including handling missing values and recoding variable	
3	Descriptive Statistics with SPSS: Focuses on calculating and interpreting descriptive statistics, such as mean, median, standard deviation, and frequency distributions for healthcare data	
4	Inferential Statistics in SPSS: Introduces basic statistical tests like t-tests, chi-square tests, and ANOVA to analyze healthcare data	
5	Data Visualization with SPSS: Teaches how to create charts, graphs, and tables in SPSS to effectively present healthcare data and research finding	

References

- SPSS for Windows Step by Step: A Simple Guide and Reference by Darren George and Paul Mallery

SEMESTER III:**Course: SAS**

S.No	Topics	COMMENTS
1	Introduction to SAS Programming: Covers the basics of SAS, including its interface, syntax, and data step processing, with an emphasis on healthcare data manipulation	
2	Data Import and Export in SAS: Teaches how to import, export, and manage datasets from different formats (CSV, Excel, databases) for healthcare analysis	
3	Data Cleaning and Transformation: Focuses on using SAS to clean and preprocess healthcare data, including handling missing values, filtering, and transforming variables	
4	Basic Statistical Analysis with SAS: Introduces key statistical procedures in SAS for analyzing healthcare data, such as descriptive statistics, t-tests, and regression analysis	
5	Data Visualization in SAS: Teaches how to create visualizations like graphs and charts to present healthcare data insights using SAS's graphical capabilities	

References

1. Book: The Little SAS Book: A Primer by Lora D. Delwiche and Susan J. Slaughter
2. Book: SAS for Data Management: A Guide for Beginners by Michelle P. Sage
3. Book: Practical Business Statistics with SAS by A. K. Sharma

SEMESTER III:**Course: Data Visualization**

S.No	Topics	COMMENTS
	Introduction to Data Visualization in Healthcare: Covers the importance of data visualization in healthcare, emphasizing how visual tools can help convey complex medical data clearly	
	Types of Healthcare Data Visualizations: Teaches different types of visualizations, such as bar charts, line graphs, pie charts, and heatmaps, used to represent healthcare data.	
	Design Principles for Effective Visualization: Focuses on principles such as simplicity, clarity, and accessibility in designing visuals that enhance decision-making in healthcare.	
	Tools for Data Visualization in Healthcare: Introduces software and tools like Tableau, Excel, and R for creating healthcare-related visualizations.	
	Interpreting Healthcare Visualizations: Teaches students how to read and interpret data visualizations in clinical settings to support evidence-based healthcare decisions	

References

1. Data Visualization: A Practical Introduction by Kieran Healy

SEMESTER III:**Course: GIS**

S.No	Topics	COMMENTS
1	Geographical information systems • Different GIS Functions • Trends in GIS applications • GIS and the internet	
2	Types of Healthcare Data Visualizations: • Field and object data • Types of spatial data • Tessellation and vector data models • Cartographic • Representation • Metadata	
3	Mapping Health Information: • The mapping process • Representing Health information • Viewing Health information • Resources for geocoding & Mapping	
4	Spatial Clustering Methods: • Mapping Disease Rates • Spatial Clustering methods • Space time Clustering • Analyzing Data sets from India and abroad	
5	Application • Modelling Transmissions and diffusion of diseases • Detecting disease outbreaks - Locating Health Services • Analysing environmental exposures and hazards • Mapping and studying health disparities	

References

1. GIS and Public Health, Second Edition Ellen K. Cromley PhD (Author), Sara L. McLafferty (Author) Publisher: The Guilford Press; Second Edition edition (September 20, 2011)

SEMESTER III:**Course: Evidence based Medical Tools**

S.No	Topics	COMMENTS
1	Introduction to Evidence-Based Medicine (EBM): Covers the principles of EBM, emphasizing the importance of integrating clinical expertise, patient values, and the best research evidence in decision-making.	
2	Key Tools in EBM: Teaches students how to use tools like PubMed, Cochrane Library, and clinical decision support systems (CDSS) to access reliable medical evidence	
3	Critical Appraisal of Medical Literature: Focuses on evaluating the quality, relevance, and applicability of research articles, systematic reviews, and clinical trials in healthcare settings	
4	Evidence-Based Guidelines and Protocols: Explores how to apply clinical guidelines and protocols based on evidence to improve patient care and outcomes.	
5	Digital Tools for Evidence-Based Practice: Introduces mobile apps, databases, and software that support evidence-based decision-making in clinical practice and healthcare management	

References

1. Book: Evidence-Based Medicine: How to Practice and Teach EBM by Sharon E. Straus, W. Scott Richardson, Paul Glasziou, and R. Brian Haynes
2. Book: The Cochrane Handbook for Systematic Reviews of Interventions by Julian PT Higgins and Sally Green

SEMESTER III:**Course: Health Algorithms to Application**

S.No	Topics	COMMENTS
1	Introduction to Health Algorithms: • Overview of health Algorithms • Types of Algorithms	
2	Core Components of Health Algorithms: • Data Collection and Healthcare Data Types • Data Preprocessing • Features Selection and Engineering	
3	Machine Learning in Healthcare: • Introduction to ML • Building Predictive Models • Common Application of ML	
4	Introduction to Predictive Analytics in Healthcare: • Concepts of Predictive Analytics • Healthcare Case Studies • Predictive Model Evaluation	
5	Clinical Decision Support Systems (CDSS): • Introduction to CDSS • Building a simple Decision Support system • Case studies	
6	Implementing Health Algorithms into Clinical Practice • From Algorithms to Application • User Interface and Experience	
7	Ethical and Legal Considerations in Health algorithms • Ethics of AI in Healthcare • Data Privacy and Security • Regulatory and Legal Framework	

References

1. Artificial Intelligence in Healthcare by Adam Bohr & Kira S. M. S. Kovačević
2. Machine Learning for Healthcare by Manav Ratan, Vinod Sharma, and K. S. Rajasekaran
3. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again by Eric Topol

SEMESTER III:

Course: Mobile Apps & web Apps

S.No	Topics	COMMENTS
1	Introduction to Mobile and Web Apps in Healthcare: • What are Mobile Apps • What are Web Apps	
2	Components of a Mobile App: • Frontend Components (UI/UX) • Backend Components • Mobile App Platforms	
3	Components of a Web App: • Frontend Components (UI/UX) • Backend Components • Web App Deployment	
4	Tools and Technologies for Development: • Mobile App Development Tools • Web App Development Tools	
5	Real-World Applications and Hands on Projects: • Mobile App Project Ideas • Web App Project Ideas	

References

1. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics by Jennifer Niederst Robbins
2. Flutter for Beginners: An Introductory Guide to Building Cross-Platform Mobile Applications with Flutter and Dart by Alessandro Biessek

SEMESTER III:

Course: Database Features

S.No	Topics	COMMENTS
1	Introduction to Mobile and Web Apps in Healthcare: • What are Mobile Apps • What are Web Apps	
2	Components of a Mobile App: • Frontend Components (UI/UX) • Backend Components • Mobile App Platforms	
3	Components of a Web App: • Frontend Components (UI/UX) • Backend Components • Web App Deployment	
4	Tools and Technologies for Development: • Mobile App Development Tools • Web App Development Tools	
5	Real-World Applications and Hands on Projects: • Mobile App Project Ideas • Web App Project Ideas	

References

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
2. Designing Data-Intensive Applications by Martin Kleppmann

SEMESTER III:

Course: API, Plug-in integration

S.No	Topics	COMMENTS
1	Introduction to Mobile and Web Apps in Healthcare: • What are Mobile Apps • What are Web Apps	
2	Components of a Mobile App: • Frontend Components (UI/UX) • Backend Components • Mobile App Platforms	
3	Components of a Web App: • Frontend Components (UI/UX) • Backend Components • Web App Deployment	
4	Tools and Technologies for Development: • Mobile App Development Tools • Web App Development Tools	
5	Real-World Applications and Hands on Projects: • Mobile App Project Ideas • Web App Project Ideas	

References

1. API Design for C++ by Martin Reddy
2. REST API Design Rulebook by Mark Masse

SEMESTER III:**Course: Dashboards for Healthcare**

S.No	Topics	COMMENTS
1	Introduction to Healthcare Dashboards: • Patient Dashboards • Public Health Dashboards	
2	Key Features of Interactive Dashboards for Healthcare: • Data Visualization • Filters and Segmentation • Real-Time Updates • KPIs (Key Performances Indicators) • User Interaction • Data Export	
3	Tools for Developing Interactive Dashboards: • Power BI/ Tableau/ Google Data Studio	
4	Key Metrics for Healthcare Dashboards: • Patients data Dashboards • Public Health Dashboards • Operational Dashboards for Hospitals	
5	Hands-on practice: • Case studies	

References

1. Power BI for the Excel Analyst by Michael Alexander and Jared Decker
2. Learning Tableau by Joshua N. Milligan
3. Google Data Studio for Beginners by E. J. P. C. Thier

SEMESTER IV:**Course: Introduction to Electronic Circuits and Platforms**

S.No	Topics	COMMENTS
1	Fundamentals of Electronic Circuits • Basic Components of Electronic Circuits • Circuit Design and Simulation	
2	Platform Design and Integration • Microcontroller and Processor Platforms • Sensor Integration	
3	Types of Sensors for Vital Signs and Remote Monitoring • Vital Signs Sensors • Optical Sensor • Radar and Lidar Sensors	
4	Test Beds for Sensor Platforms • Building Sensor Test Beds • Output Visualization • Download and Data Analysis	
5	Data Quality, Form Factors, and Limitations • Quality of Sensor Data • Form Factors • Sensor Limitations	
6	Ecosystem Effects and Mil-Standards • Ecosystem Considerations • Military Standards (MIL-STD)	
7	Power Systems for Remote Monitoring • Power Management • Wireless Communication	
8	Standard Operating Procedures (SOPs) for Sensor Development • SOP for Sensor Calibration and Testing • Safety Standards and Protocols	

References

1. Practical Electronics for Inventors by Paul Scherz and Simon Monk
2. The Art of Electronics by Paul Horowitz and Winfield Hill

SEMESTER IV:**Course: Introduction to Sensors & Health Functions**

S.No	Topics	COMMENTS
1	Overview of Sensors in Health Monitoring Systems - Types of Sensors • Temperature Sensors • Heart Rate Sensors • Respiratory Sensors • Electrocardiogram (ECG) • Oxygen Saturation (SpO2) • Motion Sensors • Electromyography (EMG)	
2	Microcontrollers & Processors for Health Applications • Introduction to Microcontrollers (Arduino/Raspberry Pi/STM32/ESP32) • Microcontroller Selection - Programming Microcontrollers	
3	Power Sources for Wearable Health Devices • Types of Power Sources – Batteries, Power Management, Wireless Charging • Energy Harvesting	
4	Connectivity Modules for Health Monitoring • Wireless Communication - Bluetooth Low Energy (BLE), Wi-Fi (e.g., ECG data), Zigbee, NFC (Near Field Communication). • Mobile Integration	
5	Data Storage and Display • Data Storage Options (Local Storage: Onboard memory, Cloud Storage, Real-time Data Processing) • Display Systems (LCD/OLED Displays, Mobile Apps) • Visualization of Health Metrics (Body Temperature, Heart Rate, and Activity)	
6	User Interface Design for Health Monitoring Systems • User Interface (UI) Design Principles (Implicitly, Data Feedback, Mobile App UI) • UX (User Experience)	
7	Algorithms for Sensor Data Processing and Analysis • Basic Algorithms (Filtering, Signal Processing) • Machine Learning (ML) for Health Monitoring (Classification Algorithms Predictive Analytics)	
8	Practical Example • Wearable Temperature Monitoring System	

References

1. Practical Electronics for Inventors by Paul Scherz and Simon Monk

2. Arduino For Dummies by John Nussey

SEMESTER IV:**Course: Introduction to Robotics Components**

S.No	Topics	COMMENTS
1	Actuators (For Motion) - Definition and Role - Types of Actuators (Electric Motors, Pneumatic Actuators, Hydraulic Actuators)	
2	Sensors (For Perception) - Definition and Role - Types of Sensors - Proximity Sensors, Vision Sensors (Cameras), Force/Torque Sensors, Gyroscopes and Accelerometers, Touch Sensors, Temperature Sensors	
3	Power Supply Definition and Role - Types of Power Supply - Battery-Powered, AC/DC Power Supply, Solar Power	
4	Controller (The Brain) - Definition and Role - Types of Controllers - Microcontrollers (MCUs), Embedded Systems, Industrial Controllers - Programming [C/C++, Python, ROS (Robot Operating System), or LabVIEW]	
5	Physical Structure - Definition and Role - Materials Used - Lightweight Materials, Stronger Materials - Types of Structures - Wheeled Robots, Legged Robots, Articulated Robots	
6	Programming Definition and Role Programming Languages - C/C++, Python, Robot Operating System (ROS), Scratch or Blockly - Control Algorithms - PID control (e.g., path planning, object recognition, machine learning)	
7	End Effectors (Tools or Attachments) - Definition and Role - Types of End Effectors – Grippers, Welding Torches, Sprayers/Brushes, Suction Cups - Cutting Tools	

References

1. Introduction to Robotics: Mechanics and Control by John J. Craig
2. Robotics: Control, Sensing, Vision, and Intelligence by K.S. Fu, R.C. Gonzalez, and C.S.G. Lee

SEMESTER IV:**Course: Sensing using ultrasonic LIDAR & RADAR**

S.No	Topics	COMMENTS
1	Ultrasonic Sensing • Definition and Principles • Key Components (Transmitter, Receiver, Microcontroller) • Applications (Obstacle detection in robots (e.g., autonomous vehicles, robots for navigation) • Level measurement (e.g., water levels, container fullness) • Proximity sensors (e.g., parking sensors in cars, HC-SR04 Ultrasonic Sensor)	
2	LiDAR (Light Detection and Ranging) • Definition and Principles • Types of LiDAR (Terrestrial LiDAR, Mobile LiDAR) • Applications (3D Mapping, Obstacle Avoidance, Construction and Architecture) • Example Sensor (RPLiDAR A1/A2)	
3	Radar (Radio Detection and Ranging) • Definition and Principles • Key Components (Transmitter, Receiver) • Applications (Human Tracking, Autonomous Vehicles, Industrial Automation) • Example Sensor (IWR6843 mmWave Radar)	
4	Case studies/ Application	

References

1. Fundamentals of Radar and Sonar Signal Processing by Mark A. Richards
2. LiDAR: Technology and Applications by Pinaki Chakraborty and Subhrakanti Dandapat

SEMESTER IV:**Course: AI/ML/Gen AI/Computer vision**

S.No	Topics	COMMENTS
1	Introduction to AI and ML in Healthcare: • Overview of AI And ML • Application in Healthcare (Bedside Robotic Feeding arm)	
2	Types of Machine Learning Algorithms: • Supervised Learning • Unsupervised Learning • Reinforcement learning	
3	Generative AI in Healthcare: • Generative AI models, like GANs (Generative Adversarial Networks), can be applied in creating synthetic medical data, drug discovery, and personalized treatment plans.	
4	Data Preparation and Feature Engineering for AI/ML: • Healthcare data Types (e.g., EHRs, imaging, and genomic data) for AI/ML models, including cleaning, transformation, and feature selection	
5	Ethics and Challenges in AI/ML for Healthcare: • Discusses the ethical considerations, data privacy concerns, and challenges in implementing AI/ML models in healthcare, ensuring fairness and transparency in predictions	
6	Computer Vision: • Overview of Computer vision • Application in Healthcare	

References

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
2. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster
3. Computer Vision: Algorithms and Applications by Richard Szelisk

SEMESTER IV:**Course: Rapid Prototyping and 3D Printing**

S.No	Topics	COMMENTS
1	Introduction to Additive Manufacturing - Types of 3D Printing Technologies: Fused Deposition Modelling (FDM), Stereolithography (SLA), Selective Laser Sintering (SLS) - Differences between additive and subtractive manufacturing	
2	Designing for Healthcare Users: Teaches how to design digital healthcare tools (e.g., mobile apps, telehealth platforms) with the needs of patients, healthcare providers, and administrators in mind	
3	3D Printing Materials - Thermoplastics: PLA, ABS, PETG - Biocompatible Resins & Medical-Grade Polymers - Metal & Ceramic 3D Printing	
4	3D Modelling & Design - Introduction to CAD Software (AutoCAD, SolidWorks, Fusion 360) - Creating STL, and OBJ file formats for 3D printing - Optimizing designs for printability and reducing material waste	
5	Prototyping & Testing in Healthcare 3D Printed Medical Applications: Prosthetic limbs, Dental implants, Orthotic devices - Bioprinting & Tissue Engineering: Emerging trends - Quality assessment and strength testing of printed models	
6	Post-Processing & Finishing Techniques - Support Removal, Surface Smoothing, Sterilization Techniques - Coating and painting for biocompatibility - Sterilization processes in medical applications	
7	Industry Applications & Future Trends 3D Printing in Surgery & Implants - Use in Custom Prosthetics & Assistive Devices - Future of Bioprinting and Organ Printing	

References

1. Rapid Prototyping: Principles and Applications by Richard Hague, Chris Lynch, and David P. Mansour
2. 3D Printing: The Next Industrial Revolution by Christopher Barnatt

EMESTER IV:

Course: Digital Signal Processing

S.No	Topics	COMMENTS
1	Introduction to Digital Signal Processing - Key Concepts - Signals and Systems, Sampling, Quantization and DSP Systems - Practical Activities - Sampling an analogue signal and converting it to a digital signal using a Raspberry Pi or Arduino	
2	Mathematical Foundations of DSP - Key Concepts - Discrete-time signals, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Z-Transforms - Practical Activities: - Use MATLAB or Python to compute the DFT of a signal and visualize its frequency components. - Apply FFT to analyse audio signals or images	
3	Filters in Digital Signal Processing Digital Filter - FIR Filters (Finite Impulse Response), IIR Filters (Infinite Impulse Response) Filter Design: The process of designing digital filters to meet specific requirements, including low-pass, high-pass, band-pass, and band-stop filters.	
4	Practical Activities: - Implement FIR and IIR filters using MATLAB or Python. - Design a filter to process audio or sensor data. - Implement filters on a Raspberry Pi using Python and test with real-world sensor data	
5	Case Studies/ Application	

References

- Digital Signal Processing: Principles, Algorithms, and Applications by John G. Proakis and Dimitris K. Manolakis
- Understanding Digital Signal Processing by Richard G. Lyons

SEMESTER V:**Course: Autonomous Mobile Navigation for Robotics**

S.No	Topics	COMMENTS
1	Introduction to Autonomous Mobile Navigation – Key Concepts - Mobile Robot Navigation: The process of moving a robot through an environment while avoiding obstacles and reaching a goal position. - Autonomy in Robotics: Systems that can make decisions based on sensory input without human guidance. - Types of Mobile Robots: Differentiating between wheeled robots, legged robots, drones, etc. - Practical Activities - Demonstration of a simple mobile robot moving autonomously in a controlled environment using basic obstacle avoidance	
2	Sensors for Autonomous Navigation - Types of Sensors - LiDAR, Ultrasonic, RGB-D Cameras, IMUs (Inertial Measurement Units), and GPS. - Sensor Fusion - Combining data from multiple sensors to create a reliable, unified perception of the environment. - SLAM (Simultaneous Localization and Mapping) - Building a map of an unknown environment while simultaneously keeping track of the robot's location within that map. - Practical Activities - - Implementing basic sensor setups using Raspberry Pi or NVIDIA Jetson with LiDAR and cameras. - Real-time data visualization from sensors and understanding of sensor fusion concepts	
3	Localization and Mapping Localization: Determining the robot's position in the environment. Mapping: Creating a representation of the environment (map) that the robot can use for navigation. Odometry: Estimating the position of the robot using sensor data (e.g., wheel encoders, IMUs). Global vs. Local Localization: Global localization using GPS or external systems vs. local, sensor-based methods for short-range navigation. - Practical Activities - - Implementing SLAM algorithms using ROS and Raspberry Pi or Jetson Nano. - Building and visualizing maps using sensor data	

	(e.g., RPLiDAR or RGB-D cameras) Testing the robot's localization accuracy in dynamic environments	
4	Path Planning and Obstacle Avoidance Path Planning: Determining an optimal path from a start position to a goal while avoiding obstacles. Grid-based and Sampling-based Algorithms: Methods like <i>A</i> (A-star), Dijkstra's algorithm, and Rapidly-Exploring Random Trees (RRT). Dynamic Obstacle Avoidance: Handling obstacles that appear during navigation using real-time reactive algorithms. Practical Activities - - Implementing and testing A* and Dijkstra's algorithms for path planning in simulated or real environments. - Developing a basic reactive obstacle avoidance system for mobile robots using LiDAR or Ultrasonic sensors	
5	Autonomous Navigation with ROS (Robot Operating System) ROS: An open-source framework that provides tools and libraries to help design and develop robotic systems, including navigation. ROS Navigation Stack: A collection of ROS packages for mobile robot navigation, including localization, path planning, and control. Robot Control: Implementing velocity control to drive the robot based on planned paths or sensor data. Practical Activities - - Setting up and running the ROS Navigation Stack on a robot. - Building and testing a simple robot using ROS for localization and path planning. - Implementing a closed-loop control system for movement based on sensor feedback	
6	Autonomous Navigation in Real-World Environments Real-World Challenges: Navigating in dynamic, unpredictable environments, such as outdoor settings with changing lighting conditions, moving obstacles, and terrain. Sensor Calibration: Ensuring that sensors are correctly aligned and tuned for accurate data collection. Autonomous Vehicle Safety: Safety protocols for ensuring robot safety during autonomous navigation, including emergency stop systems and collision detection. Practical Activities -	

	○ Outdoor navigation using GPS and LiDAR ○ Real-world testing of a mobile robot's ability to avoid obstacles and navigate autonomously in an outdoor or semi-outdoor environment. ○ Implementing simultaneous localization and mapping (SLAM) in real-world settings with ROS	
7	Deep Learning for Autonomous Navigation • Deep Learning in Robotics: Using deep neural networks for tasks such as perception, decision-making, and control. • Vision-Based Navigation: Utilizing computer vision techniques like object detection and semantic segmentation for autonomous navigation. • End-to-end Learning: Learning control policies directly from sensor data using reinforcement learning or imitation learning. • Practical Activities - ○ Implementing Convolutional Neural Networks (CNNs) for obstacle detection or lane following on a robot. ○ Training a robot to perform autonomous navigation using Reinforcement Learning ○ Testing deep learning models for real-time decision-making on a robot	
8	Case studies/ Application	

References

1. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms by Nikolaus Correll, Bradley Hayes, and Adam S. K
2. Robotics: Control, Sensing, Vision, and Intelligence by K. S. Fu, R. C. Gonzalez, and C. S. G. Lee

SEMESTER V:**Course: Swarm Robotics**

S.No	Topics	COMMENTS
1	Introduction to Swarm Robotics • Key Concepts - Swarm Intelligence, Autonomous Robots, Decentralization and Centralization, Self-Organization • Practical Activities – ○ Group discussion on biological inspiration for swarm robotics and examples from nature	
2	Key Components of Swarm Robotics Systems • Swarm Robotic - Making robots work together to perform complex tasks. • Inter-Robot Communication - They exchange information to coordinate and synchronize actions. • Local Decision-Making - Decisions are made based on local sensor data and neighbouring robot's behaviour. • Environment Interaction - Robots sense and interact with their surroundings to navigate obstacles and complete tasks. • Practical Activities - ○ Setting up basic robots for communication and coordination tasks. ○ Simple demonstrations of robot behaviour and communication in a swarm using Arduino or Raspberry Pi robots	
3	Swarm Coordination and Control Algorithms • Boids Algorithm - Robots simulate flocking through cohesion, alignment, and separation. • Coordination Methods - Use leader-follower or peer-to-peer models for cooperation. • Foraging Algorithms - Robots search for and collect resources or reach goals. • Formation Control - Maintain geometric formations like lines, grids, or circles. • Emergent Behavior - Complex group behavior arises from simple individual rules. • Practical Activities – ○ Programming robots to simulate the Boids Algorithm for flocking behaviors. ○ Implementing basic task allocation algorithms using ROS (Robot Operating System) or other robot platforms. ○ Testing formation control algorithms using	

	simulated or real robot	
4	Applications of Swarm Robotics • Search and Rescue - Swarms collaboratively search areas, map environments, and detect hazards. • Environmental Monitoring - Collect data on pollution, weather, and forest conditions. • Agriculture - Assist in crop monitoring and precision farming. • Warehouse Automation - Transport and organize goods collaboratively. • Distributed Sensing - Gather and process real-time data through multiple robots. • Practical Activities - ○ Demonstrating a search and rescue task using multiple robots in a controlled environment. ○ Simulating environmental monitoring with multiple robots collecting data on the state of an environment. ○ Group discussion on the real-world applications of swarm robotics and potential future uses.	
5	Swarm Robotics in Simulation and Hardware • Swarm Simulation - Use of software tools like Gazebo, V-REP, or Webots to simulate swarm robotics systems and test algorithms. • Robot Hardware - Different platforms and sensors that can be used in swarm robotics, including Arduino-based robots, Raspberry Pi, mobile robots, and drones. • Virtual Swarm - Working in virtual environments before transitioning to physical robots. • Practical Activities - ○ Gazebo simulation - Students will design and simulate a swarm of robots in a virtual environment to test swarm behaviours like coordination and collision avoidance. ○ Building and programming a physical swarm of robots using Arduino and Raspberry Pi to work on simple tasks like line following or object detection. ○ Testing communication and coordination in a multi-robot environment	
6	Challenges and Limitations of Swarm Robotics • Scalability - How well a swarm system scales as the number of robots increases. • Communication Overhead - The challenges of maintaining communication between many robots in real-time. • Fault Tolerance - How swarm systems maintain	

	functionality even when some robots fail or are removed from the system. • Environment Complexity - The complexity of operating in unknown, unstructured, or dynamic environments. • Practical Activities - ○ Fault Tolerance Test: Simulate the failure of one or more robots in a swarm and see how the rest of the swarm adapts to complete the task. ○ Group discussion and problem-solving exercises on how to handle scalability and communication challenges	
7	Case Study/Application	

References

1. "Swarm Robotics: From Algorithms to Implementations" by Heiko Hamann, et al
2. "Swarm Intelligence: From Natural to Artificial Systems" by Eric Bonabeau, Marco Dorigo, Guy Théraulaz

SEMESTER V:**Course: AR/VR/MR for Healthcare**

S.No	Topics	COMMENTS
1	Introduction to AR, VR and MR: • AR • VR • MR	
2	Applications of AR/VR/MR: • Medical Training and Education • Surgical Planning and Assistance • Pain Management and Therapy • Mental Health Treatment • Patient Engagement and Education • Remote Consultation and Monitoring	
3	Software for AR/VR/MR: • AR (Microsoft HoloLens Development Studio, Unity 3D) • VR (Oculus SDK, Engage VR) • MR (HoloAnatomy, Microsoft Dynamics 365 Remote Assist)	
4	Hardware for AR/VR/MR • AR (Microsoft HoloLens2, Google Glass Enterprise Edition) • VR (Oculus Rift S/ Oculus Quest 2, HTC Vive Pro) • MR (Microsoft HoloLens 2, Oculus Quest 2)	
5	Types of Data sets for AR/VR/MR: • EMR Data sets • Sensing data sets • Image data sets • Video data set	

References

1. Augmented Reality in Healthcare: Applications, Technologies, and Challenges by Amir H. Alavi and Seyedali S. Jafari
2. Virtual Reality and Augmented Reality: Myths and Realities by Steven A. Brown
3. Mixed Reality and 3D Technologies in Medicine by André Biedenkapp, Javier García, and Eduardo R. P. de Souza

SEMESTER V:**Course: Simulation of Robotics**

S.No	Topics	COMMENTS
1	Introduction to Robotics Simulation - Robotics Simulation – Process of creating a digital model of a robot and its environment for testing algorithms and behaviours. - Virtual Environments - Using 3D simulation software to recreate real-world environments and robot tasks. - Types of Simulation - Physical simulation (e.g., dynamics, kinematics) and task simulation (e.g., path planning, motion control). - Simulation Benefits - Saving resources, testing algorithms, training, and debugging before hardware implementation. - Practical Activities – - Explore different robot simulation platforms and run introductory simulations. - Discuss the advantages and limitations of using simulations in robot development	
2	Introduction to Simulation Tools and Platforms - Gazebo - Open-source simulator integrated with ROS for robots, sensors, and environments. - V-REP (CoppeliaSim) - Versatile simulator with support for various robots, sensors, and detailed physics. - Webots - User-friendly simulator with built-in sensors and actuators for mobile robots. - ROS Integration - Enables testing algorithms in simulation before real-world deployment. - Practical Activities – - Installing and configuring Gazebo, V-REP, and Webots for simulations. - Running simple simulation tasks such as robot movement and sensor data collection.	
3	Modelling Robots in Simulation - Robot Model - The digital representation of a robot that includes its physical attributes (e.g., size, shape, joints, wheels). - Kinematics and Dynamics - Modelling the robot's motion, forces, and torques. - Sensor Modelling - Simulating sensors like cameras, LiDAR, ultrasonic, IMUs (Inertial Measurement Units), etc., for data collection. - Actuator Simulation - Simulating motors and actuators to move the robot in the virtual world	

	• Practical Activities – ○ Build a simple robot model in Gazebo or V-REP, defining its parts and joints. ○ Simulate basic robot movements (e.g., linear motion, turning) and visualize the outputs in the simulation. ○ Integrate and simulate sensors (e.g., cameras, LiDAR, IMUs) with the robot	
4	Path Planning and Motion Control in Simulation • Path Planning - The process of calculating an optimal or feasible path for a robot to move through its environment. • Motion Control - Algorithms that control how a robot moves along a planned path, ensuring smooth, safe, and accurate movement. • Obstacle Avoidance - Techniques to avoid obstacles in the robot's environment while moving towards the goal. • Simulating Path Planning Algorithms - How to simulate algorithms like A*, Dijkstra, or Rapidly-exploring Random Trees (RRT) in a virtual environment. • Practical Activities - ○ Implement a path planning algorithm (e.g., A* or RRT) in a simulation environment. ○ Simulate the motion control of a robot along a planned path, using a PID controller or other methods. ○ Test the robot's ability to avoid obstacles using sensors like ultrasonic, LiDAR, or camera data.	
5	Sensor Simulation and Data Analysis • Sensor Simulation - Creating virtual representations of sensors (e.g., LiDAR, ultrasonic, camera) and using them in simulations to gather data. • Data Fusion - Combining data from multiple sensors to improve the robot's understanding of its environment. • Sensor Noise - Simulating the imperfections and noise in sensor readings. • Data Analysis - Analyzing simulated sensor data and interpreting the robot's environment in real time. • Practical Activities - ○ Simulate a robot with a LiDAR sensor and analyze the point cloud data. ○ Simulate ultrasonic sensors for distance measurement and integrate the data with obstacle avoidance systems. ○ Use sensor fusion algorithms to combine data from different sensors (e.g., LiDAR and IMU)	

	for improved environmental mapping	
6	Robot Behaviour and Task Execution in Simulation • Behaviour-Based Control - A type of control where robots perform tasks based on pre-programmed behaviours. • Task Execution - Defining tasks for robots (e.g., pick-and-place, exploration) and simulating them in a virtual environment. • Multi-Robot Systems - Simulating the behaviour of multiple robots working together to complete a shared task. • Artificial Intelligence (AI) - Integrating AI techniques, such as machine learning, for autonomous decision-making in robot behaviour. • Practical Activities - ○ Implement a behaviour-based control system for a robot to perform a task (e.g., object pickup or delivery). ○ Simulate a multi-robot system where robots work together on tasks like area coverage or exploration. ○ Test simple AI algorithms for robot decision-making (e.g., reinforcement learning for navigating the environment)	
7	Testing and Debugging in Simulation • Simulation Debugging - Identifying and fixing issues in robotic algorithms and behaviours in a virtual environment before deployment. • System Performance Analysis - Analyzing how the robot performs in different simulation scenarios (e.g., collision detection, speed, energy consumption). • Verification and Validation - Ensuring that the robotic system behaves as expected in a simulated environment before transitioning to real-world tests. • Practical Activities - ○ Debug and optimize robotic algorithms using the simulation environment. ○ Analyze robot performance through simulated tasks and determine bottlenecks or issues. ○ Conduct verification and validation tests to confirm that the robot will behave as expected in the real world.	
8	Case studies/ Application	

References

1. Robotics, Vision and Control: Fundamental Algorithms in MATLAB by Peter Corke

2. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms by Nikolaus Correll, Bradley Hayes, and Adam S. K

SEMESTER V:**Course: Market Research and Need Assessment**

S.No	Topics	COMMENTS
1	Introduction to Market Research in Healthcare: Understanding the role of market research in identifying gaps in healthcare services, evaluating patient needs, and assessing the potential for new health technologies or services	
2	Needs Assessment Methodologies: Study of various methods for conducting needs assessments in healthcare, including surveys, interviews, focus groups, and data analysis to identify unmet healthcare needs within populations or specific patient groups	
3	Health Technology Adoption: Exploring the factors influencing the adoption of health technologies, including user preferences, market trends, regulatory considerations, and cost-effectiveness in addressing healthcare challenges	
4	Competitive Analysis in Healthcare: Examining how to assess the competitive landscape of healthcare products and services, identifying key players, and evaluating the strengths and weaknesses of existing solutions	
5	Developing Strategic Plans: Using market research and needs assessment findings to inform the development of strategic healthcare initiatives, including product development, service delivery models, and patient-centered care approaches	

References

1. Healthcare Market Research: A Practical Guide by N. D. M. R. S. A. Spalding
2. Health Technology Assessment: A Practical Guide for the Health Professional by G. E. P. S. Martin
3. Health Systems and Policy by J. M. R. R. Smit

SEMESTER VI:**Course: Digital Twins for Robotics**

S.No	Topics	COMMENTS
1	Introduction to Digital Twins in Healthcare: • What is a Digital Twin? • Components of Digital Twins How Digital Twins Work	
2	Applications in Digital Twins in Healthcare • Personalised Medicine • Patient Monitoring and Management • Medical Simulations and Training Hospital and Healthcare System Management	
3	Enabling Technologies Behind Digital Twins: • IoMT • AI and ML learning • Cloud Computing • Blockchain	
4	Challenges and Ethical Considerations • Discussing the challenges in implementing digital twins in healthcare, including data privacy, interoperability, accuracy, and the ethical concerns of using highly sensitive personal health data for simulations	
5	Case studies/Application	

References

1. Digital Twin Technologies and Smart Cities by S. M. G. H. G
2. The Role of Digital Twins in Healthcare by J. M. P. J. K

SEMESTER VI:**Course: Robotics Digital Bedside patient Monitoring**

S.No	Topics	COMMENTS
1	Introduction to Digital Bedside Patient Monitoring: - Overview of Patient Monitoring Systems - Roles and Benefits in Healthcare	
2	Key Parameters Monitored in Bedside Systems - Vital Signs - Advanced Parameters - Specialized Monitoring - Patient Status Data Integration	
3	Components of Digital Bedside Monitoring Systems - Sensors and Wearable Devices - Data Collection Devices - Central Monitoring Systems - Integration with Electronic Health Records (EHR)	
4	Data Management and Analytics in Patient Monitoring - Data Collection and Transmission - Data Security and Privacy - Predictive Analytics and Artificial Intelligence - Alert Systems and Decision Support	
5	Case studies/Application	

References

1. Medical Instrumentation: Application and Design by John G. Webster
2. Patient Safety and Quality in Nursing: A Systems Approach by Kathleen M. White

SEMESTER VI:**Course: Robotics for Emergency and ICU Care**

S.No	Topics	COMMENTS
1	Introduction to Digital Emergency and ICU Care: • What is a Digital Emergency and ICU Care? • Digital Technologies in Emergency and ICU Care • Clinical Decision Support Systems (CDSS)	
2	Patient Monitoring in Emergency and ICU Care • Real-Time Patient Monitoring System • Data Integration and Interoperability • Telemedicine and Remote Patient Monitoring	
3	Artificial Intelligence and Machine Learning in Critical Care • AI in Emergency and ICU Care • Machine Learning for Patient Risk Stratification • AI and Robotics in ICU	
4	Telemedicine in Emergency and ICU Care • Telemedicine Overview • Tele-ICU • Telemedicine in Rural and Remote Areas	
5	Case studies/ Application	

References

1. Medical Device Technologies: A Systems-Based Overview Using Engineering Standards by Gail D. Baura
2. Critical Care Nursing: Diagnosis and Management by Linda D. Urden, Kathleen M. Stacy, and Mary E. Lough

SEMESTER VI:**Course: Robotics for Home-based Healthcare**

S.No	Topics	COMMENTS
1	Introduction to Robotics for Home-based Healthcare: - What is a Digital Home-based healthcare? - The Role of Telemedicine in Home-Based Care - Technological Drivers of Digital Home Healthcare	
2	Key Applications of Robotics in Home Healthcare - Assistive Robots for the Elderly (Companion Robots), (Mobility Assistance Robots), Personal Care Assistants) - Medical Monitoring and Health Tracking (Telepresence Robots), (Vital Signs Monitoring Robots) - Robotic Rehabilitation (Rehabilitation Robots), (Wearable Exoskeletons) - Robotic Medication Management	
3	Components of Robotics for Home-Based Healthcare - Sensors (Vital Sign Sensors) - Actuators - Control Systems (Autonomous Control), (Teleoperated Control) - Communication Systems	
4	Enabling Technologies Behind Home-Based Healthcare Robots - Artificial Intelligence (AI), Natural Language Processing (NLP), Computer Vision - Robotic Arms and Manipulators - Wireless Communication	
5	Data Management and Security in Home-Based Healthcare Robotics - Patient Data Collection and Transmission: - Data Privacy and Security - Predictive Analytics	

References

- Home Healthcare Handbook by Sarah E. L. Shepherd
- Remote Monitoring and Telemedicine: A Healthcare Revolution by Patricia K. Kenned
- Medical Robotics: Minimally Invasive Surgery by Jacob Rosen, et al.

SEMESTER VI:**Course: Robotics for Occupational Well-being**

S.No	Topics	COMMENTS
1	Introduction to Digital Occupational Well-Being: - What is Occupational Well-Being - Factors Affecting Occupational Well-Being - Digital Solutions and Occupational Health	
2	Key Areas Where Robotics Enhances Occupational Well-Being - Ergonomics and Assistive Robotics (Exoskeletons), (Assistive Devices for Manual Labor), (Posture Correction Systems) - Reducing Repetitive Stress Injuries, Collaborative Robots (Cobots), (Task Automation) - Mental Health and Stress Reduction (Telepresence Robots), (AI-Powered Virtual Assistants), (Robotic Stress Relievers)	
3	Key Technologies in Robotics for Occupational Well-Being - Collaborative Robots (Cobots) - Exoskeletons - Robotic Process Automation (RPA)	
4	Application of Robotics in Specific Industries - Manufacturing and Assembly (Robotic Arms and Automated Systems), (Industrial Robotics for Hazardous Environments) - Healthcare and Nursing (Robots for Physical Therapy), (Robots for Elderly Care), (Surgical Robots) - Logistics and Warehousing (Automated Guided Vehicles (AGVs), (Automated Picking and Sorting Systems) - Agriculture (Robotic Harvesters and Planters), (Agricultural Drones)	
5	Benefits of Robotics for Occupational Well-Being - Physical Health Benefits (Injury Prevention, Reduction of Physical Strain, Mental Health Benefits, Stress Reduction, Improved Work-Life Balance) - Productivity Benefits (Increased Efficiency, Task Optimization)	
6	Robotics for Enhancing Work-Life Balance and Reducing Stress - Virtual Reality (VR) and Robotics for Stress Relief (VR-based Relaxation, Robotic Stress Relievers) - Telepresence Robots for Remote Work	
7	Case studies/ Application	

References

1. Robotics for Engineers by Yoram Koren
2. Assistive Robotics: Concepts, Design, and Applications by Reza S. Ghaffari and Marjan G. Ghaffari

SEMESTER VI:**Course: Robotics for Elderly Care**

S.No	Topics	COMMENTS
1	Introduction to Digital Elderly Care: • What is Digital Elderly Care? • Challenges in Elderly Care • Types of Robotics Solutions in Elderly care	
2	Types of Robotics for Elderly Care • Assistive Robots • Social Companion Robots • Robotic Caregivers • Cognitive Assistance Robots	
3	Technologies Behind Robotics for Elderly Care • Artificial Intelligence (AI) • Sensors and Wearables • Robotic Perception and Navigation • Telemedicine and Remote Monitoring	
4	Applications of Robotics in Elderly Care • Assistive Daily Activities (Robot Caregivers for Daily Task, Robotic Bathing Assistants, Mobility Assistance) • Medication Management and Health Monitoring • Social and Cognitive Engagement • Emergency Response	
5	Challenges in Implementing Robotics in Elderly Care • Technological Acceptance (Intergenerational Acceptance) • Cost and Accessibility • Privacy and Data Security • Complexity of Interaction	
6	Case studies/ Application	

References

1. Assistive Robotics: Concepts, Design, and Applications by Reza S. Ghaffari and Marjan G. Ghaffari
2. Healthcare Robotics by Jacob Rosen, Oussama Khatib, and Bilge Mutlu

SEMESTER VI:**Course: Robotics for Health care Logistics**

S.No	Topics	COMMENTS
1	Introduction to Healthcare Logistics • What is Healthcare Logistics? • Key Components of Healthcare Logistics • Challenges in Healthcare Logistics	
2	Robotics in Healthcare Logistics: An Overview • Role of Robotics in Healthcare Logistics • Types of Robotics in Healthcare Logistics (Autonomous Mobile Robots (AMRs), Robotic Delivery Systems, Robotic Arm Systems) • Automated Guided Vehicles (AGVs)	
3	Key Applications of Robotics in Healthcare Logistics • Medication Delivery • Inventory Management • Supply and Equipment Transport • Disinfection and Sterilization • Waste Management	
4	Technologies Behind Robotics in Healthcare Logistics • Autonomous Navigation and Mapping • Artificial Intelligence and Machine Learning • Connectivity and Communication • Robotic Control Systems	
5	Challenges in Robotics for Healthcare Logistics • Integration with Existing Systems • Cost of Implementation • Regulatory Compliance • Robot Acceptance by Healthcare Workers	
6	Case studies/ Application	

References

1. Healthcare Robotics by Jacob Rosen, Oussama Khatib, and Bilge Mutlu
2. Robots in Healthcare: Revolutionizing Care and Changing Lives by Sean F. Hennessey and John B. O'Connell

SEMESTER VI:**Course: Robotics for Healthcare E-Commerce**

S.No	Topics	COMMENTS
1	Introduction to Healthcare E-Commerce • What is Healthcare E-Commerce? • E-Commerce Segments in Healthcare • Market Trends in Healthcare E-Commerce	
2	E-Commerce Platforms for Healthcare Products • Designing E-Commerce Platforms for Healthcare Products • Payment Systems and Logistics in Healthcare E-Commerce • Integration with Healthcare Systems	
3	E-Commerce Platforms for Healthcare Products and Services • Healthcare products (medical devices, drugs) • Services (telemedicine) are sold and delivered online	
4	Marketing and Consumer Behaviour • Digital marketing strategies for healthcare products understanding consumer decisions in online healthcare shopping.	
5	Technology and Security in Healthcare E-Commerce • Role of AI, blockchain • Security measures in improving e-commerce platforms and safeguarding data	
6	Case studies/ Application	

References

1. Healthcare E-Commerce: Integrating Telemedicine and Medical Devices into Digital Health by Chris Green
2. Telemedicine and E-Health by Richard Wootton and J. L. Williams

SEMESTER VI:**Course: Finance for Healthcare Robotics Settings**

S.No	Topics	COMMENTS
1	Introduction to Healthcare Finance Basics of financial management in healthcare, including key financial statements like balance sheets and income statements.	
2	Healthcare Budgeting Understanding the process of creating and managing budgets for healthcare organizations, focusing on cost control and allocation.	
3	Revenue Cycle Management How healthcare organizations handle billing, insurance claims, patient payments, and the overall revenue cycle.	
4	Healthcare Financial Performance Key metrics (e.g., profitability, liquidity) and tools (e.g., ROI, cost-benefit analysis) used to assess the financial health of healthcare institutions.	
5	Financing and Investment in Healthcare Sources of capital for healthcare organizations (loans, grants, equity) and evaluating investment projects, such as new technology or facility expansions.	
6	Case studies/ Application	

References

- Healthcare Finance: An Introduction to Accounting and Financial Management by Louis C. Gapenski and George H. Pink

SEMESTER VII:**Course: Digital Transformation of Healthcare**

S.No	Topics	COMMENTS
1	Introduction to Digital Transformation of Healthcare • Definition of Digital Transformation of Healthcare • Technologies (EHR, Telemedicine, AL&ML, mHealth, IoT)	
2	Core Technologies and Their Impact • Electronic Health Records (HER) • Telemedicine and Telehealth • AI-driven Healthcare Solutions	
3	Improving Healthcare Access and Efficiency Using Digital Tools • Improving Access to Care • Improving Efficiency in Healthcare Delivery	
4	The Role of Data Security and Privacy in Digital Healthcare • Regulations • Data Security Challenges • Best Practices for Data Security	
5	Future Trends and Innovations in Digital Healthcare • Personalized Medicine • Blockchain Technology • 5G and Healthcare • Robotics in Healthcare	
6	Case studies/ Application	

References

1. Digital Health: Meeting Patient and Professional Needs Online by Alan Davies
2. Healthcare Digital Transformation: The Roadmap for Change by Edward W. Marx & Paddy Padmanabhan

SEMESTER VII:**Course: Digital Health Project Management**

S.No	Topics	COMMENTS
1	Introduction to Digital Health Project Management • What is Digital Health • Introduction to Project Management • Importance of Project Management in Digital Health	
2	Digital Health Project Planning • Defining Project Scope and Objectives • Stakeholder Identification and Analysis • Project Charter	
3	Agile Methodology in Digital Health Projects • Introduction to Agile Project Management • Scrum Framework • Managing Iterative Development and Stakeholder Feedback	
4	Resource and Budget Management in Digital Health Projects • Resource Planning • Budget Planning and Financial Management • Cost and Value Analysis in Digital Health Projects	
5	Risk Management in Digital Health Projects • Identifying Risks • Risk Assessment and Mitigation Strategies	
6	Legal and Regulatory Compliance in Digital Health Projects • Healthcare Regulations • Data Privacy and Security • Ethical Considerations	
7	Project Implementation and Monitoring • Project Implementation Plan • Monitoring Project Progress • Post-Implementation Evaluation and Project Closure	
8	Case studies/ Application	

References

1. Digital Health: Meeting Patient and Professional Needs Online" by Alan Davies

SEMESTER VII:**Course: Wearable Diagnostics**

S.No	Topics	COMMENTS
1	Introduction to Wearable Diagnostics - Definition - Types of wearable devices (smartwatches, fitness trackers, wearable ECG monitors, wearable blood pressure monitors, wearable ECG monitors, sleep and oxygen monitoring devices)	
2	How Wearable Diagnostic Work - Sensors and Data Collection - Data Processing and Algorithms - Real-Time Monitoring and Feedback - Integration with Healthcare Systems	
3	Applications of Wearable Diagnostics - Chronic Disease Management - Preventive Health and Early Diagnosis - Post-Surgical Monitoring - Mental Health Monitoring - Fitness and Wellness	
4	Benefits of Wearable Diagnostics - Empowering Patients - Early Detection and Prevention - Remote Monitoring and Telemedicine - Data-Driven Healthcare	
5	Challenges and Limitations - Accuracy and Reliability - User Compliance and Adoption - Data Privacy and Security - Regulatory and Ethical Issues	
6	Future Trends in Wearable Diagnostics - Advancements in Sensor Technology - AI and Machine Learning in Wearable Diagnostics - Wearables for Personalized Medicine - Integration with Other Digital Health Tools	
7	Case studies/ Application	

References

1. Wearable Sensors: Fundamentals, Implementation, and Applications by J. C. Suh, J. J. P. Tsai
2. Digital Medicine: Implications for Healthcare by Dr. Faisal Khan

SEMESTER VII:**Course: Exoskeletons & Humanoid for Healthcare**

S.No	Topics	COMMENTS
1	Introduction to Exoskeletons & Humanoid for Healthcare • Definition • Applications in Healthcare	
2	Components of Exoskeletons & Humanoid Robots Sensors and Data Collection • Robotics and Actuation • Motion Control and AI Algorithms • Sensors and Feedback Systems • VR-Assisted Therapy Integration • Patient Interaction and User Interface	
3	Design and Implementation of Exoskeletons • Design Considerations • Types of Exoskeletons • Steps in Development • Regulatory Standards and Approvals	
4	Humanoid Robots for Healthcare • Human-Robot Interaction • Social Care Assistance • Clinical Applications • AI and Cognitive Capabilities	
5	Integration of Exoskeletons & Humanoids in Healthcare Systems • Healthcare Facility Deployment • Impact on Patient Outcomes • Cost-Effectiveness	
6	VR-Assisted Therapy in Rehabilitation • Virtual Reality for Physical Therapy • Integration with Exoskeletons • Applications in Stroke and Spinal Cord Injury Recovery • Ethical and Regulatory Issues	
7	Case studies/ Application	

References

1. Robotics in Medicine” by Paulo S. Diniz
2. Human-Robot Interaction in Healthcare” by R. S. Zohdy
3. Medical Robotics” by Adam H. L. Chang

SEMESTER VII:**Course: Drone & UAVs**

S.No	Topics	COMMENTS
1	Introduction to Drone & UAV • Definition • Applications in Healthcare	
2	Components of a UAV for medical use • Frames • Motors & Propulsion system • Power system • Flight controller & Sensor • Communication system • Payload Accessories	
3	UAV Operation in Healthcare: BVLOS & AI Navigation • BVLOS Operations (Beyond Visual Line of Sight) • AI-Powered Navigation • AI- in Medical Delivery	
4	Payload Integration for Medical Deliveries • Designing Payload Systems for Medical Deliveries • Integration of Cameras and Thermal Imaging • Emergency Medical UAV Payloads	
5	Regulatory and Legal Framework for UAV Operations • Regulatory Compliance in UAV Operations • Privacy and Data Protection • Safety Standards	
6	Drone Applications in Disaster Response and Remote Healthcare • Disaster Response • Remote Healthcare • Future Trends	
7	Case studies/ Application	

References

1. Drone Science: The Technology Behind UAVs by Bruce D. McDonald
2. The Future of UAVs in Healthcare by Karen K. Roberts

SEMESTER VII:**Course: Sustainability & Recycling**

S.No	Topics	COMMENTS
1	Introduction to Sustainability and Recycling in Technology • What is Sustainability? • Importance of Sustainability and Recycling	
2	Lifecycle of Robotics and Medical Devices • Stages in the Lifecycle • Environmental Impact at Each Stage • Key Factors Influencing Sustainability	
3	Sustainable Design Principles • Green Design for Robotics and Medical Devices: • Eco-friendly Manufacturing Processes • Design for Longevity	
4	Recycling of Robotics and Medical Devices • Materials in Robotics and Medical Devices • Recycling of Electronic Waste (e-Waste) • Challenges in Recycling Robotics and Medical Devices	
5	Innovations in Sustainable Robotics • Robotic Systems Powered by Renewable Energy • Energy Harvesting Robots • Green Robotics	
6	Case studies/ Application	

References

1. "Sustainable Robotics and Automation" by A. J. B. Al-Alam
2. "Environmental Sustainability with Robotics: Design and Innovation" by T. O. Nordin

SEMESTER VII:**Course: Cyber Security for Health**

S.No	Topics	COMMENTS
1	Introduction to Cyber Security for Health - E-Healthcare Information Management - Types and Trends in E-Healthcare Information - Frameworks and Architectures of E-Healthcare systems - The Internet and WWW	
2	Securing E-Healthcare Security - Significance of security - Challenges in security - Issues of Information Security	
3	Security Challenges - Breaches of Privacy and confidentiality - Information Utilization Challenge - Legal Protection Challenge - The IT Security Challenge for Security information	
4	Identification and E-Healthcare information - Anonymisation and Pseudonymisation - De-identification of Personal Information - Permitted Uses and Disclosures of Health Information - Definition of Identifiability - Modelling of Threat - Breach Notification	
5	Secure E-Healthcare Information Systems - The mechanisms of ensuring security - Assessment of security - Case studies-Canada, Norway, Sweden, U.K, Denmark	
6	Ethics, Laws and Standards - Information Ethics and Principals - Rationale for Laws and Standards - Laws & Standards Relationships and Interactions - Legal Protection of Privacy & Confidentiality - International and Cultural considerations - Standardization Challenges	

References

- Electronic Healthcare Information Security Charles A. Shoniregun (Author)
Publisher: Springer; 2010 edition (December 27, 2012)
- Public Health Informatics and Information Systems [Paperback] Patrick W. O'Carroll (Editor), William A. Yasnoff (Editor), et al. Publisher: Springer
(December 1, 2010)

SEMESTER VII:**Course: Research Project Design**

S.No	Topics	COMMENTS
1	Introduction to Healthcare Research Projects • Definition and Importance of Research in Healthcare • Understanding the basic steps involved in healthcare research • Types of Research Designs	
2	Developing Research Questions and Hypothesis • Formulating a Research Question • Developing Hypotheses • Creating a Conceptual Framework	
3	Designing Research Methodology • Choosing the Right Research Methodology • Sampling Techniques • Data Collection Methods	
4	Statistical Methods in Healthcare Research • Introduction to Statistical Concepts • Applying Statistical Methods • Software for Data Analysis	
5	Data Analysis and Interpretation • Organizing and Cleaning Data • Analyzing Data • Reporting and Presenting Results • Conclusions and Recommendations	
6	Ethical Considerations in Healthcare Research • Importance of Ethics in Healthcare Research • Informed Consent • Research Ethics Committees	
7	Implementing a Research Project • Managing a Healthcare Research Project • Challenges in Healthcare Research • Real-world Case Studies	

References

1. Research Methods in Health: Investigating Health and Health Services by Ann Bowling
2. Introduction to Healthcare Research Methods by Steven R. Brown
3. Statistics for Healthcare Professionals by Ian McDowell

SEMESTER VIII:**Course: Critical Thinking**

S.No	Topics	COMMENTS
1	Introduction to Critical Thinking in Healthcare - What is Critical Thinking? - Components of Critical Thinking (Analysis, Evaluation, Inference, Reasoning) - Why is Critical Thinking Important in Healthcare?	
2	Problem-Solving in Healthcare - Defining Problem-Solving - Steps in Problem-Solving - Common Healthcare Problems - Creative Problem-Solving Techniques	
3	Decision-Making in Healthcare - Understanding Decision-Making - Types of Decision-Making in Healthcare - Steps in Decision-Making	
4	Logical and Creative Approaches to Analyzing Complex Healthcare Issues - Logical Analysis - Creative Approaches - Combining Logic with Creativity	
5	Implementing Critical Thinking and Problem-Solving Skills in Real-World Healthcare Contexts - Clinical Scenarios - Simulations - Collaborative Decision-Making	
6	Ethical Considerations in Healthcare Decision Making - Importance of Ethics in Healthcare Research - Informed Consent - Research Ethics Committees	

References

1. Critical Thinking in Healthcare: A Guide for Health Professionals” by Caroline E. Harkness
2. The Art of Critical Thinking: A Guide to the Thought Process in Healthcare” by Michael C. Chien
3. Decision Making in Healthcare: An Evidence-Based Approach” by Alan J. Duran

SEMESTER VIII:**Course: Healthcare Startup Pathway**

S.No	Topics	COMMENTS
1	Introduction to Healthcare Startups • What is Healthcare Startups • Why Healthcare Startups?	
2	Strategic Planning for a Digital Health Startup • Identifying Market Opportunities • Defining Your Value Proposition • Building a Business Model • Developing the Product	
3	Legal and Regulatory Considerations in Healthcare Startups • Navigating Healthcare Regulations (HIPAA, FDA, GDPR, Telemedicine regulation) • Legal Structures for Healthcare Startups • Compliance and Risk Management • Protecting Intellectual Property	
4	Financial Aspects of Healthcare Entrepreneurship • Creating a Financial Plan • Funding Your Startup • Revenue Models for Digital Health • Managing Financial Risk and Cash Flow	
5	Scaling and Growing a Healthcare Startup • Building a Team • Attracting Partnerships • Scaling Your Startup • Iterative Development	
6	Marketing and Launching Your Healthcare Startup • Developing a Go-To-Market Strategy • Patient-Centered Marketing • Launching Your Product	

References

1. The Lean Healthcare Startup by Peter H. Diamandis
2. Digital Health: Scaling Healthcare to the World by Deborah Estrin and Deborah G. Kessler
3. Healthcare Entrepreneurship: A Guide to Developing and Growing a Successful Digital Health Business by Dave Albert and Larry Shy