



MALLA REDDY VISHWAVIDYAPEETH

SCHOOL OF DIGITAL HEALTH SCIENCES AND TECHNOLOGY

Program

Master of Science (M.Sc.)

Health Informatics

2026-27

MALLA REDDY VISHWAVIDYAPEETH
SCHOOL OF DIGITAL HEALTH SCIENCES AND TECHNOLOGY
MASTER OF SCIENCE (M.Sc.) IN HEALTH INFORMATICS

VISION

To develop research-capable, industry- and academia-ready postgraduates who can independently design, implement, secure and govern health-information systems, and apply health-data analytics to improve clinical decision-making, health-system efficiency and population-health outcomes.

MISSION

1. Deepen competence in health-systems thinking, national/global digital-health policy (ABDM, national health programmes) and the health-information life-cycle.
2. Build advanced proficiency in health-data standards, interoperability (HL7/FHIR/DICOM/SNOMED CT/LOINC), electronic health records and hospital information systems.
3. Develop mastery of health-data analytics, clinical data management, health-information security and clinical decision-support/AI applications through dedicated electives and practical's.
4. Cultivate independent research aptitude, critical thinking and health-IT project-leadership competence through an intensive research project/thesis and advanced elective review in the final semester.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Within a few years of graduation, graduates of the M.Sc. Health Informatics programme will:

1. Lead the design, implementation, and evaluation of electronic health record, hospital information and health-data-exchange systems in clinical, public-health, government or industry settings.
2. Advance into specialist careers such as Health Informatics Specialist, Clinical/Health Data Manager, EHR/HIS Analyst, Health Data Governance Officer or Health IT Project Manager, or pursue doctoral research (Ph.D.) in health informatics or allied fields.
3. Demonstrate advanced professional, ethical, regulatory and data-governance responsibility while managing sensitive health information and deploying data-driven and AI-enabled clinical tools.
4. Conduct independent, rigorous research and lead innovation addressing emerging challenges in health-information management, interoperability and health-data-driven care delivery, including in rural and resource-constrained settings.

PROGRAMME OUTCOMES (POs)

On completion of the programme, postgraduates will be able to:

1. Healthcare Data Management and Analytics: Gaining knowledge in biostatistics, epidemiology, and advanced analytics to extract insights from healthcare data and optimize decision-making.
2. Design and Implementation of Health Informatics Systems: Developing and integrating EHR, telemedicine, clinical decision support, and patient monitoring systems with secure and scalable architectures.
3. Data Visualization and Digital Health Infrastructure: Building dashboards, GIS-based tools, and informatics-driven solutions to enhance healthcare accessibility and operational efficiency.
4. Cybersecurity, Compliance, and Ethical Governance: Ensuring data security, privacy, and adherence to global health informatics regulations while addressing ethical concerns in digital health.

5. Innovation and Research in Health Informatics: Gaining knowledge on consumer health informatics, biometrics, and health finance solutions through research-driven informatics applications.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Integrate clinical/health-systems knowledge with health-data standards and interoperability frameworks to design robust health-information systems.
2. Apply advanced analytics, data-mining and machine-learning techniques to large, heterogeneous healthcare datasets for actionable insight.
3. Design and enforce health-information security, privacy and governance frameworks compliant with national and global regulation.
4. Independently formulate, execute and defend a research project/thesis or advanced elective review addressing a real-world health-informatics problem.

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SCHOOL OF DIGITAL HEALTH SCIENCES AND TECHNOLOGY
MASTER OF SCIENCE (M.Sc.) IN HEALTH INFORMATICS
COURSE STRUCTURE

I year I semester

S.NO	SUBJECT	L	T	P	C
1	Introduction to Health Systems	2	-	-	2
2	National Health Programs & ABDM	2	-	-	2
3	Introduction to AYUSH	2	-	-	2
4	Occupational Health	2	-	-	2
5	English & Communication Skills	2	-	-	2
6	Computer Foundation	2	-	-	2
7	Understanding Data- Source, Structure, Preparation and Annotation	2	-	-	2
8	Languages for Coding	2	-	-	2
9	Introduction to Github	1	-	-	1
10	Digital Health Terminology	2	-	-	2
11	Practicals in Coding	-	-	2	1
	TOTAL	19	-	2	20

I year II semester

S.NO	SUBJECT	L	T	P	C
1	Principles of Epidemiology & Research Methodologies	3	-	-	3
2	Introduction to Biostatistics	2	-	-	2
3	Electronic health records	3	-	-	3
4	Healthcare data standards	2	-	-	2
5	Advanced data analytics (R/ SPSS/ STATA/ SAS)	2	-	-	2
6	Data Visualization & GIS	2	-	-	2
7	Dashboards for Healthcare	1	-	-	1
8	Database Features	1	-	-	1
9	Practicals in Advanced data analytics (R/ SPSS/ STATA/ SAS)	-	-	4	2
10	Practicals in Data Visualization & GIS	-	-	4	2
	TOTAL	16	-	8	20

II year III semester

S.NO	SUBJECT	L	T	P	C
1	Telemedicine	3	-	-	3
2	Developing Health Informatics systems: Software, Hardware, Network & Sensors	3	-	-	3
3	Clinical Decision Support Systems	2	-	-	2
4	Patient Monitoring Systems	2	-	-	2
5	Consumers Health Informatics	2	-	-	2
6	Health Finance and Insurance	2	-	-	2
7	Cybersecurity for Health	2	-	-	2
8	Biometrics for Health Systems	2	-	-	2
9	Ethics in Health Informatics	2	-	-	2
	TOTAL	20	-	-	20

II year IV semester

S.NO	SUBJECT	L	T	P	C
1	Research Project/Thesis	-	-	-	12
2	Review of Topics/Electives	8	-	-	8
	TOTAL	8	-	-	20

1.1 Post Graduate Programme

Sl. No.	Course	Duration	Eligibility for admission
1	M.Sc. in Health Informatics (Two-Year Postgraduate, NEP 2020 / UGC-CCFUP-PG compliant)	2 years (4 semesters)	Candidate must hold a Bachelor's degree (3- or 4-year, NEP 2020 compliant) in Health Informatics, Digital Health, Life Sciences, Allied Health Sciences, Nursing, Pharmacy, Computer Science/IT, Biomedical/Biotechnology Engineering, or any other discipline recognized as equivalent by the University, from a recognized university. Minimum aggregate of 50% marks (45% for SC/ST/OBC and other reserved categories as per applicable State/UGC norms) in the qualifying Bachelor's degree. Admission shall be based on merit in the qualifying examination and/or any national/state-level postgraduate entrance test (e.g., CUET-PG or University-conducted entrance test) as notified by the University from time to time, followed by counseling as per Malla Reddy Vishwavidyapeeth admission regulations. Candidates from non-technical/non-life-science backgrounds may be required to complete a bridge module (in coordination with the School) in basic health systems and computing fundamentals during Semester I.

1.2. Medium of Instruction:

English.

1.3 Duration of the Course

2 years (4 semesters). Two semesters per year (odd: July-December; even: January-May), each of minimum 90 working days including internal assessment and examinations.

1.4 Examination Regulations

1.4 Examination Regulations

1.4.1 Attendance:

A minimum of 75% attendance in each course (theory and practical) is mandatory for eligibility to appear in the End-Semester Examination; condonation up to 65% may be granted by the Vice-Chancellor on genuine medical/other grounds as per University rules.

1.4.2 Internal Assessments:

Course Type	Component	Weightage	Description
Theory Courses	Continuous Internal Assessment (CIA)	30%	Two mid-term tests (best of 2 or average), assignments/quizzes, seminars, attendance.
Practical / Laboratory Courses	Continuous Internal Assessment	30%	Lab records, in-lab performance, viva-voce during the semester.

Exam pattern for internal assessment**Theory Courses (Internal Examination, 30 marks, 2 hours)**

Section	Instruction	No. of Questions	Total Marks
A	Very Short Questions	5 × 2 marks	10
B	Short Questions	2 × 5 marks	10
C	Essay Questions	1 × 10 marks	10

Practical Courses (Internal Examination, 30 marks, 2 hours)

Section	Instruction	Total Marks
A	Spotter- Lab practical evaluation	15
B	Viva voce	15
	Total	30

1.4.3 University Examinations (External):

Course Type	Component	Weightage	Description
Theory Courses	End-Semester University Examination (ESE)	70%	Written examination of 3 hours covering the entire syllabus (all units).
Practical / Laboratory Courses	End-Semester Practical Examination	70%	Conduct of experiment/task, output/demo, record and viva-voce by internal + external examiner.

Theory Courses (End-Semester Examination, 70 marks, 3 hours)

Section	Instruction	No. of Questions	Total Marks
A	Very Short Questions	10 × 2 marks	20
B	Short Questions	6 × 5 marks	30
C	Essay Questions	2 × 10 marks	20

Total End-Semester marks = 70 (scaled from the above, or awarded directly out of 70 as per University question-paper template); combined with 30 CIA marks to yield 100.

Practical Courses (End-Semester Examination, 0 marks)

Section	Instruction	Total Marks
A	Spotter- Lab practical evaluation	20
B	Major Practical	10
C	Internal Viva	15
D	External Viva	15
E	Record	10
	Total	70

A student must secure a minimum of 'P' grade (40% aggregate, with at least 40% in ESE) to pass a course. A student who fails in a course may reappear in the subsequent supplementary/arrear examination.

Promotion to the next semester is automatic; however, a student must clear all backlog courses up to Semester IV before being permitted to register for Semester VII, and must clear all UG-level backlogs before the award of degree.

Malpractice in examinations shall be dealt with as per the University's Unfair Means regulations, ranging from cancellation of the concerned examination to debarment.

The Research Project/Dissertation (Semester VIII) must be submitted with a plagiarism similarity index within University-prescribed limits (typically $\leq 10\%$ excluding references) prior to viva-voce.

I year I semester

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1	Introduction to Health Systems	2	-	-	2
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3	Introduction to AYUSH	2	-	-	2
4	Occupational Health	2	-	-	2
5	English & Communication Skills	2	-	-	2
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8	Languages for Coding	2	-	-	2
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10	Digital Health Terminology	2	-	-	2
11	Practicals in Coding	-	-	2	1
	TOTAL	19	-	2	20

SEMESTER-I**INTRODUCTION TO HEALTH SYSTEMS****L/T/P/C**
2/-/-/2**Learning Outcome:**

1. Describe Evolution of Healthcare Systems (Global & Indian), with particular reference to historical perspectives.
2. Explain Levels of Healthcare, with particular reference to primary, secondary, tertiary care.
3. Apply Healthcare Financing & Insurance Models, with particular reference to universal health coverage (uhc).
4. Analyse and evaluate Public and Private Healthcare Systems; Health Policy & Governance, and relate these to emerging practice in Introduction to Health Systems.

UNIT-I**EVOLUTION OF HEALTHCARE SYSTEMS (GLOBAL & INDIAN)**

1. Historical perspectives
2. Key reforms in healthcare
3. Comparative global healthcare models

UNIT-II**LEVELS OF HEALTHCARE**

1. Primary, Secondary, Tertiary Care
2. Role of different levels in disease prevention & management

UNIT-III**HEALTHCARE FINANCING & INSURANCE MODELS**

1. Universal Health Coverage (UHC)
2. Public & private insurance schemes
3. Challenges & future trends

UNIT-IV**PUBLIC AND PRIVATE HEALTHCARE SYSTEMS**

1. Structure and roles of public vs. private providers
2. Public-Private Partnerships (PPP) in healthcare

UNIT-V**HEALTH POLICY & GOVERNANCE**

1. National Health Policy
2. Regulatory bodies (WHO, MoHFW, NMC)
3. Health law & ethics

RECOMMENDED TEXT BOOKS

1. Essentials of Global Health – Richard Skolnik
2. Health Policy and Systems Thinking – Thomas Rice
3. Public Health Administration: Principles for Population-Based Management – Leiyu Shi & James A. Johnson

4. Berman, P. (2011). Health Systems Analysis for Developing Countries. World Bank Publications.
5. WHO. (2007). Everybody's Business: Strengthening Health Systems to Improve Health Outcomes.
6. World Bank. (2018). The Role of the World Bank in Health Systems Development.

NATIONAL HEALTH PROGRAMS & ABDM (AYUSHMAN BHARAT DIGITAL MISSION)

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Introduction to National Health Programs, with particular reference to understanding the burden of communicable & non-communicable diseases in India.
2. Explain Key National Health Programs – objectives, structure and implementation, with particular reference to RNTCP (revised national tuberculosis control program) – TB control strategy.
3. Apply Overview of other National Health Programs, with particular reference to national AIDS control program (NACP).
4. Analyse and evaluate Ayushman Bharat Program; ABDM Architecture & Ecosystem, and relate these to emerging practice in National Health Programs & ABDM (Ayushman Bharat Digital Mission).

UNIT-I

INTRODUCTION TO NATIONAL HEALTH PROGRAMS

1. Understanding the burden of communicable & non-communicable diseases in India
2. Role of government initiatives in public health improvement

UNIT-II

KEY NATIONAL HEALTH PROGRAMS – OBJECTIVES, STRUCTURE AND IMPLEMENTATION

1. RNTCP (Revised National Tuberculosis Control Program) – TB control strategy
2. NVBDCP (National Vector Borne Disease Control Program) – Malaria, Dengue, and other vector-borne diseases
3. NLEP (National Leprosy Eradication Program) – Leprosy control and rehabilitation strategies

UNIT-III

OVERVIEW OF OTHER NATIONAL HEALTH PROGRAMS

1. National AIDS Control Program (NACP)
2. NPCDCS – Cancer, Diabetes, Cardiovascular Diseases & Stroke
3. National Mental Health Programme (NMHP)
4. Maternal & Child Health Programs

UNIT-IV

AYUSHMAN BHARAT PROGRAM

1. PMJAY (Health Insurance)
2. HWCs (Health & Wellness Centers)

UNIT-V

ABDM ARCHITECTURE & ECOSYSTEM

1. Digital health records
2. Data interoperability & exchange

RECOMMENDED TEXT BOOKS

1. Park, K. (2021). Textbook of Preventive and Social Medicine (26th ed.). M/s Banarsidas Bhanot Publishers.

2. Goel, S. (2017). Public Health Policy and National Health Programs of India. Deep & Deep Publications.
3. Gupta, M. C., & Mahajan, B. K. (2018). Textbook of Preventive and Social Medicine. Jaypee Brothers Medical Publishers.
4. Dhrubajyoti Bhattacharya. (2013). Public Health Policy: Issues, Theories, and Advocacy. Jossey-Bass.
5. Additional Reading Material
6. Ministry of Health & Family Welfare (MoHFW), Government of India. (2022). National Health Mission Guidelines & Annual Reports. (<https://nhm.gov.in/>)
7. National Digital Health Mission (NDHM) / Ayushman Bharat Digital Mission (ABDM). (2022). Policy & Implementation Guidelines. (<https://abdm.gov.in/>)
8. World Health Organization (WHO). (2017). Primary Health Care Systems (PRIMASYS) India Report.
9. WHO. (2007). Everybody's Business: Strengthening Health Systems to Improve Health Outcomes.

INTRODUCTION TO AYUSH

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Introduction to Traditional Medicine, with particular reference to definition and scope of traditional medicine.
2. Explain Key Principles of Major Traditional Systems, with particular reference to core concepts, diagnostic approaches, and treatment principles of ayurveda, siddha, unani, yoga, naturopathy, and homeopathy.
3. Apply Clinical Application of Traditional Medicine, with particular reference to common ailments treated with traditional medicine (digestive issues, respiratory problems, skin conditions, pain management).
4. Analyse and evaluate Research in Traditional Medicine, with particular reference to role of scientific validation and clinical trials in traditional medicine.

UNIT-I

INTRODUCTION TO TRADITIONAL MEDICINE

1. Definition and scope of traditional medicine
2. Historical context of different traditional medicine systems
3. Philosophical and theoretical foundations of Ayurveda, Traditional Chinese Medicine (TCM), and Unani
4. Cultural and social aspects of traditional medicine practices

UNIT-II

KEY PRINCIPLES OF MAJOR TRADITIONAL SYSTEMS

1. Core concepts, diagnostic approaches, and treatment principles of Ayurveda, Siddha, Unani, Yoga, Naturopathy, and Homeopathy

UNIT-III

CLINICAL APPLICATION OF TRADITIONAL MEDICINE

1. Common ailments treated with traditional medicine (digestive issues, respiratory problems, skin conditions, pain management)
2. Case studies and clinical applications of traditional medicine therapies

UNIT-IV

RESEARCH IN TRADITIONAL MEDICINE

1. Role of scientific validation and clinical trials in traditional medicine
2. Understand how traditional medicine is integrated with modern healthcare through evidence-based practice

RECOMMENDED TEXT BOOKS

1. Mukherjee, P. K. (2015). Evidence-Based Validation of Herbal Medicine. Elsevier.
2. Sharma, P. V. (1995). History of Medicine in India. Indian National Science Academy.
3. Bhattacharya, N. (2012). Traditional Medicine in South East Asia and India. Springer.
4. Warrier, P. K. (1994). Indian Medicinal Plants: A Compendium of 500 Species. Orient Blackswan.
5. World Health Organization. (2013). WHO Traditional Medicine Strategy 2014-2023.

OCCUPATIONAL HEALTH

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Introduction to Occupational Health, with particular reference to definition, scope, and significance of occupational health.
2. Explain Workplace Hazards and Risk Assessment, with particular reference to types of workplace hazards (physical, chemical, biological, ergonomic, psychosocial).
3. Apply Occupational Diseases and Injuries, with particular reference to common occupational diseases (respiratory illnesses, musculoskeletal disorders, occupational cancers).
4. Analyse and evaluate Health and Safety Regulations; Digital Health in Occupational Safety, and relate these to emerging practice in Occupational Health.

UNIT-I

INTRODUCTION TO OCCUPATIONAL HEALTH

1. Definition, scope, and significance of occupational health
2. Historical evolution of workplace health and safety
3. Impact of workplace conditions on employee well-being and productivity

UNIT-II

WORKPLACE HAZARDS AND RISK ASSESSMENT

1. Types of workplace hazards (physical, chemical, biological, ergonomic, psychosocial)
2. Methods for hazard identification and risk assessment
3. Control measures and risk mitigation strategies

UNIT-III

OCCUPATIONAL DISEASES AND INJURIES

1. Common occupational diseases (respiratory illnesses, musculoskeletal disorders, occupational cancers)
2. Workplace factors contributing to occupational illnesses and injuries
3. Prevention, treatment, and rehabilitation strategies

UNIT-IV

HEALTH AND SAFETY REGULATIONS

1. Overview of national and international occupational health regulations (OSHA, Factories Act, ESIC)
2. Employer and employee responsibilities in ensuring workplace safety
3. Compliance strategies and enforcement mechanisms

UNIT-V

DIGITAL HEALTH IN OCCUPATIONAL SAFETY

1. Role of digital tools (wearables, IoT monitoring) in workplace safety
2. AI and predictive analytics for occupational health surveillance
3. Case studies on the effectiveness of workplace safety technologies

RECOMMENDED TEXT BOOKS

1. Friis, R. H. (2015). Occupational Health and Safety for the 21st Century. Jones & Bartlett Learning.

2. LaDou, J., & Harrison, R. J. (2021). Current Occupational & Environmental Medicine (6th ed.). McGraw-Hill Education.
3. Levy, B. S., Wegman, D. H., Baron, S. L., & Sokas, R. K. (2017). Occupational and Environmental Health. Oxford University Press.
4. Additional Reading Material
5. International Labour Organization (ILO). (2021). Global Strategy on Occupational Safety and Health. <https://www.ilo.org/>
6. National Institute for Occupational Safety and Health (NIOSH). (2022). Occupational Safety and Health Guidelines. <https://www.cdc.gov/niosh/>
7. World Health Organization (WHO). (2018). Protecting Workers' Health: Global Perspectives.
8. OSHA (Occupational Safety and Health Administration). (2021). Occupational Safety Standards and Guidelines. <https://www.osha.gov/>

ENGLISH & COMMUNICATION SKILLS**L/T/P/C**
2/-/-/2**Learning Outcome:**

1. Describe Fundamentals of Communication, with particular reference to definition and importance of communication in healthcare and professional settings.
2. Explain Scientific & Technical Writing in Healthcare, with particular reference to structure and format of scientific documents.
3. Apply Grant & Proposal Writing, with particular reference to basics of proposal writing for research and funding.
4. Analyse and evaluate Communication for Healthcare Professionals; Presentation & Public Speaking Skills, and relate these to emerging practice in English & Communication Skills.

UNIT-I**FUNDAMENTALS OF COMMUNICATION**

1. Definition and importance of communication in healthcare and professional settings
2. Types of communication (verbal, non-verbal, written, digital)
3. Barriers to effective communication and overcoming them

UNIT-II**SCIENTIFIC & TECHNICAL WRITING IN HEALTHCARE**

1. Structure and format of scientific documents
2. Writing research papers, abstracts, and summaries
3. Citation styles and plagiarism prevention

UNIT-III**GRANT & PROPOSAL WRITING**

1. Basics of proposal writing for research and funding
2. Structure of grant proposals and common funding sources
3. Effective writing techniques for securing grants

UNIT-IV**COMMUNICATION FOR HEALTHCARE PROFESSIONALS**

1. Effective patient communication and empathy in healthcare
2. Medical terminology and professional interactions
3. Ethical considerations in communication

UNIT-V**PRESENTATION & PUBLIC SPEAKING SKILLS**

1. Preparing and delivering impactful presentations
2. Body language, tone, and clarity in speech
3. Handling Q&A sessions confidently

RECOMMENDED TEXT BOOKS

1. Bailey, S. (2018). Academic Writing: A Handbook for International Students. Routledge.
2. Alred, G. J., Brusaw, C. T., & Oliu, W. E. (2012). Handbook of Technical Writing. St. Martin's Press.
3. Huckin, T., & Olsen, L. (1991). Technical Writing and Professional Communication. McGraw-Hill.

4. Additional Reading Material
5. Turabian, K. L. (2018). A Manual for Writers of Research Papers, Thesis, and Dissertations. University of Chicago Press.
6. Guffey, M. E., & Loewy, D. (2018). Business Communication: Process and Product. Cengage Learning.
7. Chaturvedi, P. D., & Chaturvedi, M. (2011). Business Communication: Concepts, Cases, and Applications. Pearson Education.

COMPUTER FOUNDATIONL/T/P/C
2/-/-2**Learning Outcome:**

1. Describe Definition of Computer, with particular reference to characteristics of computer, components of computer.
2. Explain Typing text in MS Word, with particular reference to manipulating text, formatting text – using different font sizes, bold, italic, bullets.
3. Apply Creating with MS Excel & MS PowerPoint, with particular reference to ms excel – cell editing, formulas and functions, sorting, drawing graphs and charts.
4. Analyse and evaluate Introduction to Computer Networks; AI & Machine Learning, and relate these to emerging practice in Computer Foundation.

UNIT-I**DEFINITION OF COMPUTER**

1. Characteristics of computer, Components of Computer
2. Hardware – Input & Output devices, Memories – RAM and ROM
3. Software – Application Software and Systems software
4. Data and Information, Different computer languages – Number systems

UNIT-II**TYPING TEXT IN MS WORD**

1. Manipulating text, formatting text – using different font sizes, bold, italic, bullets
2. Aligning text, choosing paper size, adjusting margins, header and footer
3. Inserting page numbers, printing, spell check, find and replace, mail merge, tables

UNIT-III**CREATING WITH MS EXCEL & MS POWERPOINT**

1. MS Excel – Cell editing, formulas and functions, sorting, drawing graphs and charts
2. MS PowerPoint – slide transition, animation, sounds, clip arts, tables, and graphs

UNIT-IV**INTRODUCTION TO COMPUTER NETWORKS**

1. Computer Network Devices (Hubs, Switches, Routers, Gateway, Bridge, Modems, Wireless Access Points, Firewalls & NIC)
2. Types of Computer Networks (LAN, MAN & WAN), Network Topologies
3. Internet-Based Applications, E-Mail components, Search Engines

UNIT-V**AI & MACHINE LEARNING**

1. History of AI, Sub Areas of AI, Applications of AI in Healthcare
2. Benefits and Challenges of AI in Healthcare
3. Introduction to Machine Learning, Algorithms, and Real-world Use Cases

RECOMMENDED TEXT BOOKS

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 – O'Reilly, 2nd Edition.

UNDERSTANDING DATA SOURCES & STRUCTURE

L/T/P/C
2/-/-/2

Learning Outcome:

1. Describe Healthcare Data Sources, with particular reference to types of healthcare data (ehr, claims data, registries, surveys).
2. Explain Data Standards in Healthcare, with particular reference to hl7, fhir, snomed, icd coding systems.
3. Apply Data Cleaning & Processing, with particular reference to data quality assessment (missing data, inconsistencies).
4. Analyse and evaluate Data Privacy & Security, with particular reference to hipaa, gdpr, and other healthcare data regulations.

UNIT-I

HEALTHCARE DATA SOURCES

1. Types of healthcare data (EHR, claims data, registries, surveys)
2. Public health databases and data repositories
3. Data collection methods and challenges

UNIT-II

DATA STANDARDS IN HEALTHCARE

1. HL7, FHIR, SNOMED, ICD coding systems
2. Interoperability and data exchange frameworks
3. Role of standards in digital health ecosystems

UNIT-III

DATA CLEANING & PROCESSING

1. Data quality assessment (missing data, inconsistencies)
2. Normalization and standardization techniques
3. Handling categorical and numerical variables

UNIT-IV

DATA PRIVACY & SECURITY

1. HIPAA, GDPR, and other healthcare data regulations
2. Ethical considerations in data handling
3. Encryption, anonymization, and secure storage practices

RECOMMENDED TEXT BOOKS

1. McDonald, C. J., & Huff, S. M. (2015). Health Data Standards: A Common Language for Data Exchange. Springer.
2. Raghupathi, W., & Raghupathi, V. (2014). Big Data Analytics in Healthcare: Promise and Potential. Health Information Science and Systems.
3. Benson, T., & Grieve, G. (2016). Principles of Health Interoperability: SNOMED CT, HL7, and FHIR. Springer.

LANGUAGES FOR CODING

L/T/P/C
2/-/-/2

Learning Outcome:

1. Describe Introduction to Programming Languages, with particular reference to basics of python: syntax, data types, and control structures.
2. Explain Data Analysis with Python, with particular reference to using pandas for healthcare data processing.
3. Apply Data Visualization in Healthcare, with particular reference to creating charts and graphs using matplotlib and seaborn.
4. Analyse and evaluate Machine Learning for Healthcare; Healthcare Data Integration and Automation, and relate these to emerging practice in Languages for Coding.

UNIT-I

INTRODUCTION TO PROGRAMMING LANGUAGES

1. Basics of Python: syntax, data types, and control structures
2. Importance of Python in healthcare analytics
3. Introduction to Jupyter Notebook and Google Collaboration
4. Handling medical datasets with Python

UNIT-II

DATA ANALYSIS WITH PYTHON

1. Using Pandas for healthcare data processing
2. Data cleaning, filtering and manipulation techniques
3. Applying NumPy for numerical healthcare data analysis
4. Working with real-world health datasets (EHR, Patient records, Clinical Trials)

UNIT-III

DATA VISUALIZATION IN HEALTHCARE

1. Creating charts and graphs using Matplotlib and Seaborn
2. Visualizing health trends, disease spread, and patient outcomes
3. Dashboard creation for healthcare reporting

UNIT-IV

MACHINE LEARNING FOR HEALTHCARE

1. Overview of machine learning in healthcare
2. Applying Scikit-learn for disease prediction
3. Building models for classification and regression
4. Evaluating healthcare ML models using accuracy, precision, recall

UNIT-V

HEALTHCARE DATA INTEGRATION AND AUTOMATION

1. Introduction to healthcare data interoperability
2. Extracting, transforming, and loading (ETL) healthcare data
3. Automating repetitive healthcare workflows using Python
4. Integration of APIs (FHIR, HL7) for health data exchange

RECOMMENDED TEXT BOOKS

1. Gutttag, J. V. (2016). Introduction to Computation and Programming Using Python. MIT Press.
2. McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. O'Reilly Media.
3. VanderPlas, J. (2016). Python Data Science Handbook. O'Reilly Media.
4. Raschka, S., & Mirjalili, V. (2019). Python Machine Learning. Packt Publishing.
5. Additional Reading Material
6. Bailey, M. (2021). Healthcare Analytics with Python. Springer.
7. Chakraborty, C., & Banerjee, A. (2020). Machine Learning Techniques for Healthcare Data Analytics. Springer.
8. Faur, D. (2020). Hands-On Healthcare Data: Analyzing Patient Data with Python and Pandas. Packt Publishing.

INTRODUCTION TO GITHUB

L/T/P/C

1/-/-1

Learning Outcome:

1. Describe Version Control & Git Basics, with particular reference to introduction to git and installation.
2. Explain Branching & Merging, with particular reference to concept of branches and workflows.
3. Apply Working with GitHub, with particular reference to setting up a github repository.
4. Analyse and evaluate GitHub Actions & Automation; Best Practices & Security, and relate these to emerging practice in Introduction to GitHub.

UNIT-I

VERSION CONTROL & GIT BASICS

1. Introduction to Git and installation
2. Git commands: init, add, commit, status, log
3. Importance of version control in software development

UNIT-II

BRANCHING & MERGING

1. Concept of branches and workflows
2. Creating and switching branches
3. Merging strategies and resolving conflicts

UNIT-III

WORKING WITH GITHUB

1. Setting up a GitHub repository
2. Cloning, pushing, pulling, and forking repositories
3. Collaborating with teams using GitHub

UNIT-IV

GITHUB ACTIONS & AUTOMATION

1. Introduction to GitHub Actions
2. Setting up CI/CD pipelines
3. Automating tasks with GitHub workflows

UNIT-V

BEST PRACTICES & SECURITY

1. Writing good commit messages
2. Protecting branches and repository settings
3. Managing repository permissions and security

RECOMMENDED TEXT BOOKS

1. Loeliger, J., & McCullough, M. (2012). Version Control with Git. O'Reilly Media.
2. Chacon, S., & Straub, B. (2019). Pro Git. Apress.
3. Torres, J. (2021). GitHub for Dummies. Wiley.

DIGITAL HEALTH TERMINOLOGY

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Medical Word Building & Clinical Fundamentals, with particular reference to roots, prefixes, suffixes, hospital specialties, and common clinical abbreviations.
2. Explain Body Systems & Disease Terminology, with particular reference to major anatomical systems, common pathological conditions, and diagnostic modalities.
3. Apply Digital Health Systems & Workflow Terms, with particular reference to electronic records (EMR/EHR/PHR), point-of-care tools, and virtual care platforms.
4. Analyse and evaluate Health Data, Analytics & Governance Concepts, and relate these to emerging practice in Digital Health Terminology.

UNIT-I

BASICS OF MEDICAL TERMINOLOGY & HOSPITAL SPECIALTIES

1. Structure of medical terms: Word roots, combining forms, prefixes, and suffixes
2. Common medical abbreviations, clinical acronyms, and chart symbols used in healthcare settings
3. Hospital departments, clinical specialties, and levels of care (primary, secondary, tertiary)
4. Clinical encounter vocabulary: Triage, vital signs, physical examination, admission, and discharge notes

UNIT-II

BODY SYSTEMS, DISEASES & DIAGNOSTIC TERMINOLOGY

1. Essential terminology of major organ systems: Cardiovascular, respiratory, musculoskeletal, nervous, and digestive systems
2. General pathological vocabulary: Acute vs. chronic diseases, signs vs. symptoms, and etiology
3. Diagnostic and imaging modalities: Radiography (X-ray), Ultrasonography (USG), CT, MRI, and endoscopy
4. Core clinical laboratory tests (complete blood count, metabolic panels, cultures) and basic pharmacology terms (routes of administration, generic vs. brand names)

UNIT-III

DIGITAL HEALTH CONCEPTS & CLINICAL SYSTEMS

1. Foundational digital health definitions: eHealth, mHealth, telehealth, and telemedicine
2. Clinical record systems: Electronic Medical Records (EMR), Electronic Health Records (EHR), and Personal Health Records (PHR)
3. Hospital automation systems: Computerized Provider Order Entry (CPOE), Laboratory Information Systems (LIS), and Radiology Information Systems / PACS
4. Clinical decision support vocabulary: Order sets, alerts, clinical reminders, and alert fatigue

UNIT-IV

DIGITAL CARE DELIVERY & PATIENT-FACING TECHNOLOGIES

1. Telemedicine encounter modalities: Synchronous (video/audio) vs. asynchronous (store-and-forward) consultations
2. Remote patient monitoring (RPM), internet-connected biosensors, and digital medical peripherals
3. Patient engagement terms: Patient portals, personal health apps, and digital intake forms
4. Emerging digital care models: Virtual wards, digital therapeutics (DTx), and home-based telecare

UNIT-V

HEALTH DATA, ANALYTICS, PRIVACY & GOVERNANCE

1. Nature of health data: Structured, semi-structured, and unstructured clinical documentation
2. Core health analytics vocabulary: Descriptive indicators, predictive modeling, machine learning, and clinical dashboards
3. High-level data interoperability concepts: Data exchange, interfaces, and health information exchanges (HIE)
4. Privacy, security, and governance terms: Confidentiality, integrity, patient consent, de-identification, and national digital health identifiers (ABHA)

RECOMMENDED TEXT BOOKS

1. Digital Health: A Path to Validation by Homero Rivas and Katarzyna Wac
2. Health Information Management: Concepts, Principles, and Practice by Kathleen M. LaTour and Shirley A. D. Thomas
3. Clinical Informatics: A Practical Approach for Healthcare and Information Technology Professionals by Jon M. N. McCarthy and William L. Hersh
4. Chabner, D. E. – The Language of Medicine, 12th Edition, Elsevier (2020).

PRACTICALS IN CODING & VERSION CONTROL

L/T/P/C
-/-/2/1

Learning Outcome:

1. Write and debug Python scripts for basic health-data handling tasks.
2. Use Git and GitHub for version control of practical assignments.
3. Collaborate on a shared repository using branching and pull requests.

Course Content:

Practical exercises covering: setting up a Python development environment; writing scripts using variables, control structures and functions on sample health datasets; installing and configuring Git; creating a GitHub repository, committing, branching, merging and resolving conflicts; and documenting a small coding project with a README.

RECOMMENDED TEXT BOOKS

1. Practical manuals prepared by the course coordinator.
2. Official Python and Git/GitHub documentation.

I year II semester

S.NO	SUBJECT	L	T	P	C
1	Principles of Epidemiology & Research Methodologies	3	-	-	3
2	Introduction to Biostatistics	2	-	-	2
3	Electronic health records	3	-	-	3
4	Healthcare data standards	2	-	-	2
5	Advanced data analytics (R/ SPSS/ STATA/ SAS)	2	-	-	2
6	Data Visualization & GIS	2	-	-	2
7	Dashboards for Healthcare	1	-	-	1
8	Database Features	1	-	-	1
9	Practicals in Advanced data analytics (R/ SPSS/ STATA/ SAS)	-	-	4	2
10	Practicals in Data Visualization & GIS	-	-	4	2
	TOTAL	16	-	8	20

SEMESTER-II**PRINCIPLES OF EPIDEMIOLOGY & RESEARCH METHODOLOGIES****L/T/P/C**
3/-/-3**Learning Outcome:**

1. Describe Foundations of Epidemiology & Measures of Disease Frequency, with particular reference to morbidity, mortality, and association metrics.
2. Explain Epidemiological Study Designs, with particular reference to observational and experimental methodologies and control of biases.
3. Apply Infectious Disease Epidemiology & Outbreak Investigation, with particular reference to surveillance systems and disease transmission dynamics.
4. Analyse and evaluate Research Design, Sampling, Bioethics & Scientific Dissemination, and relate these to emerging practice in Principles of Epidemiology & Research Methodologies.

UNIT-I**FOUNDATIONS OF EPIDEMIOLOGY & MEASURES OF DISEASE FREQUENCY**

1. Definition, historical perspective, scope, and core functions of epidemiology
2. Natural history of disease, iceberg phenomenon, and agent-host-environment triad
3. Measures of morbidity and mortality: Incidence rate, cumulative incidence, point and period prevalence
4. Association and impact metrics: Risk Ratio (RR), Odds Ratio (OR), Attributable Risk (AR), and Number Needed to Treat (NNT)

UNIT-II**EPIDEMIOLOGICAL STUDY DESIGNS**

1. Descriptive and observational studies: Case reports, case series, cross-sectional surveys, and ecological studies
2. Analytical studies: Case-control design (matching, selection of cases/controls) and cohort studies (prospective vs. retrospective)
3. Experimental studies: Randomized Controlled Trials (RCTs), blinding, allocation concealment, crossover, and field trials
4. Methodological errors: Random error, systematic bias (selection, information/recall), and confounding control (stratification, matching)

UNIT-III**INFECTIOUS DISEASE EPIDEMIOLOGY & SURVEILLANCE**

1. Dynamics of disease transmission: Reservoirs, vectors, modes of transmission, incubation period, and herd immunity
2. Outbreak investigation: Case definition, active case finding, epidemic curves, and contact tracing
3. Public health surveillance systems: Active, passive, sentinel, and syndromic surveillance
4. Role of digital disease detection and automated reporting in outbreak containment

UNIT-IV**RESEARCH FORMULATION, SAMPLING & STUDY CONDUCT**

1. Research question formulation: FINER criteria, PICOT framework, and hypothesis generation
2. Sampling methodologies: Probability (simple random, stratified, cluster) and non-probability sampling

3. Sample size estimation principles, statistical power, and margin of error
4. Instrument development: Questionnaire design, validation, reliability testing, and survey administration

UNIT-V

BIOETHICS, REGULATORY FRAMEWORKS & SCIENTIFIC DISSEMINATION

1. Ethical foundations: Belmont Report, Declaration of Helsinki, and ICMR ethical guidelines
2. Institutional Review Boards (IRB) / Ethics Committees: Protocols, review processes, and patient autonomy
3. Reporting guidelines: STROBE, CONSORT, and PRISMA statements
4. Scientific writing, peer review mechanics, and translating epidemiological findings into health policy

RECOMMENDED TEXT BOOKS

1. Epidemiology – Leon Gordis (Elsevier Saunders, 2014)
2. Modern Epidemiology – Kenneth J. Rothman, Sander Greenland, Timothy L. Lash (Lippincott Williams & Wilkins, 2008)
3. Designing Clinical Research – Stephen B. Hulley, Steven R. Cummings, Warren S. Browner, Deborah G. Grady, Thomas B. Newman (LWW, 2013)
4. Basic Epidemiology – R. Bonita, R. Beaglehole, T. Kjellström (World Health Organization, 2006)
5. Principles of Epidemiology in Public Health Practice – CDC (U.S. Department of Health and Human Services, 2012)

INTRODUCTION TO BIOSTATISTICS

L/T/P/C
2/-/-2

Learning Outcome:

1. Explain the fundamental concepts of Introduction to Biostatistics, with particular reference to types of data, central tendency, and measures of variability.
2. Apply the principles of Probability and Distributions, with particular reference to normal and binomial distributions in health data interpretation.
3. Analyse and evaluate Hypothesis Testing and Confidence Intervals, with particular reference to t-tests, chi-square tests, and statistical significance estimation.
4. Design and develop solutions using Correlation and Regression Analysis; Epidemiology and Survival Analysis, and relate these to emerging practice in Biostatistics.

UNIT-I

INTRODUCTION TO BIOSTATISTICS

1. Foundation in basic statistical concepts
2. Types of data (categorical, numerical, discrete, continuous)
3. Measures of central tendency: Mean, median, mode
4. Measures of variability: Range, variance, standard deviation
5. Data presentation and exploratory summaries for health metrics

UNIT-II

PROBABILITY AND DISTRIBUTIONS

1. Introduction to probability theory and basic axioms
2. Conditional probability and rules of addition and multiplication
3. Essential discrete statistical distributions: Binomial and Poisson distributions
4. Continuous distributions: Normal distribution and standard normal curve
5. Applications of statistical distributions in health data interpretation

UNIT-III

HYPOTHESIS TESTING AND CONFIDENCE INTERVALS

1. Formulation of research hypotheses: Null and alternative hypotheses
2. Significance levels (α), p-values, and statistical power
3. Point estimates and confidence interval calculations
4. Parametric hypothesis testing: One-sample, two-sample, and paired Student's t-tests
5. Non-parametric and categorical testing: Chi-square (χ^2) test of independence

UNIT-IV

CORRELATION AND REGRESSION ANALYSIS

1. Analyzing relationships between variables: Correlation vs. causation
2. Pearson product-moment correlation and Spearman rank correlation
3. Simple linear regression: Model formulation, slope, intercept, and interpretation
4. Introduction to multivariable regression and prediction models in health outcomes
5. Coefficient of determination (R^2) and goodness-of-fit assessment

UNIT-V

EPIDEMIOLOGY AND SURVIVAL ANALYSIS

1. Key techniques in epidemiology: Incidence, prevalence, and risk association metrics
2. Overview of follow-up cohorts and time-to-event health data
3. Introduction to survival analysis methods and censoring concepts
4. Kaplan-Meier survival curves and estimation
5. Log-rank test to study patient outcomes and disease progression over time

RECOMMENDED TEXT BOOKS

1. Wayne W. Daniel, Chad L. Cross – Biostatistics: A Foundation for Analysis in the Health Sciences, 11th Edition, Wiley (2018).
2. Bernard Rosner – Fundamentals of Biostatistics, 8th Edition, Cengage Learning (2015).
3. Leon Gordis – Epidemiology, 5th Edition, Elsevier Saunders (2014).
4. David Bowers – Medical Statistics from Scratch: An Introduction for Health Professionals, 4th Edition, Wiley (2019).
5. Relevant peer-reviewed journal articles, standard textbooks prescribed by the Board of Studies, and open-access health datasets.

ELECTRONIC HEALTH RECORDS

L/T/P/C
3/-/-3

Learning Outcome:

1. Describe Foundations & Architecture of EHR Systems, with particular reference to clinical documentation, legal health records, and transition strategies.
2. Explain Clinical Workflows, CPOE & Decision Support Integration, with particular reference to closed-loop medication management and order sets.
3. Apply Technical Infrastructure, Data Storage & Cloud Deployment, with particular reference to client-server vs. cloud EHR architectures and database models.
4. Analyse and evaluate EHR Implementation Lifecycles, Usability, Governance & Regulations, and relate these to emerging practice in Electronic Health Records.

UNIT-I

FOUNDATIONS & ARCHITECTURE OF EHR SYSTEMS

1. Definition, evolution, and core components of Electronic Medical Records (EMR) vs. Electronic Health Records (EHR)
2. Legal medical records, hybrid record environments, and paper-to-digital migration
3. EHR functional models: Core clinical modules (demographics, problem lists, clinical notes, charting)
4. Patient engagement mechanisms: Patient portals and Personal Health Records (PHR)

UNIT-II

CLINICAL WORKFLOWS & ORDER ENTRY SYSTEMS

1. Clinical workflow analysis, process mapping, and bottleneck identification
2. Computerized Provider Order Entry (CPOE): Clinical orders, order sets, and closed-loop medication administration (e-prescribing)
3. Integration of diagnostic services: Laboratory Information Systems (LIS) and Radiology Information Systems (RIS)
4. Basic Clinical Decision Support (CDS) alerts, reminders, and order validation logic

UNIT-III

INFRASTRUCTURE, DATABASES & SYSTEM INTEROPERABILITY

1. Hardware and system topologies: On-premises, client-server, and cloud-hosted EHR deployments.
2. Data schemas and backend structures: Relational vs. document-store database setups in EHRs.
3. Role of interoperability in EHR: Connecting internal hospital systems and external registries.
4. Health data backup, archiving, disaster recovery, and high availability architectures

UNIT-IV

IMPLEMENTATION LIFECYCLE, USABILITY & GOVERNANCE

1. System selection, Request for Proposal (RFP), and EHR vendor evaluation Change management, clinician burnout mitigation, end-user training, and adoption frameworks.
2. Usability principles, user interface assessment, and cognitive load reduction in charting Regulatory compliance: ABDM guidelines, HIPAA security rules, audit trails, and data confidentiality

RECOMMENDED TEXT BOOKS

1. Electronic Health Records: Understanding and Using Computerized Medical Records – Richard Garte (Pearson, 2016)

2. Health Informatics: Practical Guide – William R. Hersh (Lulu.com, 2021)
3. Biomedical Informatics: Computer Applications in Health Care and Biomedicine – Edward H. Shortliffe, James J. Cimino (Springer, 2021)
4. Clinical Informatics Study Guide: Text and Review – John T. Finnell, Brian E. Dixon (Springer, 2022)
5. Electronic Health Record: A Systems Approach – Jerome H. Carter (American College of Physicians, 2008)

HEALTHCARE DATA STANDARDSL/T/P/C
2/-/-/2**Learning Outcome:**

1. Describe Principles of Health Interoperability & Standardization Entities, with particular reference to information governance, health information exchange (HIE) models, and standards development organizations.
2. Explain Clinical Terminologies & Classification Schemes, with particular reference to SNOMED CT concept models, implementation approaches, and cross-system mappings.
3. Apply Messaging Standards, Interchange Formats & HL7 FHIR, with particular reference to HL7 v2/v3, CDA, and RESTful FHIR resources.
4. Analyse and evaluate Standards Integration, Data Harmonization & Interoperability Profiles, and relate these to emerging practice in Healthcare Data Standards.

UNIT-I**PRINCIPLES OF HEALTH INTEROPERABILITY & GOVERNANCE**

1. The health information revolution and the imperative for health data exchange
2. Understanding the challenges of healthcare interoperability (technical, semantic, organizational)
3. Role of standards in achieving seamless data exchange; Health Information Exchange (HIE) architectures and federated models
4. Foundational modeling and representation tools: UML, BPMN, XML, and JSON structures
5. Health information governance frameworks and the role of Standards Development Organizations (SDOs: ISO/TC 215, HL7 International, SNOMED International)

UNIT-II**CLINICAL TERMINOLOGIES & SNOMED CT**

1. Need for controlled clinical vocabularies, coding schemes, and classifications (ICD, LOINC)
2. SNOMED CT architecture: Concept identifiers, descriptions, relationship types, and concept models
3. Post-coordination and compositional grammar; creating and binding terminology reference sets (Refsets)
4. Implementing terminologies: Concept mapping, terminology server deployment, and clinical validation

UNIT-III**HL7 MESSAGING & CLINICAL DOCUMENT INTERCHANGE FORMATS**

1. Evolution of HL7 messaging: HL7 Version 2.x structure, trigger events, segments, fields, and delimiter syntax
2. The HL7 Version 3 Reference Information Model (RIM) and constrained information models
3. Clinical Document Architecture (CDA) and Continuity of Care Document (CCD): XML headers, narrative blocks, and coded entries
4. HL7 dynamic workflow models; document sharing paradigms and Integrating the Healthcare Enterprise (IHE) Cross-Enterprise Document Sharing (XDS)

UNIT-IV**FAST HEALTHCARE INTEROPERABILITY RESOURCES (HL7 FHIR)**

1. Core principles and design philosophy of FHIR; comparing FHIR with legacy HL7 formats
2. FHIR RESTful API: Endpoints, HTTP methods (CRUD), search parameters, and bundle transactions

3. Core FHIR clinical and administrative resources (Patient, Encounter, Observation, Condition, DiagnosticReport)
4. Conformance and Terminology Services: ValueSets, CodeSystems, ConceptMaps, and StructureDefinitions
5. Implementing and profiling FHIR: Implementation Guides (IGs) and adaptation within national digital health ecosystems (such as ABDM)

UNIT-V

INTEGRATION, HARMONIZATION & INTEROPERABILITY PROFILES

1. Rationale for multi-standard data integration and semantic harmonization in healthcare systems
2. Interoperable technologies supporting health workforces and primary care networks
3. IHE Integration Profiles for clinical workflow automation and cross-facility communication
4. Device interoperability: Continua Design Guidelines (CDG) and Personal Connected Health Alliance (PCHA) frameworks
5. Harmonizing connected medical devices, IoT peripherals, and enterprise hospital services

RECOMMENDED TEXT BOOKS

1. Principles of Health Interoperability: SNOMED CT, HL7 and FHIR – Tim Benson, Grahame Grieve (Springer, 2016)
2. Health Data Standards: A Common Language for Data Exchange – Clement J. McDonald, Stanley M. Huff (Springer, 2015)
3. FHIR in Action – Dan Davis (Manning Publications, 2023)
4. Connecting Medical Informatics and Bio-Informatics – Rolf Engelbrecht et al. (IOS Press, 2005)
5. Official Technical Specifications: HL7 FHIR (hl7.org/fhir), SNOMED CT Starter Guide (snomed.org), and IHE Technical Frameworks (ihe.net)

ADVANCED DATA ANALYTICS (R/ SPSS/ STATA/ SAS)**L/T/P/C**
3/-/-3**Learning Outcome:**

1. Describe Introduction to Data Analytics in Healthcare, with particular reference to role of analytics in healthcare.
2. Explain Overview of R, SPSS, STATA, and SAS, with particular reference to introduction to software environments.
3. Apply Data Importing, Cleaning & Transformation, with particular reference to handling structured and unstructured data.
4. Analyse and evaluate Exploratory Data Analysis (EDA); Statistical Analysis & Regression Models, and relate these to emerging practice in Advanced Data Analytics (R/ SPSS/ STATA/ SAS).

UNIT-I**INTRODUCTION TO DATA ANALYTICS IN HEALTHCARE**

1. Role of analytics in healthcare
2. Big data and digital health
3. Ethical considerations in health data analysis

UNIT-II**OVERVIEW OF R, SPSS, STATA, AND SAS**

1. Introduction to software environments
2. Interface and functionalities
3. Choosing the right tool for specific analyses

UNIT-III**DATA IMPORTING, CLEANING & TRANSFORMATION**

1. Handling structured and unstructured data
2. Missing value imputation
3. Outlier detection and Data normalization

UNIT-IV**EXPLORATORY DATA ANALYSIS (EDA)**

1. Descriptive statistics
2. Data visualization techniques
3. Identifying trends and anomalies in healthcare data

UNIT-V**STATISTICAL ANALYSIS & REGRESSION MODELS**

1. Hypothesis testing (T-tests, ANOVA, Chi-square)
2. Regression models (Linear, Logistic, Cox regression)
3. Time series analysis for patient data trends

RECOMMENDED TEXT BOOKS

1. Data Analysis Using Regression and Multilevel/Hierarchical Models – Andrew Gelman, Jennifer Hill (Cambridge University Press, 2006)
2. Discovering Statistics Using IBM SPSS Statistics – Andy Field (SAGE Publications, 2017)

3. A Handbook of Statistical Analyses Using Stata – Brian S. Everitt, Sophia Rabe-Hesketh (Chapman and Hall/CRC, 2014)
4. SAS Essentials: Mastering SAS for Data Analytics – Alan C. Elliott, Wayne A. Woodward (Wiley, 2019)
5. The R Book – Michael J. Crawley (Wiley, 2012)

DATA VISUALIZATION & GISL/T/P/C
2/-/-2**Learning Outcome:**

1. Describe Foundations of Data Visualization, with particular reference to visual encoding, chart selection, and perception principles.
2. Explain Spatial Epidemiology & GIS Fundamentals, with particular reference to coordinate systems, vector/raster data models, and disease mapping.
3. Apply Spatial Analysis Methods in Public Health, with particular reference to disease clustering, buffer analysis, and accessibility mapping.
4. Analyse and evaluate Advanced Visualization Libraries, Web-GIS & Interactive Storytelling, and relate these to emerging practice in Data Visualization & GIS.

UNIT-I**FOUNDATIONS & PRINCIPLES OF DATA VISUALIZATION**

1. Visual perception, human cognitive factors, and Gestalt principles in health communication
2. Encoding data: Position, length, angle, area, color palettes, and color blindness considerations
3. Selecting chart types: Trends (line charts), distributions (histograms, violins), proportions (treemaps, stacked bars), and relationships (scatter plots)
4. Avoiding visual bias and chart junk; integrity metrics in clinical and public health reporting

UNIT-II**GEOGRAPHIC INFORMATION SYSTEMS (GIS) & SPATIAL DATA MODELS**

1. Introduction to spatial thinking and GIS in public health and epidemiological surveillance
2. Spatial data formats: Vector models (points, lines, polygons, shapefiles, GeoJSON) and raster models (satellite, heatmaps)
3. Geographic and projected coordinate reference systems (CRS), map projections, and datum transformations
4. Geocoding clinical addresses, patient encounters, and health facility coordinates

UNIT-III**SPATIAL ANALYSIS & DISEASE MAPPING**

1. Thematic mapping: Choropleth maps, proportional symbol maps, and dot density maps
2. Spatial epidemiology methods: Disease rate smoothing, standardized incidence/mortality ratios (SIR/SMR)
3. Spatial clustering and hot-spot detection: Moran's I, Getis-Ord, and kernel density estimation
4. Healthcare accessibility modeling: Buffer zones, network service areas, and travel-time to care facilities

UNIT-IV**INTERACTIVE WEB-GIS & HEALTH STORYTELLING**

1. Visualization software and toolkits: QGIS, ArcGIS Online, ggplot2, and Seaborn
2. Web mapping frameworks: Leaflet, OpenLayers, and Mapbox for real-time spatial dashboards
3. Building interactive health storytelling narratives and situational outbreak response maps
4. Privacy preserving geocoding: Geomasking, spatial aggregation, and HIPAA compliance for location data

RECOMMENDED TEXT BOOKS

1. GIS and Public Health – Ellen K. Cromley, Sara L. McLafferty (Guilford Press, 2012)
2. Spatial Analysis in Epidemiology – Dirk U. Pfeiffer et al. (Oxford University Press, 2008)
3. Fundamentals of Data Visualization – Claus O. Wilke (O'Reilly Media, 2019)
4. The Visual Display of Quantitative Information – Edward R. Tufte (Graphics Press, 2001)
5. Geospatial Health Data: Modeling and Visualization with R-INLA and Shiny – Paula Moraga (Chapman and Hall/CRC, 2019)

DASHBOARDS FOR HEALTHCARE

L/T/P/C

1/-/1

Learning Outcome:

1. Describe Dashboard Design Principles & Healthcare KPIs, with particular reference to clinical, financial, and operational indicators.
2. Explain Data Modeling & Interactivity for Health Dashboards, with particular reference to star schemas, DAX expressions, and drill-down analytics.
3. Apply Enterprise Dashboard Tools (Power BI / Tableau), with particular reference to dashboard authoring, data refreshes, and governance.
4. Analyse and evaluate Deployment, Usability Testing & Automated Reporting, and relate these to emerging practice in Dashboards for Healthcare.

UNIT-I**DASHBOARD FUNDAMENTALS & HEALTHCARE KEY PERFORMANCE INDICATORS (KPIs)**

1. Role of executive and operational dashboards in healthcare leadership and clinical departments
2. Defining healthcare KPIs: Average length of stay (ALOS), bed occupancy rates, readmission rates, emergency wait times, infection rates, and billing metrics User-centered dashboard layout: Information hierarchy, visual rhythm, and cognitive clutter reduction

UNIT-II**HEALTHCARE DATA MODELING & ANALYTICAL CALCULATIONS**

1. Data modeling for business intelligence: Star and snowflake schemas in healthcare data marts
2. Data transformation and pipeline configuration (Power Query, calculated fields) Writing analytical expressions and metrics: DAX in Power BI or calculated fields/LOD expressions in Tableau
3. Implementing interactive navigation: Cross-filtering, drill-through paths, dynamic parameters, and slicers

UNIT-III**DESIGN, DEPLOYMENT & GOVERNANCE IN CLINICAL SETTINGS**

1. Designing specialized healthcare dashboards: Hospital operations command centers, clinical quality scorecards, and public health tracking panels
2. Responsive design considerations: Mobile, tablet, and executive display formats
3. Access control, role-based row-level security (RLS) for protected health information (PHI) Scheduled data refreshes, alert triggers, automated reporting workflows, and usability validation

RECOMMENDED TEXT BOOKS

1. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring – Stephen Few (Analytics Press, 2013)
2. Mastering Power BI – Brett Powell (Packt Publishing, 2021)
3. Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software – Daniel G. Murray (Wiley, 2016)
4. Key Performance Indicators in Healthcare – Peter Bauer (Healthcare Executive Guides, 2018)
5. Healthcare Business Intelligence, Second Edition: A Guide to Empowering Successful Data Reporting and Analytics – Laura B. Madsen (Wiley, 2015)

DATABASE FEATURES

L/T/P/C

1/-/-1

Learning Outcome:

1. Describe Database Fundamentals (SQL & NoSQL), with particular reference to sql (postgresql, mysql) vs. nosql (mongodb, firebase).
2. Explain Healthcare Data Models & EMR Integration, with particular reference to electronic medical record (emr) database design.
3. Apply Query Optimization & Indexing, with particular reference to indexing strategies for large medical datasets.
4. Analyse and evaluate Cloud Databases (AWS, Google Cloud, Azure); Security & Privacy in Health Data Management, and relate these to emerging practice in Database Features.

UNIT-I

DATABASE FUNDAMENTALS (SQL & NOSQL)

1. SQL (PostgreSQL, MySQL) vs. NoSQL (MongoDB, Firebase)
2. Relational vs. non-relational databases
3. Choosing the right database for healthcare applications

UNIT-II

HEALTHCARE DATA MODELS & EMR INTEGRATION

1. Electronic Medical Record (EMR) database design
2. Normalization and de-normalization in healthcare
3. FHIR and HL7 data exchange standards

UNIT-III

QUERY OPTIMIZATION & INDEXING

1. Indexing strategies for large medical datasets
2. SQL query optimization techniques
3. Joins, Views, and Stored Procedures for health data analysis

UNIT-IV

CLOUD DATABASES (AWS, GOOGLE CLOUD, AZURE)

1. Introduction to cloud-based database solutions
2. AWS RDS, Google Firebase, Microsoft Azure SQL

UNIT-V

SECURITY & PRIVACY IN HEALTH DATA MANAGEMENT

1. Data encryption at rest and in transit
2. Access control and user authentication in databases
3. Regulatory compliance (HIPAA, GDPR) in database management

RECOMMENDED TEXT BOOKS

1. Elmasri, R., & Navathe, S. (2017). Fundamentals of Database Systems (7th Ed.). Pearson.
2. Kumar, V. (2018). Big Data Analytics and Machine Learning in Healthcare. Springer.
3. Redmond, E. (2017). Introduction to NoSQL Databases. O'Reilly Media.
4. Ritchie, B. (2021). SQL for Data Analytics (2nd Ed.). Packt Publishing.

5. Gates, R. (2020). Cloud Databases: Deploying Scalable Data Storage Solutions. Wiley.

PRACTICALS IN ADVANCED DATA ANALYTICS**L/T/P/C**
-/-/4/2**Learning Outcome:**

1. Import, clean and transform health datasets in R/SPSS/STATA/SAS.
2. Conduct exploratory data analysis and hypothesis tests on clinical/operational data.
3. Build and interpret regression models for a health-analytics use-case.

Course Content:

Practical exercises covering: data import and cleaning in R/SPSS; descriptive statistics and exploratory data analysis; hypothesis testing (t-test, ANOVA, chi-square); simple and multiple regression on a sample clinical/operational dataset; and preparation of a short analytical report.

RECOMMENDED TEXT BOOKS

1. Practical manuals prepared by the course coordinator; datasets from public health-data repositories.
2. Software documentation: R/RStudio, IBM SPSS, STATA.

PRACTICALS IN DATA VISUALIZATION AND GIS**L/T/P/C**
-/-/4/2**Learning Outcome:**

1. Prepare and clean tabular and spatial datasets for visual analysis.
2. Construct thematic, choropleth, and spatial buffer maps for epidemiological scenarios using GIS tools.
3. Design interactive analytical healthcare dashboards to communicate epidemiological and operational metrics.

Course Content:

This lab curriculum delivers hands-on training in healthcare data analytics, spatial epidemiology, and business intelligence. Students advance from crafting statistical charts in Python or R to performing GIS-based disease mapping, facility buffering, and hot-spot analysis in QGIS. The sequence finishes in Power BI or Tableau, where learners build relational data models, compute custom clinical KPIs with DAX, and publish interactive, multi-tab hospital operations and surveillance dashboards.

RECOMMENDED TEXT BOOKS

1. QGIS Training Manual – QGIS Project Documentation (Open Source Geospatial Foundation).
2. Practical manuals prepared by the course coordinator; spatial and demographic open datasets.
3. Dashboard authoring guides: Microsoft Power BI and Tableau official resources.

II year III semester

S.NO	SUBJECT	L	T	P	C
1	Telemedicine	3	-	-	3
2	Developing Health Informatics systems: Software, Hardware, Network & Sensors	3	-	-	3
3	Clinical Decision Support Systems	2	-	-	2
4	Patient Monitoring Systems	2	-	-	2
5	Consumers Health Informatics	2	-	-	2
6	Health Finance and Insurance	2	-	-	2
7	Cybersecurity for Health	2	-	-	2
8	Biometrics for Health Systems	2	-	-	2
9	Ethics in Health Informatics	2	-	-	2
	TOTAL	20	-	-	20

SEMESTER-III**TELEMEDICINE****L/T/P/C**
3/-/-/3**Learning Outcome:**

1. Describe Introduction to Telemedicine, with particular reference to definition & history.
2. Explain Technologies in Telemedicine, with particular reference to communication networks and services.
3. Apply Wireless Telemedicine System Deployment, with particular reference to planning and deployment considerations.
4. Analyse and evaluate Wireless Technologies in Patient Monitoring; Technologies in medical information processing; Telemedicine's Impact on Health Care Delivery; Regulations & Compliance – Guidelines for electronic flow of health information and records; Future Trends in Telemedicine, and relate these to emerging practice in Telemedicine.

UNIT-I**INTRODUCTION TO TELEMEDICINE**

1. Definition & History
2. Understanding the role of telehealth
3. Benefits & Limitations

UNIT-II**TECHNOLOGIES IN TELEMEDICINE**

1. Communication Networks and Services
2. Wireless networks
3. Outdoor operating environment

UNIT-III**WIRELESS TELEMEDICINE SYSTEM DEPLOYMENT**

1. Planning and deployment considerations
2. Scalability to support future growth
3. Integration with existing IT infrastructure
4. Evaluating IT service and solution provider, Quality measurement

UNIT-IV**WIRELESS TECHNOLOGIES IN PATIENT MONITORING**

1. Body area networks
2. Emergency and disaster monitoring
3. In-hospital monitoring

UNIT-V**TECHNOLOGIES IN MEDICAL INFORMATION PROCESSING**

1. Collecting data from patients
2. Bio signal transmission and processing
3. Decision support systems

UNIT-VI

TELEMEDICINE'S IMPACT ON HEALTH CARE DELIVERY

1. Cost of Care, Quality of Care, Access to care
2. Relationship with health care providers
3. Market for telehealth services

UNIT-VII

REGULATIONS & COMPLIANCE – GUIDELINES FOR ELECTRONIC FLOW OF HEALTH INFORMATION AND RECORDS

1. Licensing & reimbursement policies
2. Data security & HIPAA compliance

UNIT-VIII

FUTURE TRENDS IN TELEMEDICINE

1. AI & machine learning in telehealth
2. 5G & IoT integration

RECOMMENDED TEXT BOOKS

1. Telemedicine: Technology and Applications – R.S. Khandpur, PHI Learning (2017)
2. Telemedicine Technologies: Information Technologies in Medicine and Telehealth – Hemanth D. Jude, Elsevier (2019)
3. Understanding Telehealth – Karen Schuller Rheuban, Elizabeth Krupinski, McGraw Hill (2017)
4. Digital Health: Scaling Healthcare to the World – Homero Rivas, Katarzyna Wac, Springer (2018)
5. Telemedicine and E-Health Law – L. Camille Hebert, Bloomberg Law (2020)

DEVELOPING HEALTH INFORMATICS SYSTEMS: SOFTWARE, HARDWARE, NETWORK & SENSORS

L/T/P/C
3/-/-3

Learning Outcome:

1. Describe System Development Lifecycles for Health Informatics, with particular reference to clinical requirement gathering and system design models.
2. Explain Hardware Architectures & Medical Sensor Interfacing, with particular reference to biosignal acquisition and microcontroller interfaces.
3. Apply Healthcare Network Topologies & Wireless Communication, with particular reference to LAN/WAN design and body area networks.
4. Analyse and evaluate System Testing, Integration & Interoperability Standards, and relate these to emerging practice in Developing Health Informatics Systems.

UNIT-I

HEALTH SOFTWARE ENGINEERING & LIFECYCLE MODELS

1. Health information systems lifecycle: Waterfall, Agile, and iterative approaches
2. Clinical requirements analysis, stakeholder mapping, and workflow diagrams
3. Architectural design: Monolithic, client-server, microservices, and cloud-native health apps
4. Database design for clinical systems: Relational structures and FHIR data repositories

UNIT-II

HARDWARE ARCHITECTURE & COMPUTING PLATFORMS

1. Computing infrastructure in healthcare: Clinical workstations, point-of-care tablets, and medical-grade servers
2. Embedded systems: Microcontrollers (Arduino, ESP32, Raspberry Pi) in health devices
3. Power supply management, battery considerations, and hardware reliability in clinical environments
4. Storage solutions: Storage Area Networks (SAN), Network Attached Storage (NAS), and cloud backup

UNIT-III

BIOMEDICAL SENSORS & BIOSIGNAL ACQUISITION

1. Introduction to physiological sensors: Temperature, pulse oximetry (), ECG, blood pressure, and glucose sensors
2. Signal transduction, analog-to-digital conversion (ADC), and noise filtering
3. Interfacing sensors with computing units using I2C, SPI, and UART protocols
4. Calibration, sensor accuracy, and safety isolation for patient contact

UNIT-IV

HEALTHCARE NETWORKING & WIRELESS PROTOCOLS

1. Hospital local area networks (LAN), VLAN segmentation for medical devices, and enterprise Wi-Fi
2. Wireless Body Area Networks (WBAN): IEEE 802.15.6 standard
3. Short-range communication: Bluetooth Low Energy (BLE), Zigbee, and NFC
4. Long-range communication protocols: Cellular networks (4G/5G) and LoRaWAN for public health tracking

UNIT-V

INTEGRATION, VERIFICATION & DEPLOYMENT

1. Interface engines and middleware in hospital IT ecosystems
2. Testing strategies: Unit, integration, user acceptance testing (UAT), and clinical simulation testing
3. Ensuring system safety, fail-safe mechanisms, and high availability (HA)
4. Deployment, user training, and maintenance of health informatics systems

RECOMMENDED TEXT BOOKS

1. Health Informatics: Practical Guide – William R. Hersh (Lulu.com, 2021)
2. Biomedical Informatics: Computer Applications in Health Care and Biomedicine – Edward H. Shortliffe, James J. Cimino (Springer, 2021)
3. Medical Instrumentation: Application and Design – John G. Webster (Wiley, 2020)
4. Computer Networks – Andrew S. Tanenbaum, David J. Wetherall (Pearson, 2013)

CLINICAL DECISION SUPPORT SYSTEMSL/T/P/C
2/-/-2**Learning Outcome:**

1. Describe Foundations & Architecture of CDSS, with particular reference to knowledge bases, inference engines, and taxonomy of decision tools.
2. Explain Knowledge Representation & Rule-Based Systems, with particular reference to clinical practice guidelines, if-then logic, and decision tables.
3. Apply Machine Learning & AI-Driven Clinical Decision Support, with particular reference to diagnostic prediction models and risk stratification.
4. Analyse and evaluate Usability, Alert Fatigue & Regulatory Governance, and relate these to emerging practice in Clinical Decision Support Systems.

UNIT-I**INTRODUCTION TO CLINICAL DECISION SUPPORT SYSTEMS**

1. Definition, historical development (MYCIN, DXplain), and objectives of CDSS
2. Taxonomy of CDSS: Knowledge-based vs. non-knowledge-based systems; active vs. passive alerts
3. Components of a CDSS: Knowledge base, inference mechanism, and user communication interface
4. Impact on healthcare quality: Enhancing patient safety, adhering to guidelines, and reducing errors

UNIT-II**KNOWLEDGE-BASED CDSS & CLINICAL WORKFLOWS**

1. Methods of knowledge acquisition and knowledge representation
2. Rule-based systems: Production rules (If-Then logic), decision tables, and Arden Syntax
3. Order checking: Drug-drug interactions, drug-allergy contraindications, and dose calculations
4. Clinical reminders and preventive care alerts integrated within EHR workflows

UNIT-III**AI & MACHINE LEARNING IN CDSS**

1. Transition from rule-based systems to data-driven and predictive CDSS
2. Bayesian belief networks and probability models in medical diagnosis
3. Machine learning models for readmission prediction, sepsis early warning, and risk score generation
4. Explainable AI (XAI) in medicine: Importance of interpretability for clinician trust

UNIT-IV**HUMAN FACTORS, IMPLEMENTATION & GOVERNANCE**

1. Human-computer interaction: Displaying recommendations effectively without interrupting workflow
2. The problem of alert fatigue: Causes, consequences, and optimization strategies (alert tiering)
3. Evaluation of CDSS: Measuring clinical utility, adoption rates, and patient outcome improvements
4. Regulatory frameworks, software as a medical device (SaMD) classifications, and ethical considerations

RECOMMENDED TEXT BOOKS

1. Clinical Decision Support Systems: Theory and Practice – Eta S. Berner (Springer, 2016)
2. Biomedical Informatics: Computer Applications in Health Care and Biomedicine – Edward H. Shortliffe, James J. Cimino (Springer, 2021)

3. Health Informatics: Practical Guide – William R. Hersh (Lulu.com, 2021)
4. Machine Learning for Healthcare Analytics – Pethuru Raj et al. (CRC Press, 2021)

PATIENT MONITORING SYSTEMS

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Principles of Bedside & Ambulatory Monitoring, with particular reference to vital sign measurement and clinical indications.
2. Explain Signal Processing & Alarm Management, with particular reference to threshold detection, false alarms, and alarm safety protocols.
3. Apply Remote & Wearable Monitoring Systems, with particular reference to continuous monitoring devices, smart sensors, and home healthcare.
4. Analyse and evaluate Data Integration, Interoperability & Device Safety, and relate these to emerging practice in Patient Monitoring Systems.

UNIT-I

FUNDAMENTALS OF PATIENT MONITORING

1. Overview, purpose, and classification of patient monitoring systems (bedside, transport, ambulatory)
2. Physiological parameters: Electrocardiography (ECG), non-invasive and invasive blood pressure (NIBP/IBP), pulse oximetry (), respiration rate, and temperature
3. Multi-parameter monitors: Architecture, display modules, and operational modes in ICU/OT environments

UNIT-II

ALARM SYSTEMS & SIGNAL ANALYSIS

1. Alarm classification: High, medium, and low-priority clinical alerts
2. Alarm generation algorithms: Threshold limits, trend analysis, and pattern recognition
3. The challenge of false positive alarms, sensory overload, and clinical alarm fatigue
4. Mitigation strategies: Smart alarms, delay filters, and customizable parameter limits

UNIT-III

REMOTE PATIENT MONITORING (RPM) & WEARABLE TECHNOLOGIES

1. Home and post-discharge monitoring setups for chronic diseases (hypertension, diabetes, heart failure)
2. Wearable medical devices: Smartwatches, chest patches, continuous glucose monitors (CGM), and digital pulse oximeters
3. Data synchronization between wearables, mobile health applications, and central monitoring stations

UNIT-IV

CENTRAL STATIONS, SYSTEM INTEGRATION & SAFETY STANDARDS

1. Central nursing stations: Telemetry architectures, multi-bed overviews, and retrospective event reviews
2. Integration standards: IEEE 11073 (Health informatics - Point-of-care medical device communication)
3. Transmitting monitoring data into Hospital Information Systems (HIS) and EHRs
4. Electrical safety, patient isolation, electromagnetic compatibility (EMC), and regular preventive maintenance

RECOMMENDED TEXT BOOKS

1. Introduction to Biomedical Equipment Technology – Joseph J. Carr, John M. Brown (Pearson, 2000)
2. Medical Instrumentation: Application and Design – John G. Webster (Wiley, 2020)
3. Principles of Applied Biomedical Instrumentation – L. A. Geddes, L. E. Baker (Wiley-Interscience, 1989)
4. Remote Patient Monitoring in Healthcare – Kevin R. Leonard et al. (Springer, 2022)

CONSUMERS HEALTH INFORMATICS

L/T/P/C
2/-/-2

Learning Outcome:

1. Describe Foundations of Consumer Health Informatics, with particular reference to digital health literacy, patient empowerment, and personal health data.
2. Explain Personal Health Records & Patient Portals, with particular reference to functional models, tethered systems, and patient access rights.
3. Apply Mobile Health (mHealth) & Social Health Platforms, with particular reference to consumer health apps, digital therapeutics, and online health communities.
4. Analyse and evaluate Usability, Accessibility & Ethics in Consumer Tools, and relate these to emerging practice in Consumers Health Informatics.

UNIT-I

FOUNDATIONS OF CONSUMER HEALTH INFORMATICS (CHI)

1. Definition, scope, and objectives of Consumer Health Informatics
2. Shift from paternalistic healthcare to patient-centered care and participatory medicine
3. Digital health literacy: Understanding online health information and evaluating credibility of sources
4. Role of consumer health technologies in chronic disease self-management

UNIT-II

PERSONAL HEALTH RECORDS (PHR) & PATIENT PORTALS

1. Concepts, architecture, and types of PHRs: Standalone vs. tethered/integrated systems
2. Features of patient portals: Viewing test results, appointment booking, prescription refills, and clinician messaging
3. Data sharing and consent models: Indian ABHA (Ayushman Bharat Health Account) and consumer PHR apps
4. Barriers to patient adoption: Usability challenges, digital divide, and privacy apprehensions

UNIT-III

MOBILE HEALTH (MHEALTH) & PATIENT ENGAGEMENT

1. Ecosystem of mHealth applications: Fitness tracking, mental health apps, medication adherence tools, and symptom diaries
2. Digital Therapeutics (DTx): Clinically evaluated software delivering evidence-based therapeutic interventions
3. Social media and virtual support groups: Patient experiences, peer-to-peer support, and monitoring health misinformation

UNIT-IV

DESIGN, INCLUSIVITY & ETHICAL CONCERNS

1. User-centered design principles for diverse demographic groups (elderly, disabled, low-literacy users)
2. Language accessibility and intuitive visual interfaces
3. Commercialization of personal health data and targeted health advertising
4. Ethical, legal, and behavioral dimensions of consumer health monitoring

RECOMMENDED TEXT BOOKS

1. Consumer Health Informatics: Informing Consumers and Improving Health Care – Deborah Lewis et al. (Springer, 2005)
2. Personal Health Records: The Essential Missing Element in 21st Century Healthcare – James E. Gardner (HIMSS Publishing, 2012)
3. Health Informatics: Practical Guide – William R. Hersh (Lulu.com, 2021)
4. Digital Health: Scaling Healthcare to the World – Homero Rivas, Katarzyna Wac (Springer, 2018)

HEALTH FINANCE AND INSURANCEL/T/P/C
2/-/-/2**Learning Outcome:**

1. Describe Fundamentals of Healthcare Financing, with particular reference to revenue collection, risk pooling, and purchasing mechanisms.
2. Explain Health Insurance Models & Provider Reimbursement, with particular reference to fee-for-service, capitation, bundled payments, and DRGs.
3. Apply Health Informatics in Claims Processing & Revenue Cycle Management, with particular reference to claims adjudication, e-claims, and billing cycles.
4. Analyse and evaluate Fraud Analytics, National Insurance Schemes & Health Technology Assessment, and relate these to emerging practice in Health Finance and Insurance.

UNIT-I**FUNDAMENTALS OF HEALTH FINANCING**

1. Basic economic concepts in healthcare: Market failures, demand and supply, and moral hazard
2. Three core functions of health financing: Revenue collection, pooling of funds, and purchasing of services
3. Universal Health Coverage (UHC) and financing pathways: Out-of-pocket spending, tax-funded models (Beveridge), and social insurance (Bismarck)

UNIT-II**HEALTH INSURANCE SYSTEMS & REIMBURSEMENT MECHANISMS**

1. Types of health insurance: Public vs. private, employer-sponsored, and community-based health insurance
2. Provider payment methods: Fee-for-service, per diem, capitation, bundled payments, and Diagnosis-Related Groups (DRGs)
3. Incentive structures: Pay-for-performance and value-based purchasing vs. volume-based models

UNIT-III**REVENUE CYCLE MANAGEMENT (RCM) & CLAIMS INFORMATICS**

1. Overview of the Hospital Revenue Cycle: Patient registration, eligibility verification, coding, and charge capture
2. Medical coding in billing: ICD-10, CPT, and procedure codes
3. Electronic claims processing: Claims submission, real-time claims adjudication, and electronic remittance advice (ERA) Role of Third-Party Administrators (TPAs) and health-payer integration platforms

UNIT-IV**PUBLIC SCHEMES, FRAUD DETECTION & HEALTH TECHNOLOGY ASSESSMENT**

1. National and state health protection schemes: Ayushman Bharat PM-JAY (structure, package rates, and portability)
2. Fraud, waste, and abuse (FWA) in health insurance: Identification techniques and rules-based vs. ML-based detection systems
3. Health Technology Assessment (HTA): Cost-effectiveness analysis (CEA) and cost-utility analysis (QALY/DALY) for reimbursement decisions

RECOMMENDED TEXT BOOKS

1. Health Economics and Financing – Thomas E. Getzen (Wiley, 2013)
2. Health Care Finance: Basic Tools for Nonfinancial Managers – Judith J. Baker, R. W. Baker, Neil R. Dworkin (Jones & Bartlett Learning, 2017)
3. The Revenue Cycle Management Toolkit – HIMSS (Healthcare Information and Management Systems Society, 2019)
4. Ayushman Bharat PM-JAY Guidelines & Operational Manuals – National Health Authority (NHA), Government of India

CYBERSECURITY FOR HEALTHL/T/P/C
2/-/-/2**Learning Outcome:**

1. Describe Healthcare Cybersecurity Foundations & Threat Landscapes, with particular reference to ransomware, data breaches, and vulnerabilities in hospital networks.
2. Explain Cryptography, Access Control & Network Security, with particular reference to data encryption, PKI, and multi-factor authentication.
3. Apply Security Architecture for Medical Devices & Cloud Infrastructure, with particular reference to IoMT security, network segmentation, and cloud health data storage.
4. Analyse and evaluate Incident Response, Security Audits, Regulatory Compliance & Digital Personal Data Protection, and relate these to emerging practice in Cybersecurity for Health.

UNIT-I**HEALTHCARE CYBER THREAT LANDSCAPE**

1. Vulnerabilities of modern healthcare IT environments: High value of Protected Health Information (PHI) on black markets
2. Common cyber threats: Ransomware attacks, phishing, insider threats, and Advanced Persistent Threats (APTs)
3. Real-world case studies: Impact of hospital downtime on patient care and clinical operations
4. Cyber hygiene fundamentals and developing a culture of security awareness among clinical staff

UNIT-II**DATA PROTECTION, CRYPTOGRAPHY & ACCESS MANAGEMENT**

1. Core principles of cybersecurity: Confidentiality, Integrity, and Availability (CIA Triad) in healthcare
2. Data encryption mechanisms: Protecting data at rest, data in transit, and data in use Identity and Access Management (IAM): Role-Based Access Control (RBAC), multi-factor authentication (MFA), and single sign-on (SSO)
3. Audit logging, system monitoring, and detecting unauthorized access to patient records

UNIT-III**MEDICAL DEVICE & CONNECTED HOSPITAL SECURITY**

1. Security vulnerabilities in Internet of Medical Things (IoMT) devices (pacemakers, infusion pumps, monitors)
2. Firmware vulnerabilities, hardcoded credentials, and patch management challenges for legacy medical equipment Network defense: Network segmentation, firewalls, Intrusion Detection and Prevention
3. Systems (IDS/IPS), and virtual private networks (VPNs)
4. Securing cloud deployments and API gateways handling health data transfers

UNIT-IV**INCIDENT RESPONSE, COMPLIANCE & REGULATIONS**

1. Developing a Computer Security Incident Response Plan (CSIRP) for hospital data breaches
2. Business continuity, disaster recovery, and data restoration protocols
3. Regulatory standards: Digital Personal Data Protection Act (DPDP Act, India), HIPAA Security Rule, and ISO 27799 (Health informatics security)
4. Security audits, vulnerability assessments, and third-party risk management in healthcare IT

RECOMMENDED TEXT BOOKS

1. Healthcare Information Security and Privacy – Sean P. Murphy (McGraw-Hill Education, 2015)
2. Cybersecurity in Healthcare: Protecting Patient Data and Health Information Systems – Hamid Jahankhani et al. (Springer, 2020)
3. Medical Device Cybersecurity: A Guide for Healthcare Facilities – Axel Wirth et al. (AAMI, 2021)
4. Digital Personal Data Protection (DPDP) Act, 2023 – Ministry of Electronics and Information Technology, Government of India

BIOMETRICS FOR HEALTH SYSTEMSL/T/P/C
2/-/-2**Learning Outcome:**

1. Describe Fundamentals of Biometric Recognition, with particular reference to physiological vs. behavioral characteristics and verification vs. identification models.
2. Explain Biometric Modalities in Healthcare, with particular reference to fingerprints, iris recognition, facial analysis, and voice biometrics.
3. Apply Biometrics for Patient Identification & Staff Authentication, with particular reference to master patient indexes, infant tracking, and drug dispensing verification.
4. Analyse and evaluate Biometric System Performance, Spoofing Attacks & Privacy Protections, and relate these to emerging practice in Biometrics for Health Systems.

UNIT-I**FUNDAMENTALS OF BIOMETRIC TECHNOLOGY**

1. Definition, history, and foundational components of biometric recognition systems
2. Biometric characteristics: Universality, distinctiveness, permanence, and collectability
3. System operation modes: Verification (matching) vs. Identification (searching)
4. Biometric performance metrics: False Accept Rate (FAR), False Reject Rate (FRR), and Equal Error Rate (EER)

UNIT-II**CORE BIOMETRIC MODALITIES IN HEALTHCARE**

1. Physiological biometrics: Fingerprint patterns, palm print recognition, and vein pattern imaging
2. Ocular biometrics: Iris scanning and retina identification
3. Facial recognition: 2D/3D facial geometry and thermal facial mapping
4. Behavioral and alternative biometrics: Voice identification, keystroke dynamics, and gait recognition

UNIT-III**HEALTHCARE APPLICATIONS & PATIENT IDENTITY MANAGEMENT**

1. Eliminating duplicate records and managing Enterprise Master Patient Indexes (EMPI)
2. Positive patient identification: Emergency room registration, unconscious patient identification, and newborn/infant tracking
3. Controlled substance access: Dual biometric authentication for operating room medicine cabinets and pharmacy dispensing
4. Provider authentication for Electronic Health Records and remote telemedicine portals

UNIT-IV**SECURITY, ANTI-SPOOFING & PRIVACY REGULATIONS**

1. Vulnerabilities in biometric systems: Presentation attacks (spoofing using silicon fingers, printed masks) and liveness detection
2. Template security: Biometric encryption, cancelable biometrics, and secure enclaves
3. Ethical, privacy, and hygiene concerns: Contactless biometrics in infection-controlled zones
4. National identity systems: Integration of Aadhaar biometric authentication in Indian public health programs and hospital systems

RECOMMENDED TEXT BOOKS

1. Introduction to Biometrics – Anil K. Jain, Arun A. Ross, Karthik Nandakumar (Springer, 2011)
2. Handbook of Biometrics – Anil K. Jain, Patrick Flynn, Arun A. Ross (Springer, 2008)
3. Biometrics in Healthcare: Patient Identification and Security – HIMSS Identity Management Task Force (HIMSS, 2016)
4. Aadhaar Authentication API Specifications – Unique Identification Authority of India (UIDAI)

ETHICS IN HEALTH INFORMATICSL/T/P/C
2/-/-2**Learning Outcome:**

1. Describe Foundations of Ethics & Bioethics in Health Informatics, with particular reference to ethical theories, biomedical principles, and user-appropriate applications.
2. Explain Legal Frameworks & Patient Record Confidentiality, with particular reference to informed consent, release of information, and specialized medical records.
3. Apply Risk Management, Compliance & Quality Oversight, with particular reference to health IT risk assessment, healthcare fraud/abuse prevention, and workplace ethics.
4. Analyse and evaluate Professional Ethics, Integrity & Conflict Resolution, and relate these to emerging practice in Ethics in Health Informatics.

UNIT-I**FOUNDATIONS OF ETHICS & BIOETHICS IN HEALTH INFORMATICS**

1. Ethical issues in biomedical and health informatics; ethical theories and moral frameworks
2. Core bioethical principles: Autonomy, beneficence, non-maleficence, and distributive justice
3. Health informatics applications: Determining appropriate use, authorized users, and clinical contexts
4. Social challenges, algorithmic bias, digital divide, and ethical obligations of health IT developers

UNIT-II**LEGAL FRAMEWORKS, CONFIDENTIALITY & PATIENT RECORDS**

1. Legal systems, regulatory requirements, and legal medical record retention policies
2. Confidentiality, privacy, and electronic informed consent (e-consent) mechanisms
3. Policies surrounding access, disclosure, and redisclosure of protected health information (PHI)
4. Ethical and legal considerations in specialized patient records (mental health, substance abuse, genetic data)

UNIT-III**COMPLIANCE, RISK MANAGEMENT & HEALTHCARE FRAUD**

1. Risk management, quality improvement, and utilization management in health information systems
2. Conducting risk assessments, audits, and developing breach mitigation strategies
3. Healthcare fraud and abuse: Regulatory statutes, identifying false claims, and whistleblower provisions
4. Information systems compliance, law, and professional ethics within the healthcare workplace

UNIT-IV**PROFESSIONAL ETHICS, INTEGRITY & CONFLICT RESOLUTION**

1. Professional codes of conduct for public health and health informatics practitioners (IMIA, AHIMA)
2. Developing empathy, interpersonal communication, and patient-centered advocacy
3. Resolving ethical dilemmas, mitigating conflicts of interest, and consensus-building
4. Institutional integrity, transparency, accountability, and reporting ethical violations in health systems

RECOMMENDED TEXT BOOKS

1. McWay, D. C. (2020). Legal and Ethical Aspects of Health Information Management (5th ed.). Cengage Learning.

2. Brodnik, M. S., Rinehart-Thompson, L. A., & Reynolds, R. B. (2012). Fundamentals of Law for Health Informatics and Information Management (2nd ed.). AHIMA Press.
3. Johns, M. L. (2014). Health Information Management Technology: An Applied Approach (4th ed.). AHIMA Press.
4. Goodman, K. W. (2016). Ethics and Information Technology: A Case-Based Approach to a Health Care System in Transition. Cambridge University Press.

II year IV semester

S.NO	SUBJECT	L	T	P	C
1	Research Project/Thesis	-	-	-	12
2	Review of Topics/Electives	8	-	-	8
	TOTAL	8	-	-	20

SEMESTER-IV**RESEARCH PROJECT / THESIS****L/T/P/C**
-/-/-12**Learning Outcome:**

1. Formulate a research problem in health informatics/digital health and design an appropriate study.
2. Execute the study, analyse data and interpret findings using appropriate methods.
3. Prepare a written thesis and defend it in an open viva-voce.

Course Content:

Each student independently formulates, executes and defends a research project/thesis addressing a real-world problem in digital health or health informatics (e.g., a data-analytics application, a UI/UX or prototyping study, an AR/VR/IoMT proof-of-concept, or a market/needs-assessment study), under the guidance of an approved supervisor and the oversight of the Research Advisory Committee (RAC), following the evaluation pattern in Annexure VI.

RECOMMENDED TEXT BOOKS

1. Recent peer-reviewed journal articles, conference proceedings and technical/industry reports relevant to the topic selected by the student and approved by the course coordinator.

REVIEW OF TOPICS / ELECTIVES**L/T/P/C**
8/-/-8**Learning Outcome:**

1. Critically review recent literature on an advanced/elective topic in digital health.
2. Synthesise and present a structured review of the chosen topic.
3. Relate the reviewed topic to the student's research project.

Course Content:

Students undertake a structured, instructor-guided review of advanced or emerging topics/electives in digital health and health informatics not covered in depth elsewhere in the curriculum (e.g., advanced AI in healthcare, digital-health entrepreneurship, health-data policy and law), culminating in a written review report and seminar presentation.

RECOMMENDED TEXT BOOKS

1. Recent peer-reviewed journal articles, conference proceedings and technical/policy reports relevant to the topic selected by the student and approved by the course coordinator.