MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Manipal School of Information Sciences

Manipal Academy of Higher Education, Manipal

Outcome Based Education (OBE) Framework

Two Year full time Postgraduate Program

Master of Engineering - ME (Healthcare Data Analytics)

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NATURE AND EXTENT OF THE PROGRAM

An engineering graduate skillset requirement is changing with invent of the new technologies. In particular Healthcare is one of India's largest sector both in terms of revenue and employment. Healthcare Data Analytics are playing an important role in business, government, healthcare and education. Big Data in healthcare is important for growing importance of big data architectures in Healthcare. Data Analytics combines principles and techniques from mathematics, computer science and machine learning for offering predictive and prescriptive solutions. Digital Health Exchange provides comprehensive aggregation of information to deliver data driven care system.

ME (Healthcare Data Analytics) Program is a comprehensive two-year postgraduate program, which aims to provide hands-on experience to prepare industry-ready Healthcare Data Analytics professionals. The program ME (Healthcare Data Analytics) helps engineering graduates to learn, understand, and practice big data analytics in particular to healthcare and machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on healthcare applications. Healthcare Data Analytics enables Ease of Diagnosis & prediction, Business Intelligence supports Healthcare administrative and management's strategic plan.

ME (Healthcare Data Analytics) postgraduate degree would welcome graduates from any discipline with 50% mark in qualifying exam. Students after successfully completing the program will get career opportunities as an Big Data Architect, Healthcare Data Analyst, Data Scientists, Big Data Engineer and Business Analyst.

PROGRAM EDUCATION OBJECTIVE (PEO)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **Master of Engineering - ME (Healthcare Data Analytics) program are as follows.**

PEO No	Education Objective
PEO 1	Enable to draw upon advanced knowledge in order to apply analytical and computational approach to solve technological problems in the areas of healthcare IT and data analytics.
PEO 2	Introduce state of art technologies in the area of data analytics and inculcate ethical practices to make industry ready professional.
PEO 3	Promote multidisciplinary research and societal advancement through entrepreneurship.

GRADUATE ATTRIBUTES

S No.	Attribute	Description
1	**Scholarship of Knowledge**	Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
2	**Critical Thinking**	Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3	**Problem Solving**	Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
6	**Collaborative and Multidisciplinary work**	Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve

		common goals and further the learning of themselves as well as others.
7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9	**Life-long Learning**	Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

QUALIFICATIONS DESCRIPTORS

1. Demonstrate

   (i) A systematic, extensive and coherent knowledge and understanding of an academic field of study as a whole and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of Healthcare Data Analytics;

   (ii) Procedural knowledge that creates different types of professionals related to the Healthcare Data Analytics, including research and development, teaching and government and public service;

   (iii) Professional skills in the domain of Healthcare data management, Data visualization and data analytics, various healthcare databases, including a critical understanding of the latest developments, and an ability to use established techniques in the healthcare domain.

2. Demonstrate comprehensive knowledge about data visualization and data analytics, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the healthcare field of study, and techniques and skills required for identifying problems and issues related.

3. Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, analysis and interpretation of data.

4. Methodologies as appropriate to the subject(s) for formulating evidence based solutions and arguments

5. Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.

6. Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the healthcare data Aanalytics.

7. Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge.

8. Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyse problems and issues and seek solutions to real-life problems.

PROGRAM OUTCOMES

After successful completion of Master of Engineering - ME (Healthcare Data Analytics), Students will be able to:

PO No	Attribute	Competency
PO 1	**Scholarship of Knowledge**	Acquire in-depth knowledge of HDA domain, with an ability to discriminate, evaluate, analyze, synthesize the existing and new knowledge, and integration of the same for enhancement of knowledge.
PO 2	**Critical Thinking**	Analyze complex Healthcare Data Analytics Eco System critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
PO 3	**Problem Solving**	Think laterally and originally, conceptualize and solve Healthcare problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
PO 4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
PO 5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

PO 6	**Collaborative and Multidisciplinary work**	Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
PO 7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors
PO 8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
PO 9	**Life-long Learning**	Recognize the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
PO 10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
PO 11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

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COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)

FIRST YEAR: ME (Healthcare Data Analytics)

Semester: 1 **Semester: 2**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
BDA 601	Fundamentals of Machine Learning	3	-	-	3	BDA 605	Machine Learning for Big Data	3	-	-	3
MCL 601	Applied Probability and Statistics	3	-	-	3	MCL 602	Advanced Applications of Probability and Statistics	3	-	-	3
HDA 601	Healthcare Data Management	3	-	-	3	HDA 603	Big Data in Healthcare	3	-	-	3
HDA 602	Digital Image Processing	3	-	-	3	HDA 604	Medical Imaging Systems	3	-	-	3
	Elective - 1	3	-	-	3		Elective - 2	3	-	-	3
BDA 601L	Fundamentals of Machine Learning Lab	-	-	3	1	BDA 605L	Machine Learning for Big Data Lab	-	-	3	1
MCL 601L	Applied Probability and Statistics Lab	-	-	3	1	MCL 602L	Advanced Applications of Probability and Statistics Lab	-	-	3	1
HAD 601L	Healthcare Data Management Lab	-	-	3	1	HDA 603L	Big Data in Healthcare Lab	-	-	3	1
HDA 602L	Digital Image Processing Lab	-	-	3	1	HDA 604L	Medical Imaging Systems Lab	-	-	3	1
	Elective - 1 Lab	-	-	3	1		Elective - 2 Lab	-	-	3	1
HDA 695	Mini Project - 1	-	-	4	-	HDA 696	Mini Project - 2	-	-	-	4
HDA 697	Seminar - 1	-	-	1	-	HDA 698	Seminar - 2	-	-	-	1
Total		**15**	**-**	**15**	**25**	**Total**		**15**	**-**	**15**	**25**

SECOND YEAR (FINAL YEAR): ME (Healthcare Data Analytics)

III and IV Semester		
HDA 799	Project Work	25
Total Number of Credits to Award Degree		75

List of Electives(Theory)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
BDA-610	Principles of Data Visualization	ENP-601	Entrepreneurship
HDA-605	Data Structures and Data Interpretation with Python (For electrical stream students)	HDA-606	Text Analytics in Healthcare
		HDA-607	Block chain Technology
		IOT-605	Responsive Web Application Development
		CSE-631	IT Project Management

List of Electives(Lab)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
BDA-610L	Principles of Data Visualization Lab	ENP-601L	Entrepreneurship Lab
HDA-605L	Data Structures and Data Interpretation with Python Lab (For electrical stream students)	HDA-606L	Text Analytics in Healthcare Lab
		HDA-607L	Block chain Technology Lab
		IOT-605L	Responsive Web Application Development Lab
		CSE-631L	IT Project Management Lab

Name of the Institution / Department: Manipal School of Information Sciences

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Fundamentals of Machine Learning
Course Code: BDA-601	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Programming – preferably Python

Synopsis:	This Course provides insight on 1. This course provide the concept of machine learning, applications, techniques, design issues and approaches to machine learning. 2. This course provide the fundamental knowledge about concept learning, hypothesis and bias. 3. To implement machine learning algorithms such as Decision Tree learning, Probably Approximately Correct (PAC) learning, Bayesian learning, Instance-based learning, Principal Component Analysis (PCA) and Ensemble methods in real time data set for various analysis.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify the goals, applications, types and design issues of machine learning techniques.
CO 2:	Relate concept learning and hypothesis space.
CO 3:	Apply PCA learning approach to reduce the dimension.
CO 4:	Analyse different machine learning algorithms.
CO 5:	Design ensemble methods.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:	
Content	***Competencies***
Unit 1: Introduction	
Definition of Machine Learning, Goals and applications of machine learning, Basic design issues and approaches to machine learning, Types of machine learning techniques	1. Define Machine Learning (C1) 2. Describe about any three applications for which machine learning approaches seem appropriate. (C2) 3. Illustrate different types of machine learning techniques (C3)
Unit 2: Inductive Classification	
The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Inductive bias.	1. Relate concept learning and hypothesis space (C4). 2. Apply different algorithms to obtain most general and most specific hypotheses from the training examples. (C3)
Unit 3: Decision Tree learning	
Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute, Entropy and information gain, Searching for simple trees and computational complexity.	1. Apply decision tree algorithm to find the hypothesis space (C3) 2. Construct decision tree machine learning algorithm (C5) 3. Explain the method of choosing training examples and target function in the design of a machine learning system (C2) 4. Explain different validation technique to find the accuracy in training and testing of data set (C5)
Unit 4: Computational learning theory	
Models of learnability: learning in the limit, Probably Approximately Correct	1. Define various terms related to computational learning approach (C1).

(PAC) learning, Sample Complexity: quantifying the number of examples needed to PAC learn, Computational complexity of training. Sample complexity for finite hypothesis spaces, Noise Learning Multiple Classes, Bias-variance trade-off, under-fitting and over-fitting concepts	2. Describe different models learning in the limit (C2) 3. Calculate the number of training examples required in different types of learning approaches (C4).
Unit 5: Bayesian learning	
Probability theory and Bayes rule, Naive Bayes learning algorithm - Parameter smoothing, Generative vs. discriminative training, Logistic regression, Bayes nets and Markov nets for representing dependencies	1. Write the applications of Bayes theorem (C3) 2. Describe the use of Logistic Regression in Machine Learning (C2) 3. Predict the target value for the new instance using Naïve Bayes classifier. (C3)
Unit 6: Instance-based learning	
Constructing explicit generalizations versus comparing to past specific examples, K-Nearest Neighbour learning algorithm, Case-based reasoning (CBR) learning	1. Construct explicit generalizations (C5) 2. Discriminate Instances Based and Case-based learning (C4) 3. Explain K-nearest neighbour learning (C5)
Unit 7: Continuous Latent Variables	
Principal Component Analysis (PCA), Applications of PCA	1. Describe use of Principal Component Analysis for the complex data set (C2). 2. Apply PCA to choose principal components for the given data set (C3)
Unit 8: Ensemble methods (bagging and boosting)	
Using committees of multiple hypotheses, Bagging, Boosting, DECORATE, Active learning with ensembles	1. Choose a suitable method of ensemble learning approach (C3). 2. Explain various ensemble techniques (C5)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. T. Mitchell, "Machine Learning", McGraw-Hill, 1997. 2. E. Alpaydin, "Machine Learning", MIT Press, 2010. 3. C. Bishop," Pattern Recognition and Machine Learning", Springer, 2006.

	4. E. Hart, R. Duda and D. Stork, "Pattern Classification", Wiley-Interscience, 2000. 5. T. Hastie, R. Tibshirani and J. Friedman, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", Springer, 2nd Edition, 2009. 6. Jason Bell, "Machine Learning for Big Data", Wiley Big Data Series, 2016. 7. Rama Murthy G," Multidimensional Neural Networks Unified Theory", New Age International, 2008.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Applied Probability and Statistics
Course Code:MCL 601	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Algebra and Calculus
Synopsis:	This course provides an introduction to fundamental concepts in probability and statistics that are essential for data science applications.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Understand and apply the basic principles of sampling.
CO 2:	Model random phenomena using random variables.
CO 3:	Calculate & interpret probability as a measure of quantifying uncertainty.
CO 4:	Construct Bayesian models for analysing practical problems.
CO 5:	Use sample information and perform hypothesis-test analysis using an appropriate statistical technique to explain attributes of a population.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*	*								
CO 3	*	*	*	*				*			
CO 4		*	*	*		*		*			
CO 5		*	*	*		*				*	

Course content and outcomes:

Content	***Competencies***
Unit 1: Counting, probability concepts, and conditional probability	
Multiplication rule; permutation; combination - Sampling: with/without replacement and order matters/does not	1. Understand and apply the basic principles of sampling (C1, C3).

matter - Binomial & multinomial coefficients - Distribution problems Set theory; sample space; outcomes; events - Frequency based definition of probability - Equally likely vs. not equally likely outcomes - Axioms of probability Conditional probability; probability tree model; chain rule - Decomposition and the law of total probability - Bayes' rule - intuition, dependence/independence of events.	2. Understand and apply the basic principles of probability (C1, C3). 3. Differentiate and relate frequency-based interpretation of probability to classical approach (C4). 4. Apply Bayesian principle for modelling practical problems (C5).
Unit 2: Random variables	
Modelling using discrete random variables: Bernoulli, geometric, binomial, negative binomial, hypergeometric, and Poisson distributions - Probability mass function and cumulative distribution function - Expectation and variance: discrete case - Modelling using continuous random variables: uniform, normal, log-normal, exponential, and beta distributions; probability density function - Expectation and variance: continuous case - Functions of random variables.	1. Understand and differentiate discrete and continuous random variables of practical interest (C2, C4). 2. Gain solid foundation in the mathematical aspects of random variables (C2). 3. Understand how to use random variables to model random phenomena (C4). 4. Compare and contrast practical applicability of random variables (C6).
Unit 3: Sampling and parameter estimation	
Population and sample - Statistic & sampling distribution - Sample mean and variance - Central limit theorem – intuition and applications	1. Differentiate population and sample (C4). 2. Describe population parameters using inferences drawn from a sample (C6).

Point estimation - Standard error - Interval estimation: interpretation of confidence interval - Hypothesis testing: p-values, significance level and their interpretations, application to analysis of one- /two-sample mean and paired data.	3. Design and apply appropriate hypothesis tests for practical problems (C3). 4. Communicate and explain the results of hypothesis testing (C6).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2		*	*	*	
Assignment/Presentation	*	*	*	*	*

End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Introduction to Probability, Charles M. Grinstead, American Mathematical Society; 2nd Revised Edition 1997. Available online at https://open.umn.edu/opentextbooks/textbooks/introduction-to-probability 2. A First Course in Probability, Sheldon Ross, 9th Edition, Pearson Education India; 9th Edition, 2013. 3. Biostatistics Open Learning textbook – Online resource from University of Florida available at https://bolt.mph.ufl.edu/6050-6052/ 4. All of Statistics: A Concise Course in Statistical Inference, Larry Wasserman – Springer.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Healthcare Data Management
Course Code: HDA 601	**Course Instructor:**
Academic Year: 2020-2020	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Database Management, MSSQL, Python

Synopsis:	This Course provides insight on 1. This course provide the knowledge of healthcare system architecture, types of healthcare data and database. 2. This course provide the concept of epidemiology and achievements in epidemiology, experimental epidemiology, cofounding. 3. This course provide the knowledge of measuring disease frequency, death rates, morbidity and comparing disease occurrence. 4. This course provide knowledge of types of healthcare databases, standards, records, EMR, HER, interchange standards and genomics. 5. This course provide the concept the of structured and unstructured data, SQL, NOSQL and genome databases. 6. This course provide the concept of processes and process analysis, process re-design, quality management methods.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe the architecture of healthcare systems, healthcare databases and its applications.
CO 2:	Explain the concept of epidemiology and its uses, measuring health and disease, observational epidemiology, experimental epidemiology, confounding.
CO 3:	Differentiate different type of healthcare databases, standards and records.
CO 4:	Compare and contrast file systems and DBMS, structured and unstructured data, epidemiology databases and genome databases.
CO 5:	Describe healthcare process analysis, process-redesign, quality management methods.
Mapping of COs to POs	

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2			*								
CO 3	*	*									
CO 4				*	*						
CO 5			*			*	*				

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Healthcare	
Architecture of Healthcare systems – Healthcare Data – Types of Healthcare Data – Healthcare Databases & Applications – Healthcare Informatics vs Clinical Informatics	1. Explain about Architecture of Healthcare system? (C2) 2. Describe the 10 essential services provided by the public health at different systems? (C2)
Unit 2: Introduction to Epidemiology	
Definition, scope, and uses of epidemiology - Epidemiology and public health - Achievements in epidemiology.	3. Define Epidemiology? Purpose of Epidemiology? Two and Three board types of epidemiology with an examples? (C1) 4. Explain about Potential Errors In Epidemiologic Studies? (C2)
Unit 3: Measuring health and disease	
Defining health and disease - Measuring disease frequency - Using available information to measure health and disease - Death rates – Morbidity - Comparing disease occurrence	5. Definition of confounding? Explain about Confounding? (C1) 6. Explain about Electronic Medical records with examples? (C2)
Unit 4: Types of studies	

Observations and experiments - Observational epidemiology - Experimental epidemiology - Potential errors in epidemiological studies – Confounding	7. Explain briefly about EHR? And write Primary and Secondary Uses of an EHR. (C2)
Unit 5: Data in Healthcare	
Open Data for Healthcare – World Health Organization data - Types of Health Care Databases – Standards – Healthcare Records – Hospital Information Systems – Need for Standardization – EMR – EHR - EHR Functional Model Standards - Health Data Interchange Standards - Health Information Exchange – Introduction to Genomics – Basics of Genomics – DNA structure	8. Discover out Measuring disease frequency for a given values. (C3)
Unit 6: File Systems Vs DBMS	
Entity Relationship – Normalization - ACID properties Structured and Unstructured data - Storing data – SQL – NOSQL – Tools for Healthcare Databases – OpenMRS – Working with SQL – NOSQL tools - Epidemiology Databases and Registries-Public Health Information Tools – Genome Databases	1. Explain about Traditional file system and disadvantages of traditional file system. (C2) 2. Identify Advantages and disadvantages of Database Management System? (C1) 3. Explain the main components of ER(Entity Relation ship) models with examples. (C2) 4. Define Normalization and Levels of Normalization with examples. (C1) 5. List Types of Data? (C1) 6. Describe NOSQL Database and Types of NOSQL Database. (C1)
Unit 7: Healthcare Process Analysis	

Concepts of Processes and Process Analysis: Process Mapping Theory and Rationale - Interpreting and Creating Process Diagrams - Acquiring Clinical Process Knowledge - Process Analysis - Process Re-design - Facilitating Meetings for Implementation Decisions - Quality Improvement Methods - Leading and Facilitating Change - Process Change Implementation and Evaluation - Maintaining and Enhancing the Improvements .	1. Explain healthcare process analysis. (C2) 2. Outline process re-design. (C1) 3. Explain the concept of Quality Improvement Methods. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation		*			*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] Basic epidemiology, Bonita, Ruth, Robert Beagle hole, and Tord Kjellström, World Health Organization, 2nd edition,2006. [2] Health Informatics: An Interprofessional Approach - Ramona Nelson and Nancy Staggers. [3] Healthcare Informatics - WIlliam Hanson - McGraw-Hill Education. [4] Handbook of Research on Informatics in Healthcare and Biomedicine - Athina A. Lazakidou. [5] MOOCS, BOOKS : http://www.healthinformaticsforum.com .

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Digital Image Processing
Course Code: HDA 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic knowledge of MATLAB and signal processing

Synopsis:	This Course provides insight on 1. Basic knowledge about image processing algorithms for image enhancement, segmentation and pattern recognition 2. To design and develop image analysis algorithms for simple object recognition tasks.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Define major building blocks of an image processing pipeline.
CO 2:	Explain various image processing algorithms for enhancement segmentation and classification and apply the appropriate techniques for various scenarios.
CO 3:	Demonstrate the use of morphological operators for post processing of images.
CO 4:	Demonstrate the use of edge based and region based segmentation techniques to obtain the region of interest in an image.
CO 5:	Design a suitable feature extraction and classification approach.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*	*								
CO 3	*		*								
CO 4		*	*								
CO 5			*								

Course content and outcomes:

Content	*Competencies*
Unit 1: Digital Image Processing Fundamentals	

Digital image Representation Elements of DIP Image Model Sampling and quantization Pixel relationships.	1. Explain about the basic image processing pipeline. (C2) 2. Describe the terms sampling and quantization(C2) 3. Explain the various puxel relationships(C2)
Unit 2: Image Enhancement	
Point processing operations Neighbourhood processing operations Global processing operations Spatial and frequency domain filtering Pseudo colour image processing Colour Models and colour image processing.	1. Describe the neighbourhood relations and distance measures between pixels of an image. (C2) 2. Describe the various pseudo-color image processing techniques. (C2) 3. Write the significance of color space conversions for image analysis. (C3) 4. Calculate the modified pixels values for a given image after histogram equalization. (C4)
Unit 3: Image Segmentation	
Point, Line and Edge detection Thresholding techniques Region Based Segmentation Clustering techniques Motion based segmentation	1. Apply various edge detection filters to a given image and obtain the output image matrix. (C3) 2. Describe the various thresholding techniques for image segmentation. (C2) 3. Compare and contrast the motion based segmentation techniques namely image subtraction approach and background estimation approach. (C4) 4. Apply the concept of derivatives for design of edge detectors. (C3) 5. Compare the performance of first derivative filters with that of second derivative filters (C4) 6. Explain the mask design of an edge detector. (C5)

	7. Interpret the output image quality of an enhancement technique represented by a given transfer function. (C3) 8. Explain the impact of different levels of sampling and quantization on the image quality. (C5) 9. Describe the region based techniques used for image segmentation. (C3)
Unit 4: Morphological Image Processing	
Erosion and Dilation Opening and Closing Morphological processing applications Hit or Miss Transformation Boundary detection.	1. Describe the use of various morphological operations for post processing of images. (C3) 2. Formulate the sequence of use of morphological operators and the size and shape of structuring element for a given task. (C5) 3. Describe hit or miss transform. (C2)
Unit 5: Image Representation and Description	
Image representation Chain code, Polygonal approximation, Signature, Skeleton Boundary descriptors – Fourier descriptors, polynomial approximation Regional descriptors – topological and textural descriptors –Moments, Haralick Transform, GLCM, LBP	1. Describe the various boundary descriptors used for image representation. (C2) 2. Design a suitable boundary descriptor for detection of a given object in an image. (C4) 3. Select suitable regional descriptors for uniquely representing an object in an image. (C5) 4. Describe the use of GLCM for texture based image analysis. (C3) 5. Explain the use of LBP for texture analysis. (C3) 6. Define Haralick's transforms. (C2) 7. Design a suitable feature extraction approach for detection of an object in an image(C5)
Unit 6: Pattern Recognition	

Pattern recognition (PR) systems Pattern recognition approaches Training and learning in PR system Feature extraction and selection methods Dimensionality reduction, PCA Applications of Pattern Recognition	1. Explain the building blocks of a pattern recognition system. (C3) 2. Describe the various feature selection approach to reduce dimensionality for classification. (C3) 3. Design a classifier for the object classification problem. (C5) 4. Describe various classifiers used in pattern recognition systems. (C3) 5. Compare and contrast the various classifiers for a given pattern recognition task. (C5) 6. Compare and contrast the different cross validation techniques for performance evaluation of a classifier. (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation					*
End Semester Examination	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] Digital Image Processing- Gonzalez and Woods, Third edition, Pearson Education, 2009 [2] Pattern Classification, Richard O Duda, Peter E. Hart, David G.Strok, Wiley-Inderscience Publication, Second edition, 2001. [3] Pattern recognition and Image analysis, Earl Gose, Richard, Johnson Baugh and Steve Jost, Prentice Hall, 2002.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Principles of Data Visualization
Course Code: HAD-605	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Programming in Python

Synopsis:	This Course provides insight on 1. This course introduces data visualization, the art and science of turning data into readable graphics. 2. Teach how to design and create data visualizations based on data available and tasks to be achieved. 3. Students learn how do data extraction, data modelling and data processing. 4. Students learn to map data attributes to graphical attributes, and strategic visual encoding based on known properties of visual perception
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Extracting, transforming and storing data from various data sources.
CO 2:	An understanding of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction.
CO 3:	Exposure to number of common data domains and corresponding analysis tasks.
CO 4:	Practical experience building and evaluating visualization systems.
CO 5:	The ability to read and discuss research papers from the visualization literature.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*	*					
CO 2	*	*			*						
CO 3	*	*	*								
CO 4	*		*		*			*			
CO 5	*	*	*	*							

Course content and outcomes:	
Content	***Competencies***
Unit 1: Introduction to Web scraping	
Web scraping models and techniques, Case study: BeautifulSoup, Scrapy, Selenium	1. Understanding various formats of data. (C1) 2. Design programs to dynamically extract data from web. (C4) 3. Design programs to read data from various data sources. (C4)
Unit 2: Data Analysis	
Data structures for analysis: numpy, pandas Data Wrangling: Clean, Transform, Merge, Reshape Data Aggregation and Group Operations Case study: Exploratory analysis of public / scrapped datasets	1. Understand and integrate various data structures for data analysis process (C2). 2. Create various techniques to clean and handle missing data (C4). 3. Design data filtering and transformation techniques (C4).
Unit 3: Data Visualization	
Data Visualization – classification, infographics versus data visualization, visualization for supporting exploratory data analysis, visual art, choosing appropriate visual encodings, rules for visualization - Visualization techniques: time series, statistical distributions, maps - Data visualization for web	1. Describe what is the purpose of Visualization. (C2) 2. Describe various ways of classifying visualization. (C2) 3. Explain what is explorative and explanative visualization. (C2) 4. Differentiate data visualization and visual art. (C2) 5. Create visualization for time series data. (C4) 6. Create visualization for statistical distributions. (C4) 7. Create visualization for maps, Hierarchical data and network data. (C4)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. **Website Scraping with Python: Using BeautifulSoup and Scrapy,** Gábor & Hajba, APRESS Publications, 1st Edition, 2018.

	2. **Web Scraping with Python: Collecting More Data from the Modern Web**, Ryan Mitchell Shroff, O'Reilly, 2nd Edition, 2018. 3. **Designing Data Visualizations**, Julie Steele and Noah Iliinsky; O'Reilly Media; 1st Edition, 2011. 4. **Python for Data Analysis**, Wes McKinney; Shroff; O'Reilly; 2nd Edition, 2018.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Data Structures and Data Interpretation with Python (For electrical stream students)
Course Code: HDA 605	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** programming in C

Synopsis:	This course provides insight on fundamentals of data structures and tools for visualizing and interpreting data using Python.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe fundamentals of data structures like arrays, linked list, stacks and queues.
CO 2:	Demonstrates sorting and searching techniques.
CO 3:	Demonstrate problem solving using hashing and dictionaries.
CO 4:	Explain principles of visualization techniques and varieties of visualization techniques.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*		*								
CO 3	*		*								
CO 4	*	*	*								
CO 5	*	*	*	*	*						

Content	***Competencies***
Unit 1: Algorithm specification and analysis techniques	
Analysis of recursive programs. Solving recurrence equations. General solution for a large class of recurrences.	1. Explain recursive programs (C2). 2. Demonstrate solving recurrence equations (C3). 3. Employ general solution for a large class of recurrences (C3).
Unit 2: Elementary data structures	

Implementation of lists, stacks, queues.	1. Demonstrate implementation of lists (C3). 2. Demonstrate implementation of stacks (C3). 3. Demonstrate implementation of queues (C3).
Unit 3: Sorting and searching techniques	
Quick sort, heap sort, and merge sort. Linear search and binary search.	1. Explain techniques for quick sort, heap sort, and merge sort (C2). 2. Explain techniques for linear search and binary search (C2).
Unit 4: Hashing and dictionaries	
Hashing and dictionaries.	1. Illustrate hashing and dictionaries in data structures (C3).
Unit 5: Binary search trees	
Construction. Inorder, preorder, and postorder traversals	1. Employ binary search trees to solve problems (C3). 2. Explain different types of traversals in binary search tree (C2).
Unit 6: Principles of information visualization	
Classification of visualizations. Ingredients of successful visualizations Choose appropriate visual encodings.	1. Explain principles of visualization techniques (C2). 2. Explain classification of visualizations (C2). 3. Identify ingredients of successful visualizations (C2). 4. Demonstrate appropriate visual encodings (C3).
Unit 7: Acquiring and parsing data	
Loading data from text input. Text, CSV, JSON, XML.	1. Demonstrate various methods for loading textual data (C3).
Unit 8: Data cleansing	
Numpy and Pandas.	1. Explain data cleansing on acquired data (C3).
Unit 9: Regular expressions	
Regular expressions.	1. Illustrate regular expressions (C2).
Unit 10: Varieties of visualization techniques	

Time series. Statistical distributions, Q-Q Plots, scatter plot matrix, parallel coordinates. Maps: flow maps, choropleth maps. graduated symbol maps, cartograms.	4. Explain varieties of visualization techniques (C3). 5. Demonstrate different maps for solving problems (C3).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2		*	*	
Assignment/Presentation	*	*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback

Reference Material	1. Introduction to Algorithms - Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest. MIT Press. Edition 3 2. Data Structures and Algorithms - Aho, Hopcroft and Ulmann. Pearson Publishers. ISBN-13: 978-0201000238 3. Data Structures and Algorithms in Python - Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. John Wiley & Sons. ISBN: 9788126562176, 812656217X Edition 1 4. Designing Data Visualizations - Noah Iliinsky and Julie Steele - O'Reilly publishers ISBN: 9781449314774 Edition 1 5. Python for Data Analysis - William McKinney – O'Reilly Publishers – Edition 2

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Fundamentals of Machine Learning Lab
Course Code: BDA-601L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites: Basics of Programming**

Synopsis:	This Course provides insight on 1. This course provide the concept of machine learning, applications, techniques, design issues and approaches to machine learning. 2. This course provide the fundamental knowledge about concept learning, hypothesis and bias. 3. To implement machine learning algorithms such as Decision Tree learning, Probably Approximately Correct (PAC) learning, Bayesian learning, Instance-based learning, Principal Component Analysis (PCA) and Ensemble methods in real time data set for various analysis.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify the software and tools for designing machine learning applications.
CO 2:	Apply concept learning and hypothesis space.
CO 3:	Apply machine learning approach to reduce the dimension.
CO 4:	Analyse different machine learning algorithms.
CO 5:	Design ensemble methods.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction	
Definition of Machine Learning Goals and applications of machine learning Basic design issues and approaches to machine learning Types of machine learning techniques	1. Identify programming environments available for the machine learning (C1) 2. Classify the pros and cons of various environments for ML coding (C2)
Unit 2: Inductive Classification	
The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Inductive bias.	1. Design a machine learning model to get a Maximally Specific Hypothesis for the given training examples (C5). 2. Construct a machine learning model to obtain most general and most specific hypotheses for the given training examples (C5)
Unit 3: Decision Tree learning	
Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute Entropy and information gain. Searching for simple trees and computational complexity.	1. Develop a machine learning classifier using decision tree and random forest (C5) 2. Examine different applications of decision tree and random forest (C4)
Unit 4: Computational learning theory	

Models of learnability: learning in the limit. Probably Approximately Correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. Noise. Learning Multiple Classes. Bias-variance trade-off, under-fitting and over-fitting concepts.	1. Design a learning method to determine the sample complexity of training examples (C5) 2. Analyse bias-variance trade-off, under-fitting and over-fitting concepts (C4)
Unit 5: Bayesian learning	
Probability theory and Bayes rule. Naive Bayes learning algorithm - Parameter smoothing. Generative vs. discriminative training Logistic regression. Bayes nets and Markov nets for representing dependencies	1. Design a machine learning model using Bayes learning (C5). 2. Develop a machine learning classifier models using different approach (C5) 3. Design Bayes nets and Markov nets for representing dependencies (C5)
Unit 6: Instance-based learning	
Constructing explicit generalizations versus comparing to past specific examples. K-Nearest Neighbour learning algorithm. Case-based reasoning (CBR) learning.	1. Design machine learning models to classify the instances using K-NN and CBR approaches (C5).

Unit 7: Continuous Latent Variables	
Principal Component Analysis (PCA), Applications of PCA	1. Apply PCA for different complex applications (C3)
Unit 8: Ensemble methods (bagging and boosting)	
Using committees of multiple hypotheses. Bagging Boosting DECORATE Active learning with ensembles.	1. Design a Bayesian Networks (C5) 2. Develop machine learning models using Ensemble models. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**

Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
Laboratory Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Machine Learning, T. Mitchell, McGraw-Hill, 1997 2. Machine Learning, E. Alpaydin, MIT Press, 2010 3. Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006 4. Pattern Classification, R. Duda, E. Hart, and D. Stork, Wiley-Interscience, 2000 5. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, 2nd Edition, 2009 6. Machine Learning for Big Data, Jason Bell, Wiley Big Data Series 7. Multidimensional Neural Networks Unified Theory, Rama Murthy G 8. Current literature

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Applied Probability and Statistics Lab
Course Code: MCL 601L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** MCL 601

Synopsis:	This course provides a hands-on introduction to fundamental concepts in probability and statistics that are essential for data science applications using the R programming language.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the basic principles of sampling to practical problems.
CO 2:	Visualize probability concepts through frequency-based interpretations.
CO 3:	Simulate discrete and continuous random variables for modelling random phenomena.
CO 4:	Design and apply hypothesis tests followed by interpretation of results.
CO 5:	Interpret statistical results and communicate them unambiguously and effectively.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2		*	*		*						
CO 3	*	*	*	*	*						
CO 4		*	*	*	*	*					
CO 5				*	*	*		*		*	

Course content and outcomes:

Content	***Competencies***
Unit 1: Counting, probability concepts, and conditional probability	

Multiplication rule; permutation; combination - Sampling: with/without replacement and order matters/does not matter - Binomial & multinomial coefficients - Distribution problems Set theory; sample space; outcomes; events - Frequency based definition of probability - Equally likely vs. not equally likely outcomes - Axioms of probability Conditional probability; probability tree model; chain rule - Decomposition and the law of total probability - Bayes' rule - intuition, dependence/independence of events.	1. Understand the basic principles of the R programming language (C1). 2. Develop short code snippets to understand the basic principles of sampling and probability (C1, C3). 3. Visualise and interpret probability concepts through a frequency-based approach (C6). 4. Program and analyse Bayesian models for practical problems (C4).
Unit 2: Random variables	
Modelling using discrete random variables: Bernoulli, geometric, binomial, negative binomial, hypergeometric, and Poisson distributions - Probability mass function and cumulative distribution function - Expectation and variance: discrete case - Modelling using continuous random variables: uniform, normal, log-normal, exponential, and beta distributions; probability density function - Expectation and variance: continuous case - Functions of random variables.	1. Understand and apply R functions to simulate discrete and continuous random variables (C3). 2. Using sampling, compute and interpret different attributes of random variables (C4). 3. Visualise and interpret histograms and probability mass/density functions of random variables using state of the art visualisation libraries in R (C4). 4. Develop codes to model random phenomena using appropriate random variables (C5).
Unit 3: Sampling and parameter estimation	

Population and sample - Statistic & sampling distribution - Sample mean and variance - Central limit theorem – intuition and applications Point estimation - Standard error - Interval estimation: interpretation of confidence interval - Hypothesis testing: p-values, significance level and their interpretations, application to analysis of one- /two-sample mean and paired data	1. Visualise sample data through histograms (C3). 2. Compute estimates of population parameters using samples and communicate the uncertainty in the estimates (C4). 3. Use R in-built functions for performing hypothesis tests (C4). 4. Interpret and communicate the results of hypothesis tests (C6).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination

Lab Assignment & Viva				Viva	
Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Introduction to Probability, Charles M. Grinstead, American Mathematical Society; 2nd Revised Edition 1997. Available online at https://open.umn.edu/opentextbooks/textbooks/introduction-to-probability 2. A First Course in Probability, Sheldon Ross, 9th Edition, Pearson Education India; 9th Edition, 2013. 3. Biostatistics Open Learning textbook – Online resource from University of Florida available at https://bolt.mph.ufl.edu/6050-6052/ 4. All of Statistics: A Concise Course in Statistical Inference, Larry Wasserman – Springer.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Healthcare Data Management Lab
Course Code: HDA 601L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** DBMS and file systems

Synopsis:	This Course provides insight on Healthcare data and various methods and techniques to manage data and workflow 1. This course provide the knowledge of healthcare system architecture, types of healthcare data and database. 2. This course provide the concept of epidemiology and achievements in epidemiology, experimental epidemiology, cofounding. 3. This course provide the knowledge of measuring disease frequency, death rates, morbidity and comparing disease occurrence. 4. This course provide knowledge of types of healthcare databases, standards, records, EMR, HER, interchange standards and genomics. 5. This course provide the concept the of structured and unstructured data, SQL, NOSQL and genome databases. 6. This course provide the concept of processes and process analysis, process re-design, quality management methods.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain types of healthcare databases
CO 2:	Design healthcare database
CO 3:	Illustrate process analysis in healthcare data management

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1			*								
CO 2					*	*	*				
CO 3						*	*				

Course content and outcomes:

Content	*Competencies*
Unit 1:	
Types of healthcare databases	1. Explain EMR (C2) 2. Explain EHR (C2) 3. Explain EPR (C2)
Unit 2:	
Design Healthcare Databases	4. Building database management system (C6) 5. Implementation of SQL and NO-SQL (C3)
Unit 3:	
Process Analysis	6. Illustrate process analysis in healthcare management system (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-

TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation		*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Basic epidemiology, Bonita, Ruth, Robert Beagle hole, and Tord Kjellström, World Health Organization, 2nd edition,2006. 2. Health Informatics: An Interprofessional Approach - Ramona Nelson and Nancy Staggers. 3. Healthcare Informatics - WIlliam Hanson - McGraw-Hill Education. 4. Handbook of Research on Informatics in Healthcare and Biomedicine - Athina A. Lazakidou. 5. MOOCS, BOOKS : http://www.healthinformaticsforum.com

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Digital Image Processing Lab
Course Code: HDA 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Basic knowledge of MATLAB and signal processing

Synopsis:	This Course provides insight on 1. Image processing algorithms, their effects, appropriateness for problem solving 2. Designing an image processing pipeline for a specific case.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Implement image enhancement techniques
CO 2:	Implement image segmentation techniques
CO 3:	Implement image morphological operations

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1		*	*		*						
CO 2		*	*		*						
CO 3		*	*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Image Enhancement and Segmentation	

Point processing operations Neighbourhood processing operations Global processing operations Spatial and frequency domain filtering Pseudo colour image processing Colour Models and colour image processing. Point, Line and Edge detection Thresholding techniques Region Based Segmentation	1. Design an image analysis approach to enhance the image using image arithmetics using ImageJ and MATLAB tools. (C5) 2. Design image enhancement methods for various qualities of input images. (C5) 3. Compare the qualities of output images for varying values of parameters used for thresholding and enhancement operations. (C6) 4. Implement algorithms for threshold and point operations. (C2) 5. Illustrate the suitability of various image enhancement techniques for varying qualities of input images. (C3) 6. Design an image enhancement technique to improve the quality of a given image. (C5) 7. Compare the outputs of contrast enhancement and histogram equalization for varying qualities of input images. (C4)
Unit 2: Image Segmentation and Morphological Image Processing	
Segmentation techniques, Morphological operators	1. Compare the performance of edge detectors on images of varying qualities and characteristics.(C4) 2. Design an image segmentation approach using enhancement, segmentation and post processing using morphological operations. (C5)
Unit 3:	
Pattern Recognition and classification	1. Design a pattern recognition system to detect an object from an image. (C5)

	2. Design a classifier model for detection of object from an image. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
Laboratory examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1] Digital Image Processing- Gonzalez and Woods, Third edition, Pearson Education, 2009 [2] Pattern Classification, Richard O Duda, Peter E. Hart, David G.Strok, Wiley-Inderscience Publication, Second edition, 2001. [3] Pattern recognition and Image analysis, Earl Gose, Richard, Johnson Baugh and Steve Jost, Prentice Hall, 2002.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Principles of Data Visualization Lab
Course Code: BDA-622L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First year, semester 1
No of Credits: 1	**Prerequisites:** Programming in Python

Synopsis:	This Course provides insight on 1. This course introduces data visualization, the art and science of turning data into readable graphics. 2. Teach how to design and create data visualizations based on data available and tasks to be achieved. 3. Students learn how do data extraction, data modelling and data processing. 4. Students learn to map data attributes to graphical attributes, and strategic visual encoding based on known properties of visual perception.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Data scrapping from different data sources.
CO 2:	Data Cleaning, transformations and Analysis.
CO 3:	Data Visualization using different techniques, tools and charts.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*				*	*	
CO 2	*	*	*		*	*		*	*	*	
CO 3	*	*	*	*	*	*		*		*	

Course content and outcomes:

Content	***Competencies***
Unit 1: Data Scrapping	
Web scrapping models	1. Identify different types of data sources (C2). 2. Design applications to scrap static data (C4).

Installing and configuring tools to handle different data types.	3. Design applications to extract data from dynamic web pages (C4).
Unit 2: Data Analysis	
Working with packages like numpy, pandas, sklearn Perform exploratory data analysis.	1. Design scripts to clean, handle missing data (C4). 2. Design scripts to apply required transformations to cleaned data (C4).
Unit 3: Data Visualization	
Creating different types of Visualization. Creating different types of charts.	1. Develop applications for exploratory data visualization (C4). 2. Develop scripts to create static visualization using various visual encodings (C4). 3. Create dynamic visualization for web (C4).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**

Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*		
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
End Semester Examination	*	*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. **Website Scraping with Python: Using BeautifulSoup and Scrapy,** Gábor & Hajba, APRESS Publications, 1st Edition, 2018. 2. **Web Scraping with Python: Collecting More Data from the Modern Web**, Ryan Mitchell Shroff, O'Reilly, 2nd Edition, 2018. 3. **Designing Data Visualizations**, Julie Steele and Noah Iliinsky; O'Reilly Media; 1st Edition, 2011. 4. **Python for Data Analysis**, Wes McKinney; Shroff; O'Reilly; 2nd Edition, 2018.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Data Structures and Data Interpretation with Python (For electrical stream students) Lab
Course Code: HDA 605L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** HDA 605

Synopsis:	This course provides insight into practical understanding of data structures and data visualization using the Python programming language.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Implement data structures like arrays, linked list, stacks and queues.
CO 2:	Implement sorting and searching techniques.
CO 3:	Solve practical problems using hashing and dictionaries.
CO 4:	Use appropriate visualization techniques for interpreting data.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1					*						
CO 2			*		*						
CO 3			*		*						
CO 4		*	*		*						
CO 5		*	*	*	*						

Content	***Competencies***
Unit 1: Algorithm specification and analysis techniques	
Analysis of recursive programs. Solving recurrence equations. General solution for a large class of recurrences.	1. Implement and understand recursive programs (C3).
Unit 2: Elementary data structures	
Implementation of lists, stacks, queues.	1. Implement lists, stacks, and queues (C3).

Unit 3: Sorting and searching techniques	
Quick sort, heap sort, and merge sort. Linear search and binary search.	1. Implement and compare performances of sorting techniques such as quick sort, heap sort, and merge sort (C3, C4). 2. Implement and compare performances of search techniques such as linear search and binary search (C3, c4).
Unit 4: Hashing and dictionaries	
Hashing and dictionaries.	1. Implement hashing and dictionaries for pratical problems (C3).
Unit 5: Binary search trees	
Construction. Inorder, preorder, and postorder traversals	1. Implement binary search trees to solve practical problems (C3). 2. Implement and compare performances of different types of traversals in binary search tree (C3, C4).
Unit 6: Principles of information visualization	
Classification of visualizations. Ingredients of successful visualizations Choose appropriate visual encodings.	1. Explore and familiarise with state of the art visualisation software (C3). 2. Use appropriate visualisation techniques for interpreting data (C3).
Unit 7: Acquiring and parsing data	
Loading data from text input. Text, CSV, JSON, XML.	1. Implement various methods for loading textual data (C3).
Unit 8: Data cleansing	
Numpy and Pandas.	1. Apply Python libraries for data acquisition and wrangling using practical data sets (C3).
Unit 9: Regular expressions	
Regular expressions.	1. Implement regular expressions for analysing text from practical data sets (C3).
Unit 10: Varieties of visualization techniques	
Time series.	1. Apply in-built visualisation tools in Python for interpreting practical data sets (C3).

Statistical distributions, Q-Q Plots, scatter plot matrix, parallel coordinates. Maps: flow maps, choropleth maps. graduated symbol maps, cartograms.	2. Use Python libraries for implementing and visualising different types of maps (C3).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Case Based Learning (CBL)	03	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2		*	*	
Assignment/Presentation	*	*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback

Reference Material	1. Introduction to Algorithms - Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest. MIT Press. Edition 3 2. Data Structures and Algorithms - Aho, Hopcroft and Ulmann. Pearson Publishers. ISBN-13: 978-0201000238 3. Data Structures and Algorithms in Python - Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser. John Wiley & Sons. ISBN: 9788126562176, 812656217X Edition 1 4. Designing Data Visualizations - Noah Iliinsky and Julie Steele - O'Reilly publishers ISBN: 9781449314774 Edition 1 5. Python for Data Analysis - William McKinney – O'Reilly Publishers – Edition 2

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Mini Project - 1
Course Code: HDA 695	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 4	**Prerequisites:** Any programming language and circuit basics

Synopsis:	Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the objectives of the project work and provide an adequate background with a detailed literature survey
CO 2:	Breakdown the project into sub blocks with sufficient details to allow the work to be reproduced by an independent researcher
CO 3:	Compose hardware/software design, algorithms, flowchart, methodology, and block diagram
CO 4:	Evaluate the results
CO 5:	Summarize the work carried out

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1				*							
CO 2					*			*			
CO 3							*			*	
CO 4						*					*
CO5:							*				

Course content and outcomes:

Content	***Competencies***
Phase 1	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2) 3. Prepare the outline (C3) 4. Describe the status of the project (C2) 5. Prepare a mid-term project presentation report (C3) 6. Prepare and present mid-term project presentation slides (C3, C5) 7. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	48	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-

Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	03	-
TOTAL	**51**	**09**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Seminar - 1
Course Code: HDA 697	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Communication Skill
Synopsis:	1. To select, search and learn technical literature. 2. To Identify a current and relevant research topic. 3. To prepare a topic and deliver a presentation. 4. To develop the skill to write a technical report. 5. Develop ability to work in groups to review and modify technical content.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Show competence in identifying relevant information, defining and explaining topics under discussion.
CO 2:	Show competence in working with a methodology, structuring their oral work, and synthesizing information.
CO 3:	Use appropriate registers and vocabulary, and will demonstrate command of voice modulation, voice projection, and pacing.
CO 4:	Demonstrate that they have paid close attention to what others say and can respond constructively.
CO 5:	Develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*							*	*		*
CO 2	*							*	*		*
CO 3	*							*	*		*
CO 4	*							*	*		*

CO5:	*							*	*		*

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:	
Formative:	**Summative:**
Seminar Topic Selection	
Synopsys review	
PPT Review	

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen Seminar

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Machine Learning for Big Data
Course Code: BDA-605	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Programming with Python and Data Visualization

Synopsis:	This Course provides insight on 1. This course provide the concept of neurons and biological motivation, activation functions and threshold units, supervised and unsupervised learning, perceptron network models in Artificial Neural Networks. 2. This course provide the knowledge about learning from unclassified data using clustering techniques. 3. This course provide the concept of Support Vector Machines for linear and non-linear classification. 4. This course provide the concept of Deep Learning and design of convolutional neural network for Deep Learning. 5. This course provide the knowledge about the applications and design of Reinforcement Learning algorithms.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe activation functions, weights and threshold units used in artificial neural networks, supervised and unsupervised learning, gradient descent approach, types of perceptron models, overfitting
CO 2:	Explain the concept of hierarchical clustering and non-hierarchical clustering, support vector machine, deep neural networks and reinforcement learning
CO 3:	Demonstrate artificial neural network models, clustering models, support vector classifier models, Deep learning models and reinforcement learning models
CO 4:	Compare and contrast single layer, multilayer and deep neural networks in terms of accuracy in classification
CO 5:	Design back propagation neural network, K-means and agglomerative clustering, deep neural network, reinforcement learning models and selection of a machine learning algorithm for the given data analysis.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Artificial Neural Networks	
Neurons and biological motivation, Activation functions and threshold units, Supervised and unsupervised learning, Perceptron Model: representational limitation and gradient descent training, Multilayer networks and back propagation, Overfitting	1. Relate biological neurons with artificial neurons and the motivation for ANN development. (C1) 2. Distinguish Supervised and unsupervised learning (C2). 3. Describe about error reduction techniques in used Artificial Neural Networks based learning (C2) 4. Write the usability of different activation functions for ANN learning system. (C3) 5. Describe the architecture of various perceptron networks. (C2)
Unit 2: Clustering	
Learning from unclassified data, Clustering. Hierarchical Agglomerative Clustering, Non- Hierarchical Clustering - k-means partitional clustering, Expectation maximization (EM) for soft clustering, Semi-supervised learning with EM using labelled and unlabelled data.	1. Write the different methods of learning from unclassified data (C3). 2. Explain the operations of various clustering models in machine learning (C5) 3. Describe the methods used for measuring dissimilarity between two clusters. (C2)

	4. Apply clustering techniques for data analysis. (C3)
Unit 3: Kernel Methods	
Dual Representations, Design of Kernels .	1. Describe Dual Representations. (C2) 2. Explain the Kernel trick for learning non-linear functions (C5)
Unit 4: Support Vector Machines (SMV)	
Maximum margin linear separators, Quadratic programming solution to finding maximum margin separators, Kernels for learning non-linear functions, Varying length pattern classification using SVM	1. Describe about Maximum Margin and Support Vector Machine. (C2) 2. Examine the advantages of maximum margin linear separators technique in SVM (C4) 3. Explain the Kernel trick for learning non-linear functions (C5) 4. Show the relation between two forms of representation of a hyperplane (C3)
Unit 5: Deep Learning	
Introduction to Deep Learning, Introduction to convolutional Neural Network (CNN), CNN Architecture and layers, Building simple CNN model for classification, Training and Testing the CNN model	1. Define Deep Learning. (C1) 2. Describe the applications of deep learning. (C2) 3. Explain the architecture of Deep Neural Network and CNN (C5) 4. Design a classifier for the image classification system. (C5)
Unit 6: Reinforcement Learning	
Characteristics, N-arm Bandit Problem, Calculating the Value Function, Associative Learning – Adding States, The Markov Property & Markov Decision Process	1. Explain the concept of Multi-Armed Bandit Problem (MABP). (C2) 2. Write the functions of Upper Confidence Bound (UCB) algorithm. (C3) 3. Outline the learning process and characteristics of reinforcement learning. (C4)

	4. Explain about Markov decision process. (C5)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. T. Mitchell, “Machine Learning”, McGraw-Hill, 1997. 2. E. Alpaydin, “Machine Learning”, MIT Press, 2010.

	3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. 4. R. Duda, E. Hart, and D. Stork, "Pattern Classification", Wiley Interscience, 2000. 5. Satish Kumar, "Neural Networks - A Class Room Approach", Second Edition, Tata McGraw-Hill, 2013. 6. T. Hastie, R. Tibshirani and J. Friedman," The Elements of Statistical Learning: Data Mining", Inference and Prediction, Springer, 2nd Edition, 2009. 7. Jason Bell, "Machine Learning for Big Data", Wiley Big Data Series, 2016. 8. J. Shawe-Taylor and N. Cristianini, "Kernel Methods for Pattern Analysis", Cambridge University Press, 2004. 9. S. Haykin, "Neural Networks and Learning Machines", Prentice Hall of India, 2010. 10. Rama Murthy G, "Multidimensional Neural Networks Unified Theory", New Age International, 2008. 11. F. Camastra and A. Vinciarelli, "Machine Learning for Audio, Image and Video Analysis – Theory and Applications", Springer, 2008.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Advanced Applications of Probability and Statistics
Course Code: MCL 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** MCL 601

Synopsis:	This course provides an introduction to advanced applications of probability and statistics for multivariate and time series data.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Compute and interpret descriptive statistics for multivariate data
CO 2:	Apply linear and logistic regression models for practical problems and assess model performance
CO 3:	Interpret the output of principal component analysis (PCA) applied to multivariate data for dimension reduction
CO 4:	Identify multivariate data with mixed data type features and cluster using an appropriate technique
CO 5:	Understand the basics of time series modelling and apply to real-life problems

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*								
CO 2	*	*	*	*							
CO 3	*	*	*	*				*			
CO 4		*	*	*	*	*					
CO 5	*	*	*								

Course content and outcomes:

Content	***Competencies***
Unit 1: Multivariate Distributions	
Mean vector, covariance and correlation – population vs. sample - The	1. Understand the organisation of multivariate data (C2).

multivariate Gaussian – joint-, marginal-, and conditional distributions, Mahalanobis distance and outliers - Properties of the multivariate Gaussian - Parameter estimation: maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP).	2. Relate multivariate population and sample parameters (C4). 3. Understand and apply multivariate Gaussian modelling to practical problems (C2, C3). 4. Compare parameter estimation using different probabilistic approaches (C4).
Unit 2: Linear and Logistic Regression	
Simple linear regression – regression model, estimating and interpreting coefficients, accuracy of coefficient estimates and model, ANOVA, R2 statistic - Multiple linear regression – estimating coefficients, qualitative predictors, interaction effects, potential problems - Logistic regression – binary and multinomial logistic regression models, estimating and interpreting coefficients, assessing model calibration and discrimination, area under the ROC curve.	1. Model a linear relationship between input and output variables, and assess model performance (C5). 2. Use different performance metrics to conclude what is a good linear fit to the data (C6). 3. Interpret model coefficients and investigate the effect of input variables on output through sensitivity analysis (C6). 4. Apply logistic regression modelling for binary and multiclass classification and assess model performance (C6).
Unit 3: Principal Component Analysis, Cluster Analysis	
Geometric intuition of principal components - Maximum variance perspective – algebraic setup, eigenvectors and eigenvalues of sample correlation matrix - Interpretation and application of principal components for dimension reduction. Dissimilarity measures for mixed data types - Partition around medoids (PAM)	1. Understand the mathematical foundation of principal component analysis (PCA) (C2). 2. Perform and interpret the output of PCA applied to multivariate data for dimension reduction (C6). 3. Assess when PCA is applicable for clustering multivariate data (C6). 4. Compare and contrast methods for clustering multivariate data with mixed data types (C6).

vs. K-means algorithms - Selecting the number of clusters.	
Unit 4: Bootstrapping, Time Series Analysis	
Time series concepts: stationarity, trend, seasonality, autocorrelation - Autoregressive moving average (ARMA) models - Resampling, smoothing, windowing, and rolling average - First and second order differencing - Validating time series predictions.	1. Understand the basic principles of bootstrapping as an experimental method to estimate the sampling distributions of a statistic (C2). 2. Understand the basic mathematical principles of time series modelling (C2). 3. Apply time series modelling to practical problems (C3). 4. Interpret the results of times series model predictions (C3).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2		*	*	*	
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. An Introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer; 1st Edition, 2013, Corr. 7th printing 2017 Edition. 2. An Introduction to Applied Multivariate Analysis with R, Brian Everitt and Torsten Hothorn– Springer Publications,1st Edition, 2011. 3. Machine Learning - A Probabilistic Perspective, Kevin P. Murphy, The MIT Press; 1st Edition, 2012. 4. Mathematics for Machine Learning, Marc Peter Deisenroth, A Aldo Faisal, and Cheng Soon Ong, Cambridge University Press, 2020. – Online resource from Cambridge University Press available at https://mml-book.github.io/book/mml-book.pdf

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Big Data in Healthcare
Course Code: HDA 603	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basic Python programming, Basic Java programming

Synopsis:	This Course provides insight on 1. Students learn the concept of big data characteristics, batch and lambda architecture. 2. The basics of file systems in Big Data 3. The concepts of Hadoop framework, Spark framework and their internals. 4. Map-reduce programming, Spark programming. 5. Different layers with use cases demonstrations.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Discover the data involved in big data.
CO 2:	Infer using the distributed file system.
CO 3:	Experiment with the Hadoop and Spark framework for process the data.
CO 4:	Develop Map-reduce applications for Big Data.
CO 5:	Develop Spark applications for Big Data.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*	*							
CO 2	*	*	*	*							
CO 3	*	*	*	*							
CO 4	*	*	*	*							
CO 5	*	*	*	*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Big Data	

Big Data Terminologies – Why Big Data – Big Data in HeathCare – Case Studies of Big Data in Healthcare	1. To describe the data size in big data. (C1). 2. To analyse the Big Data use in Healthcare application. (C4) 3. Discover the healthcare applications as case study. (C3)
Unit 2: Introduction to Clustering – Architectures	
-Models of distributed computations - Global state of a distributed system - Centralized, decentralized and hybrid architectures - Virtualization and distribution of computations – Introduction to Cloud Architecture – Basics of Cloud – Introduction to AWS & AZURE	1. programs with Java. (C1). 2. To examine the different models and architectures of distributed computations. (C4). 3. To interpret the Centralized, decentralized and hybrid architectures. (C2). 4. To experiment and illustrate the cloud infrastructure and its types. (C4).
Unit 3: Google File System and Hadoop System	
The design rationale of GFS - Basic architectural –aspects - Consistency model - Implementation details	1. Review the Google File System and Hadoop System. (C2). 2. Recognize the design rationale of GFS. (C2). 3. Review and Summarise the Basic architectural and Consistency model. (C2)
Unit 4: Google Big Table	
Architecture of column-oriented data stores - Bigtable data model and its rationale Bigtable implementation details –AWS dynomo DB	1. Infer the basics of Google Big Table. (C2). 2. Describe the Architecture of column-oriented data stores. (C2). 3. Infer the Bigtable data model and its rationale Bigtable. (C2). 4. Explain and illustrate the AWS dynomo DB. (C4).
Unit 5: MapReduce	
Google's MapReduce architecture - Fault-tolerance in MapReduce systems.	1. Scalability in the batch layer MapReduce: a paradigm for Big Data computing. (C4).

- Two-stage map-reduce example. - Incremental MapReduce	2. To illustrate a Case study. Example: Summing bird library for distributed MapReduce platforms. (C5). 3. Explain the MapReduce programming and working. (C2). 4. Discuss on the Google's MapReduce architecture. (C2).
Unit 6 : The Hadoop environment	
HDFS - MapReduce with YARN - Cluster setup and configuration - Hive – data summarization, query and analysis - Spark – high volume in-memory data querying and analysis - HBase distributed database	1. Explain the concept of Fault-tolerance in MapReduce systems. (C2). 2. Practice the Two-stage map-reduce example. (C6). 3. Rearrange and explain the Incremental MapReduce. (C6).
Unit 7: The Hadoop environment	
HDFS - MapReduce with YARN - Cluster setup and configuration - Hive – data summarization, query and analysis - Spark – high volume in-memory data querying and analysis - HBase distributed database	1. Explain the working of Hadoop environment. (C2). 2. Explain the HDFS and its utility. (C2). 3. Illustrate example of MapReduce with YARN and its architecture. (C4). 4. Illustrate and experiment Cluster setup and configuration. (C4). 5. Explain Hive data summarization, query and analysis. (C2). 6. Explain the Spark high volume in-memory data querying and analysis. (C2). 7. Explain and illustrate HBase distributed database. (C2).
Unit 8: Stream data	
Steam data in HIS – handling Stream Data with kafka and Tensorflow – Models	1. Discuss on the introduction of stream data. (C2)

	2. Explain the steam data in HIS. (C2). 3. To experiment and illustrate handling Stream Data with Kafka and TensorFlow. (C2).
Unit 9: IoT in healthcare	
M2M Architecture IoT with Big Data – MQTT protocol – Case studies.	1. Discuss on the IoT in Healthcare. (C2). 2. Explain the M2M Architecture IoT with Big Data. (C2). 3. Illustrate and experiment the MQTT protocol. (C4). 4. Explain and experiment the case studies. (C2).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation					*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Health Informatics: An Interprofessional Approach - Ramona Nelson and Nancy Staggers. 2. Healthcare Informatics - WIlliam Hanson - McGraw-Hill Education. 3. Handbook of Research on Informatics in Healthcare and Biomedicine - Athina A. Lazakidou.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Medical Imaging Systems
Course Code: HDA 604	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Healthcare Data Management and Digital Imaging Representation & Characteristics

Synopsis:	1. This course provides the theoretical background of imaging techniques in medicine and standards in healthcare. 2. This course provides the depth knowledge on medical imaging formats used for reporting and visualization. 3. This course provides the overview of medical image archival and communication. 4. This course elucidate the workflow involved in Radiodiagnosis and imaging in a hospital set-up. 5. This course provides the concept of phenotyping medical images using radiomics and pathomics. 6. This course gives the knowledge of remote diagnosis using tele-radiology and telemedicine technology.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain the technique involved in medical image acquisition using different modalities and illustrate medical image format used to view, report and visualize using different anatomical planes and views for better diagnosis.
CO 2:	Identify and explain interoperability standards in Healthcare.
CO 3:	Describe the radiological workflow from patient registration for a study till reporting the study with archiving medical images and reports.
CO 4:	Demonstrate comparison of imaging data with phenotypes extracted using radiomics and pathomics.
CO 5:	Explain the importance of privacy and confidentiality in tele-radiology and telemedicine.
Mapping of COs to POs	

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*	*							
CO 2	*	*	*	*							
CO 3	*	*	*	*							
CO 4	*	*	*	*							
CO 5	*	*	*	*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Imaging Systems in Healthcare	
Introduction to Radiodiagnosis and imaging, Interoperability standards, medical imaging evolution	1. Describe the role of Radiodiagnosis and imaging in medicine (C2) 2. Understand the use of interoperability standards in healthcare (C3) 3. Classifies the evolution of medical imaging modalities (C3)
Unit 2: Human Anatomical Planes and Views	
Introduction to Human Anatomy, Directional Terms, Planes of the body, Body Cavities	1. Identifies the different anatomical planes and views to visualize medical images (C2) 2. Describe human anatomy (C2) 3. Identify and summarize the understanding on medical imaging modalities (C2)
Unit 3: Medical Imaging Modalities	
X-ray, Computed Tomography, Magnetic Resonance Imaging, Ultrasonography, Positron Emission, Tomography, Thermal Imaging	1. Recognizes the physics of electromagnetic spectrum (C1) 2. Outlines the interaction of X-rays with matters (C1, C2) 3. Describe the evolution of CT scan (C2) 4. Memorize the concept of magnetic field (C1) 5. Understand the role of magnetic field in imaging human body (C2, C3) 6. Memorize the resonance effect and its role in generating echo (C1)

	7. Explain the different modes and effects of sound waves in imaging human body (C3) 8. Explain the role of ionization and gamma radiation in imaging human body (C2) 9. Memorize the role of near-infrared illumination in low-light imaging to capture temperature (C1)
Unit 4: DICOM	
Introduction to DICOM, Value Representations and Dictionary, Encoding data elements, encoding data groups, Element and Group lengths, Storing Image Data, unique Identifier, DICOM IODs, DICOM SOPs, DIMSE Services, Conformance statement, Association Establishment, Transfer Syntax and Abstract Syntax, DICOM Modules	1. Identifies the role of interoperability standards in healthcare (C1) 2. Explains the role of DICOM in medical imaging (C2) 3. Categorize the real world data to DICOM world using DICOM dictionary and value representation (C4) 4. Identifies method for encoding and decoding DICOM data elements (C4) 5. Apply the knowledge of DICOM in understanding the workflow establish an association till releasing an association (C3) 6. Identifies DICOM services and category of services (C4)
Unit 5: HL7	
Background and general Information, reading of data based on HL7 formatting, and Data Exchange between medical applications. Essentials of messages, based on HL7 Version2 formatting.	1. Describe the background of HL7, data based on HL7 formatting (C2) 2. Construct HL7 messages for data exchange between two application using HL7 version 2 (C5, PO5)
Unit 6 : PACS	

Introduction to PACS, Comparison of a PACS system with a film based system, PACS components, Image archiving and distribution, Image database, Image workstation requirements, Systems operation, Maintenance and reliability.	1. illustrate the importance of PACS and its application in medical image archiving and communication (C3, PO6) 2. Discover the difference between traditional image archiving and PACS based (C3) 3. Demonstrate the radiological workflow (C3, PO6) 4. Explain basic functionalities of RIS (C2)
Unit 7: Radiology Information System	
Basic functionalities of RIS, Radiology work flow, Results and Reporting	1. Identify radiomic and pathomics phenotype (C2)
Unit 8: Radiomics and Pathomics	
Radiographic phenotyping, Clinical Significance of quantitative approach, features and feature selection, PyRadiomics, Image analytics using radiomic and Pathomics features	1. Explains clinical significance of the feature extraction and analysis (C2) 2. Demonstrate phenotype analysis using Pyradiomics (C6) 3. Compare radiomic features for clinical significance (C6)
Unit 9: Telemedicine and Teleradiology	
International Regulations in eHealth, Telemedicine History, Confidentiality and privacy, Telecommunication system applied to telemedicine, Devices, Image transfer and viewing, Applications of teleradiology	1. Describe regulations, confidentiality and privacy aspects in eHealth (C2, PO10) Describe telecommunication in telemedicine and tele-radiology (C1)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04

Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation					*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] "Handbook of Biomedical Instrumentation" by R.S.Khandpur, Tata McGraw Hill. [2] "Principles of Medical Imaging" by K. Kirk Shung, Michael B. Smith, Benjamin M.W. Tsui [3] "Digital Imaging and Communication in Medicine(DICOM)" by Oleg S Pianykh, Springer. [4] "HIMSS Dictionary of Healthcare Information Technology Terms, Acronyms and Organizations", Second Edition, HIMSS, ISBN 13978-1-938904-03-5

	[5] "Telemedicine and Telehealth 2.0: A Practical Guide for Medical Providers and Patients" by Victor Lyuboslavsky, Paperback. [6] "The Biomedical Engineering: Handbook" by BRONZINO, J D. Volume 1, 2. Boca Raton : CRC Press, 2000. ISBN 0-8493-0461-X.

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(Deemed to be University under Section 3 of the UGC Act, 1956)

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Entrepreneurship
Course Code: ENP-601	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** -

Synopsis:	This course introduces students to the theory of entrepreneurship and its practical implementation. It focuses on different stages related to the entrepreneurial process, including business model innovation, monetization, small business management as well as strategies that improve performance of new business ventures. Centered on a mixture of theoretical exploration as well as case studies of real-world examples and guest lectures, students will develop an understanding of successes, opportunities and risks of entrepreneurship. This course has an interdisciplinary approach and is therefore open to students from other Majors.
Course Outcomes (COs):	On successful completion of this course, students will be able to:
CO 1:	To impart knowledge on the basics of entrepreneurial skills and competencies to provide the participants with necessary inputs for creation of new ventures.
CO 2:	To familiarize the participants with the concept and overview of entrepreneurship with a view to enhance entrepreneurial talent
CO 3:	To appraise the entrepreneurial process starting with pre-venture stage
CO 4:	To Create and exploit innovative business ideas and market opportunities
CO 5:	To Build a mind-set focusing on developing novel and unique approaches to market opportunities
CO 6:	To explore new vistas of entrepreneurship in 21st century environment to generate innovative business ideas through case studies.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2				*							
CO 3			*								
CO 4						*					

CO 5								*			
CO 6										*	

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to Entrepreneurship	
Meaning and Definition of Entrepreneurship-Employment vs Entrepreneurship, Theories of Entrepreneurship, approach to entrepreneurship, Entrepreneurs VS Manager	1. Explain the meaning of Entrepreneurship (C1) 2. Discuss the theories of Entrepreneurship (C1) 3. Discuss the approaches to Entrepreneurship (C1)
Unit 2: Entrepreneurial Traits	
Personality of an entrepreneur, Types of Entrepreneurs	1. Discuss the Personality traits of entrepreneurs. (C2)
Unit 3: Process of Entrepreneurship	
Factors affecting Entrepreneurship process	1. Identify the fundamentals and responsibilities of entrepreneurship (C2) 2. Exemplify one's capabilities in relation to the rigors of successful ventures (C3) 3. Identify and differentiates the different characteristics and competencies of an entrepreneurs (C2)
Unit 4: Business Start-up Process	
Idea Generation, Scanning the Environment, Macro and Micro analysis	1. Explain the Process of Business start up (C1) 2. Develop creativity and critical thinking in identifying opportunities (C5) 3. Apply innovative approaches in envisioning ones entrepreneurial career (C3)
Unit 5: Business Plan writing	
Points to be considered, Model Business plan	1. Identify different business models (C3) 2. Describe different parts of a business plan(C2)
Unit 6: Case studies	

Indian and International Entrepreneurship	1. Perform self-assessment and analyse entrepreneurial personal traits and competencies (C4) 2. Evaluate oneself and plan courses of action to help develop one's entrepreneurial characteristics and competencies. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	*	*				
Sessional Examination 2			*	*		
Assignment/Presentation					*	*
End Semester Examination	*	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. NVR Naidu and T. Krishna Rao, "Management and Entrepreneurship", IK International Publishing House Pvt. Ltd 2008. 2. Mohanthy Sangram Keshari, "Fundamentals of Entrepreneurship", PHI Publications, 2005 3. Butler, D. (2006). Enterprise planning and development. USA: Elsevier Ltd. Gerber, M.E. (2008) Awakening the entrepreneur within. NY: Harper Collins.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Text Analytics in Healthcare
Course Code: HDA-606	**Course Instructor:**
Academic Years: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Data structures and data interpretation

Synopsis:	This Course provides insight on 1. Capable to extract transform and load text data 2. Performs text mining from loaded data 3. Apply natural processing language knowledge to analyse text
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Demonstrate regular expression, parser, and Lexical analyser.
CO 2:	Illustrates levels of linguistic analysis in natural language processing
CO 3:	Discover sampler of text mining applications and services
CO 4:	Demonstrate Document Imaging & Optical Character Recognition (OCR) in Healthcare.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2	*	*	*		*						
CO 3	*	*	*		*						
CO 4	*	*	*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Text Analytics	
Text Data – Mining – Data Mining vs Text Mining – Text as Data - Text mining terminologies	1. Describe fundamentals of data mining(C1) 2. Discuss text mining terminologies (C2)
Unit 2: Text Processing	
Introduction to regular expressions – parsers – lexical analysis.	1. Explain regular expressions and parser in text data (C2) 2. Explain lexical analysis (C2)
Unit 3: The text mining pipeline	
information retrieval, information extraction and data mining.	1. Describe information extraction and mining from text (C2)

	2. Illustrates levels of linguistic analysis in natural language processing (C3)
Unit 4: Fundamentals of natural language processing	
linguistic foundations, levels of linguistic analysis.	1. Demonstrate text extraction using python (C3) 2. Practice natural language processing techniques (C3)
Unit 5: Approaches to text mining	
rule-based vs. machine learning based vs. hybrid; generic vs. domain specific; domain adaptation. - Dealing with real text: text types, document formats and conversion, character encodings, markup, low-level processes (sentence splitting, tokenisation, part of speech tagging, chunking).	1. Interpret different types of approaches for text mining (C3) 2. Explain domain adaptation for types of real text (C2) 3. Explain low level processing of text (C2) 4. Explain information extraction from text (C2)
Unit 6: Information extraction	
term extraction, named entity recognition, relation extraction, fact and event extraction; partial analysis vs. full analysis.	1. Explain partial analysis and full analysis of extracted information (C2)
Unit 7: Evaluation of text mining systems	
evaluation measures, role of evaluation challenges, usability evaluation.	1. Illustrate role of evaluation of mining system (C2)
Unit 8: Resources for text mining	
annotated corpora, computational lexica, ontologies, computational grammars; design, construction and use issues.	1. Discuss resources for text mining (C3)
Unit 9: Issues in large scale processing of text	
distributed text mining, scalable text mining systems.	1. Discuss computational grammars for text mining (C3)

	2. Explain distributed text mining to overcome issues with large scale processing of text.(C2)	
Unit 10:		
A sampler of text mining applications and services; case studies.	1. Employ sampler of text mining applications and services (C3)	
Unit 11: Document Imaging & Optical Character Recognition (OCR) in Healthcare		
Preprocessing – Character recoginition - Postprocessing - OCR softwares and library – examples with PYTESSERACT - Deep Learning based Text Recognition (OCR) using Tesseract and OpenCV	1. Explain OCR in healthcare (C2) 2. Discuss OCR software and library (C2) 3. Explain deep learning based text analysis (C2)	
Unit 11: Text Analysis for Healthcare Algorithms		
ConText – cTakes	**1.** Explain algorithms for text analysis for healthcare data (C2)	
Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**
Assessment Methods:		
Formative:	**Summative:**	
Internal practical Test	Sessional examination	

Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation				*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] Text mining handbook: advanced approaches in analyzing unstructured data Feldman, Ronen and James Sanger, 9780521836579, CUP, 2008 [2] Linked Lexical Knowledge Bases Iryna Gurevych, Judith Eckle-Kohler, Michael Matuschek,9781627059749, Morgan & Claypool, 2016 [3] Introduction to information retrieval Manning, Christopher D. and Prabhakar Raghavan and Hinrich Schutze, 9780521865715, Cambridge University Press,2008 [4] Text mining: classification, clustering and applications Srivastava, Ashok and Mehran Sahami (eds.)., 9781420059403, Chapman & Hall,2009 [5] Weiss, S. M., Indurkhya, N., Zhang, T. (2010). Fundamentals of Predictive Text [6] Mining. Springer: New York. ISBN: 978-1849962254 [7] Pustejovsky, J. and Stubbs, A. (2012). Natural Language Annotation for Machine [8] Learning. O'Reilly. [9] Foundations and Trends in Information Retrieval, 2(1-2): 1–135. Available online at: http://www.cs.cornell.edu/home/llee/opinion-mining-sentiment-analysis-survey.html.

	[10] Manning, C. D., Raghavan, P., and Schutze, H. (2008). Introduction to Information Retrieval, Chapters 6 and 13-18, Cambridge University Press. Available online at: http://nlp.stanford.edu/IR-book/ [11] Articles: https://www.healthcatalyst.com

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics))
Course Title:	Blockchain Technology
Course Code: DA-607	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Network Concepts

Synopsis:	This Course provides insight on understanding the working of blockchain technology and how blockchain platform works. The course discuss on the nuances involved in blockchain technology and its implementation on the blockchain platform.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Outline the characteristics of the blockchain ecosystem.
CO 2:	Develop the blockchain ecosystem using Ethereum.
CO 3:	Evaluate the application based on Ethereum.
CO 4:	Examine the development process using Hyperledger.
CO 5:	Demonstrate the blockchain application development process.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*		*							
CO 2	*				*						
CO 3	*	*	*		*						
CO 4	*	*									
CO 5	*		*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1:	

Introduction to Blockchain - Potential of Blockchain – Defining Blockchain – Ownership – Understanding Ledger – Ledger Structure – Concepts of Ownership – Centralized vs Decentralized - Components of a Blockchain -Characteristics of Blockchain - The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Types of blockchain – Consensus - CAP theorem and blockchain - Decentralization using blockchain Methods of decentralization- Routes to decentralization - Blockchain and full ecosystem decentralization- Smart contracts- Decentralized Organizations.	At the end of the topic student should be able to: 1. To describe the potential of blockchain and its architecture. (C2) 2. To describe the relation between blockchain and smart contracts. (C2) 3. To describe the consensus and CAP theorem. (C2)
Unit 2:	
Ethereum and working with Smart Contracts : Understand Ethereum ,Define Smart Contracts,Identify Cryptocurrency used in Ethereum,Describe Transactions in Ethereum,Define Consensus Mechanism in Ethereum,List Development Technologies,Identify Ethereum Clients, Define Platform Functions,Understand Solidity, Describe Solidity Operators and Functions, Setting up Metamask,How to interface with ethereum network,First smart contract,Ethereum accounts and	1. To describe the working of the smart contracts (C2) 2. To illustrate the concepts involved in Ethereum and its development (C2) 3. To describe the creation of applications using solidity. (C2)

how to receive ether, Structuring a contract,Declaring a function, Deploying and redeploying of a contract,Comparing Wei & Ether,What is a gas transaction,Remix testing.	
Unit 3:	
Hyperledger : Define Hyperledger Blockchain , Understand Hyperledger Consensus Algorithm ,Explain Hyperledger Iroha ,Identify Hyperledger Components ,Describe Setting up Channels Policies ,Chaincodes List Hyperledger , Explorer Components ,Define Hyperledger Composer,Fabric Under the Hood (Concepts & Terminology),Ledger Implementation,Dev Environment Walkthrough: Peer & CouchDB setup,Ledger Implementation,Peers Nodes : Anchors and Endorsers, Anchor Peers & Endorsing Peers,Clients Node: Endorsement Policies, Client Peer & Endorsing Policies Orderer Nodes,Membership Service Provider & Certification Authority,Dev Environment Walkthrough: Orderer and CA Server,Chaincode Development.	1. To explain the concepts of Hyperledger (C2) 2. To identify different components in Hyperledger (C2) 3. To illustrate the examples of Hyperledger (C3)
Unit 4:	
Creating private Blockchain with Multichain : Define Multichain , Describe MultiChain Streams , Create	1. To define and describe the multichain blockchain (C2)

& deploy private blockchain ,Explain Connecting to a Blockchain ,Identify Multichain Interactive Mode ,List Native assets ,Define Transaction Metadata ,Explain Streams Explain Mining ,Bitcoin to private blockchain,Aim of multichain,Hand-shake process,Multi-chain use cases,Multichain permission,Multichain assets,multichain streams,Basics of retrieving from streams,Consensus model,Multichain flexibility,Deployment options,Speed and scalability of multichain	2. To explain the mining in multichain process (C3) 3. To illustrate the deployment of multichain blockchain and its applications (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	36	72
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	36	72
Revision	-	-
Assessment	6	-
TOTAL	**78**	**144**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*	*		
Sessional Examination 2			*	*	*
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	End-Semester Feedback
Reference Material	1. **Blockchain Basics: A Non-Technical Introduction in 25 Steps**, Daniel Drescher, Apress; 1st Edition, 2017. 2. **Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions**, Bikramaditya Singhal, Gautam Dhameja , Priyansu Sekhar Panda, Apress; 1st ed. Edition, 2018. 3. **Mastering Blockchain**, Imran Bashir, Ingram short title, Second Edition, 2018. 4. **Hands-On Blockchain with Hyperledger**, Petr Novotny Venkatraman Ramakrishna Nitin Gaur Anthony O'Dowd Luc Desrosiers, Ingram short title, 2018. 5. **Solidity Programming Essentials**, Ritesh Modi, Ingram short title, 2018 6. **BlockChain from Concept to Execution**, Debajani Mohanty, BPB; 2nd revised and updated edition, 2018. 7. **Mastering Blockchain Programming with Solidity: Write production-ready smart contracts for Ethereum blockchain with Solidity**, Jitendra Chittoda, Packt Publishing Limited, 2019.

8. **Hands-On Blockchain with Hyperledger**, Petr Novotny Venkatraman Ramakrishna Nitin Gaur Anthony O'Dowd Luc Desrosiers, Ingram short title, 2018
9. **Blockchain for Dummies**, Tiana Laurence, 2nd edition – 2019.
10. **Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment**, David Hoover, Kevin Solorio, Randall Kanna, Shroff/O'Reilly; First edition, 2019.
11. **Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger**, Bellaj Badr , Richard Horrocks, Xun (Brian) Wu , Packt Publishing Limited, 2018.
12. **Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners**, Chris Dannen, APRESS, 1 edition, 2017.
13. **Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations**, Henning Diedrich, CreateSpace Independent Publishing Platform; 1st edition, 2016.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Responsive Web Application Development
Course Code: IOT 605	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basic Programming

Synopsis:	This Course provides insight on 1. The front-end section includes working with HTML, CSS3 and Bootstrap to design interactive and responsive web pages whereas the back-end section consists of programming in PHP with MySQL, XML, and JSON. 2. Develop a platform friendly web application or a website using Bootstrap, Angular JS, React JS, and Node JS.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Prepare a dynamic webpage by the use of java script. (C3).
CO 2:	Summarize a well formed / valid XML document. (C2)
CO 3:	Schedule web application connect to a DBMS to perform insert, update and delete operations. (C3)
CO 4:	Practice converting the string and parse using JSON objects (C3)
CO 5:	Apply Bootstrap, Angular JS, React JS, Node JS to construct modern website (C3)

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*			*							
CO 2		*	*								
CO 3	*		*	*							
CO 4			*	*							
CO 5	*		*	*	*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Internet and Web Technology	

Client Server Model, Tier Architecture, Types of Servers, Web Hosting, Responsive Design	1. Explain Client Server Model, Tier Architecture 2. List out the types of Servers 3. Describe the importance of Web Hosting and Responsive Design
Unit 2: HTML	
Basic tags of HTML, Common Tags, Formatting Tags, Images and Linking, List and Table Structure, Forms, and control: Text, Radio, Checkbox, Select, Button, Input, HTML5: HTML Graphics, HTML Media, HTML API .	1. Construct the Basic web page using tags of HTML (C4). 2. Compare the difference between semantic and non-semantic tags (C5) 3. Design web page using Common Tags, Formatting Tags, Images and Linking, List and Table Structure. (C5) 4. Forms and control Text, Radio, Checkbox, Select, Button, Input(C5) 5. Explain the importance of HTML Graphics, HTML Media, HTML API (C4)
Unit 3: CSS3	
Inline styles, internal style sheets, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu.	1. Design web pages using Inline styles, internal style sheets, linking external style sheets(c5) 2. Differentiate between absolute and relative positioning elements(C4) 3. Apply backgrounds to web pages (c5). list out the different element dimensions (c1) 4. Importance of Box Model and text flow, Media Types (C2) 5. Building a CSS drop-down menu(c5)
Unit 4: Javascript	
Elements of Java Script - Variables, Data Types, Operators, Control Statements, Functions, Dialog - obtaining user input with prompt dialogs, Document Object	1. List out the applications of JavaScript (C1). 2. Explain the elements of Java Script - Variables, Data Types, and Operators (C3). 3. Develop web page by using conditional statement to control the execution (C5).

Model(DOM) - Document, Form, Event Handling, JQUERY, AJAX	4. Create web page to perform repetitive task using looping statements (C5) 5. Develop web page using Functions Dialog - obtaining user input with prompt dialogs. (C5) 6. Explain the importance of Document Object Model – Document(C3) 7. Validate a Form using pattern matching operators (C3). 8. Distinguish between traditional web applications and AJAX applications(C4). 9. Create web page with AJAX (C5).
Unit 5: XML vs JSON vs YAM	
Introduction and Features, Use of XML, XML document, Creating XML, DTD, Reading XML, Introduction to JSON, JSON Structure, Object Representation, YAML, YAML structure, USE Case	1. Representation, YAML, YAML structure (C3) 2. Create JSON data (C3) 3. Explain the importance of XML.(C3) 4. List out the applications of XML,(C1) 5. Construct XML document and Reading XML (C4)
Unit 6	
PHP, MYSQL Connection, CRUD Operations, Handling JSON, XML data	1. Explain the concept of server side scripting language like PHP(C2). 2. Able to connect database using MYSQL(C5) 3. Create JSON, XML data (C4)
Unit 7	
BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS	4. Create a Responsive web page using Bootstrap, Angular JS, React JS and Node JS(C5) **5.** Develop web page using the framework(C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60

Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	*	*				
Sessional Examination 2			*	*		
Assignment/Presentation	*	*	*	*	*	*
End Semester Examination	*	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004. 2. Jamsa Krishna, "Introduction to web development using HTML5", 2014. 3. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010. 4. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014. 5. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. .

	6. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008. 7. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009. 8. Brian Totty, David Gourley, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy, "HTTP: The Definitive Guide", O'Reilly Media, 2009.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	IT Project Management
Course Code: CSE 631	**Course Instructor:**
Academic Year: 2020 – 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Familiarity in developing application using any high level language

Synopsis:	This Course provides insight on 1. The concept of software development process and project management 2. Illustrates the difference between a lab assignment and group project 3. Help the students to understand the finer points of Project management 4. Bring awareness about the processes, tools and techniques involved in the field of IT project management
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Illustrate the importance of project planning.
CO 2:	Discuss and demonstrate various tools applicable for different phases of the software project.
CO 3:	Illustrate the importance of Change management.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2		*	*								
CO 3	*		*								

Course content and outcomes:

Content	***Competencies***
Unit 1: Software Project Planning	
Understand the Project Needs, Create the Project Plan, Diagnosing Project Planning Problems	1. Understand the project needs, necessity of plan, Define the Project Plan, Diagnosing Project Planning Problems (C1)
Unit 2: Estimation	

Elements of a Successful Estimate, Wideband Delphi Estimation, Other Estimation Techniques, Diagnosing Estimation Problems.	1. List the importance of estimation and describe different estimation techniques (C2) 2. Discuss the significance of Reviews and different review techniques (C2)
Unit 3: Project Schedules	
Building the Project Schedule, Managing Multiple Projects, Use the Schedule to Manage Commitments, Diagnosing Scheduling Problems.	1. Outline the steps in building project schedule.(C1) 2. Indicate mechanism of managing multiple projects. (C2)
Unit 4: Reviews	
Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming, Use Inspections to Manage Commitments, Diagnosing Review Problems.	1. Discuss the significance of Reviews and different review techniques (C2)
Unit 5: Software Requirements	
Requirements Elicitation, Use Cases, Software Requirements Specification, Change Control, Introduce Software Requirements Carefully, Diagnosing Software Requirements Problems	1. Introduce to requirement elicitation techniques, design and demonstrate the requirement documentation by field visits(C2)
Unit 6 : Design and Programming	
Review the Design, Version Control with Subversion, Refactoring, Unit Testing, Use Automation, Be Careful with Existing Projects, Diagnosing Design and Programming Problems	1. Illustrate the key steps in design and programming phase. Version control and unit testing significance (C3)
Unit 7: Software Testing	
Test Plans and Test Cases, Test Execution, Defect Tracking and Triage, Test Environment and Performance Testing, Smoke Tests, Test Automation,	1. Define the test plans, significance of test phase and the test case characteristics. Introduce different types testing and significance of type of testing.(C2)

Postmortem Reports, Using Software Testing Effectively, Diagnosing Software Testing Problems	
Unit 8: Understanding Change	
Why Change Fails, How to Make Change Succeed	1. Illustrate the necessity of Change management system – developing impact analysis document and its importance (C3).
Unit 9: Management and Leadership	
Take Responsibility, Do Everything Out in the Open, Manage the Organization, Manage Your Team	1. Understand the role of management in motivating the team, finer points of managing the team (C2)
Unit 10: Managing an Outsourced Project	
Prevent Major Sources of Project Failure, Management Issues in Outsourced Projects, Collaborate with the Vendor	1. Describe the differences of managing the outsourced project, typical point of conflicts(C2) 2. Review of the project management process (C2)
Unit 10: Process Improvement	
Life Without a Software Process, Software Process Improvement, Moving Forward	**1.** Analyse the projects without process and continuous process improvements initiatives needed for success of the project (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-

TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2	*		*
Assignment/Presentation	*	*	
End Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Applied Software Project Management" By Jennifer Greene, Andrew Stellman (O'Reilly Publications) 2005. 2. "The Art of Project Management" By Scott Berkun (O'Reilly Publications) 2005.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Machine Learning for Big Data Lab
Course Code: BDA 605L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Programming with Python and Data Visualization

Synopsis:	This Course provides insight on
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Demonstrate activation functions, weights and threshold units in artificial neural networks
CO 2:	Demonstrate Artificial Neural Network, Clustering, Support Vector Machine, Deep Neural Network and Reinforcement Learning models
CO 3:	Analyse Artificial Neural Network, Clustering, Support Vector Machine, Deep Neural Network and Reinforcement Learning models
CO 4:	Compare and contrast single layer, multilayer and deep neural networks in terms of accuracy in classification
CO 5:	Design different types of artificial neural network models, clustering models, deep neural network models, reinforcement learning models

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Artificial Neural Networks	

Neurons and biological motivation. Activation functions and threshold units. Supervised and unsupervised learning Perceptron Model: representational limitation and gradient descent training. Multilayer networks and back propagation. Overfitting.	1. Demonstrate activation functions, weights and threshold units in artificial neural networks (C3) 2. Demonstrate ANN models (C3) 3. Design of ANN models for classification (C5) 4. Analyse the performance issues (C4)
Unit 2: Clustering	
Learning from unclassified data. Clustering. Hierarchical Aglomerative Clustering. Non-Hierarchical Clustering - k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabled data.	1. Demonstrate various clustering models in machine learning (C3) 2. Design different types of clusters (C5) 3. Analyse the performance of clustering techniques on different data (C4) 4. Apply clustering techniques for data analysis. (C3)
Unit 3 Kernel Methods	
Dual Representations Design of Kernels	1. Design of different kernel techniques (C5)
Unit 4: Support Vector Machines (SMV)	
Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Varying length pattern classification using SVM	1. Demonstrate Maximum margin linear separators. (C3) 2. Design SVM classifiers (C5) 3. Analyse the performance of SVM (C4)
Unit 5: Deep Learning	
Introduction to Deep Learning	1. Develop Deep Neural Network/ CNN (C5)

Introduction to convolutional Neural Network (CNN) CNN Architecture and layers Building simple CNN model for classification Training and Testing the CNN model	2. Design a classifier for the image classification system. (C5) 3. Compare performance of CNN and ANN for image classification (C4)

Unit 6: Reinforcement Learning	
Characteristics N-arm Bandit Problem Calculating the Value Function Associative Learning – Adding States The Markov Property & Markov Decision Process	1. Apply reinforcement learning model using different principles (C3) 2. Analyse various reinforcement learning techniques (C4) 3. Design of reinforcement learning models (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**

Internal practical Test - yes	Sessional examination
Theory Assignments	End semester examination - yes
Lab Assignment & Viva - yes	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation			*	*	*
Laboratory examination			*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Machine Learning, T. Mitchell, McGraw-Hill, 1997 2. Machine Learning, E. Alpaydin, MIT Press, 2010 3. Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006 4. Pattern Classification, R. Duda, E. Hart, and D. Stork, Wiley-Interscience, 2000 5. Neural Networks - A Class Room Approach, Satish Kumar, Second Edition, Tata McGraw-Hill, 2013 6. The Elements of Statistical Learning: Data Mining, Inference and Prediction, T. Hastie, R. Tibshirani and J. Friedman, Springer, 2nd Edition, 2009 7. Machine Learning for Big Data, Jason Bell, Wiley Big Data Series 8. Kernel Methods for Pattern Analysis, J. Shawe-Taylor and N. Cristianini, Cambridge University Press, 2004 9. Neural Networks and Learning Machines, S. Haykin, Prentice Hall of India, 2010 10. Multidimensional Neural Networks Unified Theory, Rama Murthy G 11. F.Camastra and A.Vinciarelli, Machine Learning for Audio, Image and Video Analysis – Theory and Applications, Springer, 2008

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Advanced Applications of Probability and Statistics Lab
Course Code: MCL 602L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** MCL 602
Synopsis:	This course provides an introduction to advanced applications of probability and statistics for analysing multivariate and time series data using the R programming language.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Compute and interpret descriptive statistics for multivariate data
CO 2:	Build and assess linear and logistic regression models for practical problems
CO 3:	Perform principal component analysis (PCA) for dimension reduction in multivariate data
CO 4:	Cluster multivariate data with mixed data types
CO 5:	Apply time series modelling to real-life problems

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2		*	*	*	*			*			
CO 3		*	*	*	*			*			
CO 4		*	*	*	*	*		*			
CO 5	*	*	*								

Course content and outcomes:

Content	***Competencies***
Unit 1: Multivariate Distributions	
Mean vector, covariance and correlation – population vs. sample - The multivariate Gaussian – joint-,	1. Compute descriptive statistics of multivariate data (C2).

marginal-, and conditional distributions, Mahalanobis distance and outliers - Properties of the multivariate Gaussian - Parameter estimation: maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP).	2. Perform exploratory data analysis of multivariate data (C4). 3. Identify outliers in multivariate data (C3). 4. Visualise and understand the properties of multivariate Gaussian data (C3).
Unit 2: Linear and Logistic Regression	
Simple linear regression – regression model, estimating and interpreting coefficients, accuracy of coefficient estimates and model, ANOVA, R2 statistic - Multiple linear regression – estimating coefficients, qualitative predictors, interaction effects, potential problems - Logistic regression – binary and multinomial logistic regression models, estimating and interpreting coefficients, assessing model calibration and discrimination, area under the ROC curve.	1. Use in-built functions in R to build linear models for practical problem (C3). 2. Compute different performance metrics to assess model performance (C6). 3. Interpret model coefficients and investigate the effect of input variables on output through sensitivity analysis (C6). 4. Use in-built functions in R to build logistic regression models for practical binary classification problems and assess model performance (C6).
Unit 3: Principal Component Analysis, Cluster Analysis	
Geometric intuition of principal components - Maximum variance perspective – algebraic setup, eigenvectors and eigenvalues of sample correlation matrix - Interpretation and application of principal components for dimension reduction. Dissimilarity measures for mixed data types - Partition around medoids (PAM)	1. Visualise the geometric interpretation of principal component analysis (PCA) (C3). 2. Use in-built functions in R to perform PCA on multivariate data (C3). 3. Compare and contrast PCA for variance maximization vs. clustering of multivariate data (C6). 4. Cluster multivariate data with mixed data types using in-built functions in R (C3).

vs. K-means algorithms - Selecting the number of clusters.	

Unit 4: Bootstrapping, Time Series Analysis

Time series concepts: stationarity, trend, seasonality, autocorrelation - Autoregressive moving average (ARMA) models - Resampling, smoothing, windowing, and rolling average - First and second order differencing - Validating time series predictions.	1. Apply bootstrapping on a practical data set and assess performance (C3). 2. Understand and apply in-built functions in R for time series modelling (C3). 3. Apply time series modelling to practical problems (C3). 4. Interpret the results of times series model predictions (C3).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination

Lab Assignment & Viva				Viva	
Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	*
Assignment/Presentation	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. An Introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer; 1st Edition, 2013, Corr. 7th printing 2017 Edition. 2. An Introduction to Applied Multivariate Analysis with R, Brian Everitt and Torsten Hothorn– Springer Publications,1st Edition, 2011. 3. Machine Learning - A Probabilistic Perspective, Kevin P. Murphy, The MIT Press; 1st Edition, 2012. 4. Mathematics for Machine Learning, Marc Peter Deisenroth, A Aldo Faisal, and Cheng Soon Ong, Cambridge University Press, 2020. – Online resource from Cambridge University Press available at https://mml-book.github.io/book/mml-book.pdf

MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Big Data in Healthcare Lab
Course Code:	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites: Matlab or python**
Synopsis:	This Course provides insight on distributed systems and computing in healthcare
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Experiment with Hadoop framework
CO 2:	Prepare distributed file system for healthcare data
CO 3:	Design map reduce technique to compute healthcare data

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1			*		*	*					
CO 2			*		*	*					
CO 3			*		*	*					

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Big Data	1. Implement hadoop framework (C3)
Unit 2:	
Distributed System	1. Build hadoop environment (C6) 2 Build Distributed file system for healthcare data (C6)
Unit 3:	
Map Reduce Technique	1. Implement map reduce technique to compute healthcare data (C3)

	2. Implement cluster set-up with map reduce technique (C3)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	4. Digital Image Processing- Gonzalez and Woods, Third edition, Pearson Education, 2009 5. Pattern Classification, Richard O Duda, Peter E. Hart, David G.Strok, Wiley-Inderscience Publication, Second edition, 2001. 6. Pattern recognition and Image analysis, Earl Gose, Richard, Johnson Baugh and Steve Jost, Prentice Hall, 2002.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Medical Imaging Systems Lab
Course Code:	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Matlab or python
Synopsis:	This Course provides insight on variuos medical imaging modalities and interoperability standards in healthcare
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Design DICOM viewer
CO 2:	Experimenting DICOM open source simulators for various functionalities
CO 3:	Design HL7 message for healthcare data exchange

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*				*						
CO 2		*			*	*					
CO 3		*			*	*					

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Medical Imaging Modalities	1. Implement DICOM image read and Write operations (C3) 2. Implement DICOM annonymization (C3)
Unit 2:	
DICOM	1. Experiment with DVTK to perform ECHO (C3) 2. Experiment with DVTK to perform DICOM exchange and other simulators (C3)

Unit 3:	
HL7	1. Build HL7 messages to perform ADT operations 2. Build HL7 messages to build ORU/ORM operations

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3

Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Handbookof Biomedical Instrumentation" by R.S.Khandpur, Tata McGraw Hill. 2. "Principles of Medical Imaging" by K. Kirk Shung, Michael B. Smith, Benjamin M.W. Tsui 3. "Digital Imaging and Communication in Medicine(DICOM)" by Oleg S Pianykh, Springer. 4. "HIMSS Dictionary of Healthcare Information Technology Terms, Acronyms and Organizations", Second Edition, HIMSS, ISBN 13978-1-938904-03-5 5. "Telemedicine and Telehealth 2.0: A Practical Guide for Medical Providers and Patients" by Victor Lyuboslavsky, Paperback. 6. "The Biomedical Engineering: Handbook" by BRONZINO, J D. Volume 1, 2. Boca Raton : CRC Press, 2000. ISBN 0-8493-0461-X.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Entrepreneurship Lab
Course Code: ENP-601L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites: -**

Synopsis:	This Course provides insight on This course introduces students to the theory of entrepreneurship and its practical implementation. It focuses on different stages related to the entrepreneurial process, including business model innovation, monetization, small business management as well as strategies that improve performance of new business ventures. Cantered on a mixture of theoretical exploration as well as case studies of real-world examples and guest lectures, students will develop an understanding of successes, opportunities and risks of entrepreneurship. This course has an interdisciplinary approach and is therefore open to students from other Majors.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Understand the concept of entrepreneurship
CO 2:	To appraise the entrepreneurial process starting with pre-venture stage through group discussion
CO 3:	To Build a mind-set focusing on developing novel and unique approaches to market opportunities by considering case studies and understand the complete flow of entrepreneurship

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*					*		*			
CO 2						*					
CO 3								*		*	

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to Entrepreneurship	
Meaning and Definition of Entrepreneurship-Employment vs Entrepreneurship, Theories of Entrepreneurship, approach to entrepreneurship, Entrepreneurs VS Manager	1. Discuss the theories of Entrepreneurship (C1) 2. Discuss the approaches to Entrepreneurship (C1)
Unit 2: Process of Entrepreneurship	
Factors affecting Entrepreneurship process	1. Exemplify one's capabilities in relation to the rigors of successful ventures (C3) 2. Identify and differentiates the different characteristics and competencies of an entrepreneurs (C2)
Unit 3: Business Plan writing	
Points to be considered, Model Business plan	1. Identify different business models (C3) Describe different parts of a business plan(C2)
Unit 4: Case studies	
Indian and International Entrepreneurship	1. Perform self-assessment and analyse entrepreneurial personal traits and competencies (C4) 2. Evaluate oneself and plan courses of action to help develop one's entrepreneurial characteristics and competencies. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-

Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2			*
Assignment/Presentation		*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. NVR Naidu and T. Krishna Rao, "Management and Entrepreneurship", IK International Publishing House Pvt. Ltd 2008. 2. Mohanthy Sangram Keshari, "Fundamentals of Entrepreneurship", PHI Publications, 2005

	3. Butler, D. (2006). Enterprise planning and development. USA: Elsevier Ltd. Gerber, M.E. (2008) Awakening the entrepreneur within. NY: Harper Collins.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Text Analytics in Healthcare Lab
Course Code: HDA-606 L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Knowledge of NLP and data analytics
Synopsis:	This Course provides insight on • Experiment with NLTK Library. • Text extraction and analysis techniques. • Corpora of specific domain. • Working and usage of OCR.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Experiment Lexical Analyser, tokenization, POS, text chunker, and NER using NLTK Library.
CO 2:	Generate corpora of a specific domain.
CO 3:	Practice Optical Character Recognizer.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1		*	*	*	*						
CO 2		*	*	*	*						
CO 3		*	*	*	*						

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Basics of Python : Data types, assigning and deleting values, String handling, IO	1. Practice basic operations of Python (C4)

handling, Python list, tuple and dictionary example	
Unit 2:	
Introduction to NLTK, Lexical Analysis: tokenization, Stop word removal, Stemming, n-grams.	1. Discover NLTK library (C3) 2. Experiment Lexical Analyser and tokenization (C4)
Unit 3:	
Exploring corpora, Document Classification	1. Generate corpora of a specific domain (C5)
Unit 4:	
Part-of-speech (POS) taggers: HMM and CRF; Tree model and Text chunker for capturing; Named-entity recognition (NER).	1. Experiment POS, text chunker, and NER. (C4)
Unit 5:	
Optical Character Recognizer Exercises	1. Practice Optical Character Recognizer. (C3)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**
Continuous practical Test	Sessional examination
	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Assignment/Presentation			*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] Text mining handbook: advanced approaches in analyzing unstructured data Feldman, Ronen and James Sanger, 9780521836579, CUP, 2008 [2] Linked Lexical Knowledge Bases Iryna Gurevych, Judith Eckle-Kohler, Michael Matuschek,9781627059749, Morgan & Claypool, 2016 [3] Introduction to information retrieval Manning, Christopher D. and Prabhakar Raghavan and Hinrich Schutze, 9780521865715, Cambridge University Press,2008 [4] Text mining: classification, clustering and applications Srivastava, Ashok and Mehran Sahami (eds.)., 9781420059403, Chapman & Hall,2009 [5] Weiss, S. M., Indurkhya, N., Zhang, T. (2010). Fundamentals of Predictive Text [6] Mining. Springer: New York. ISBN: 978-1849962254 [7] Pustejovsky, J. and Stubbs, A. (2012). Natural Language Annotation for Machine [8] Learning. O'Reilly.

[9] Foundations and Trends in Information Retrieval, 2(1-2): 1–135. Available online at: http://www.cs.cornell.edu/home/llee/opinion-mining-sentiment-analysis-survey.html.

[10] Manning, C. D., Raghavan, P., and Schutze, H. (2008). Introduction to Information Retrieval, Chapters 6 and 13-18, Cambridge University Press. Available online at: http://nlp.stanford.edu/IR-book/

[11] Articles: https://www.healthcatalyst.com

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Blockchain Technology Lab
Course Code: HDA-607L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Network Concepts

Synopsis:	This Course provides insight on understanding the working of blockchain technology and how blockchain platform works. The course discuss on the nuances involved in blockchain technology and its implementation on the blockchain platform.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Develop the blockchain ecosystem using Ethereum.
CO 2:	Evaluate the application based on Ethereum.
CO 3:	Examine the development process using Hyperledger.
CO 4:	Demonstrate the blockchain application development process.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*						
CO 2	*	*	*		*						
CO 3	*	*			*						
CO 4	*	*			*						

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Introduction to Blockchain - Potential of Blockchain – Defining Blockchain –	At the end of the topic student should be able to:

Ownership – Understanding Ledger – Ledger Structure – Concepts of Ownership – Centralized vs Decentralized - Components of a Blockchain -Characteristics of Blockchain - The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Types of blockchain – Consensus - CAP theorem and blockchain - Decentralization using blockchain Methods of decentralization- Routes to decentralization - Blockchain and full ecosystem decentralization- Smart contracts- Decentralized Organizations.	1. To identify the required programming environment and operating systems. 2. To write simple examples and constructs of the chosen programming languages (python/solidity)
Unit 2:	
Ethereum and working with Smart Contracts : Understand Ethereum ,Define Smart Contracts,Identify Cryptocurrency used in Ethereum,Describe Transactions in Ethereum,Define Consensus Mechanism in Ethereum,List Development Technologies,Identify Ethereum Clients, Define Platform Functions,Understand Solidity, Describe Solidity Operators and Functions, Setting up Metamask,How to interface with ethereum network,First smart contract,Ethereum	1. To describe the architecture of Ethereum. 2. To illustrate and build blockchain examples with Ethereum platform.

accounts and how to receive ether, Structuring a contract,Declaring a function, Deploying and redeploying of a contract,Comparing Wei & Ether,What is a gas transaction,Remix testing.	
Unit 3:	
Hyperledger : Define Hyperledger Blockchain , Understand Hyperledger Consensus Algorithm ,Explain Hyperledger Iroha ,Identify Hyperledger Components ,Describe Setting up Channels Policies ,Chaincodes List Hyperledger , Explorer Components ,Define Hyperledger Composer,Fabric Under the Hood (Concepts & Terminology),Ledger Implementation,Dev Environment Walkthrough: Peer & CouchDB setup,Ledger Implementation,Peers Nodes : Anchors and Endorsers, Anchor Peers & Endorsing Peers,Clients Node: Endorsement Policies, Client Peer & Endorsing Policies Orderer Nodes,Membership Service Provider & Certification Authority,Dev Environment Walkthrough: Orderer and CA Server,Chaincode Development.	1. To identify different components in Hyperledger (C2) 2. To illustrate the examples of Hyperledger (C3)
Unit 4:	

Creating private Blockchain with Multichain : Define Multichain , Describe MultiChain Streams , Create & deploy private blockchain ,Explain Connecting to a Blockchain ,Identify Multichain Interactive Mode ,List Native assets ,Define Transaction Metadata ,Explain Streams Explain Mining ,Bitcoin to private blockchain,Aim of multichain,Hand-shake process,Multi-chain use cases,Multichain permission,Multichain assets,multichain streams,Basics of retrieving from streams,Consensus model,Multichain flexibility,Deployment options,Speed and scalability of multichain	1. To define and describe the multichain blockchain (C2) 2. To explain the mining in multichain process (C3) 3. To illustrate the deployment of multichain blockchain and its applications (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	36	72
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	36	72
Revision	-	-

Assessment	6	-
TOTAL	**78**	**144**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*	*	
Sessional Examination 2			*	*
Assignment/Presentation	*	*	*	*
End Semester Examination	*	*	*	*
Laboratory examination	*	*	*	*

Feedback Process	End-Semester Feedback
Reference Material	1. **Blockchain Basics: A Non-Technical Introduction in 25 Steps**, Daniel Drescher, Apress; 1st Edition, 2017. 2. **Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions**, Bikramaditya Singhal, Gautam Dhameja , Priyansu Sekhar Panda, Apress; 1st ed. Edition, 2018. 3. **Mastering Blockchain**, Imran Bashir, Ingram short title, Second Edition, 2018. 4. **Hands-On Blockchain with Hyperledger**, Petr Novotny Venkatraman Ramakrishna Nitin Gaur Anthony O'Dowd Luc Desrosiers, Ingram short title, 2018. 5. **Solidity Programming Essentials**, Ritesh Modi, Ingram short title, 2018 6. **BlockChain from Concept to Execution**, Debajani Mohanty, BPB; 2nd revised and updated edition, 2018.

	7. **Mastering Blockchain Programming with Solidity: Write production-ready smart contracts for Ethereum blockchain with Solidity**, Jitendra Chittoda, Packt Publishing Limited, 2019. 8. **Hands-On Blockchain with Hyperledger**, Petr Novotny Venkatraman Ramakrishna Nitin Gaur Anthony O'Dowd Luc Desrosiers, Ingram short title, 2018 9. **Blockchain for Dummies**, Tiana Laurence, 2nd edition – 2019. 10. **Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment**, David Hoover, Kevin Solorio, Randall Kanna, Shroff/O'Reilly; First edition, 2019. 11. **Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger**, Bellaj Badr , Richard Horrocks, Xun (Brian) Wu , Packt Publishing Limited, 2018. 12. **Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners**, Chris Dannen, APRESS, 1 edition, 2017. 13. **Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations**, Henning Diedrich, CreateSpace Independent Publishing Platform; 1st edition, 2016.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Responsive Web Application Development Lab
Course Code: IOT 605L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Basic Programming

Synopsis:	This Course provides insight on • The front-end section includes working with HTML, CSS3 and Bootstrap to design interactive and responsive web pages whereas the back-end section consists of programming in PHP with MySQL, XML, and JSON. • Develop a platform friendly web application or a website using Bootstrap, Angular JS, React JS, and Node JS.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Develop A Dynamic Webpage By The Use Of Java Script.
CO 2:	Write A Well Formed / Valid XML Document.
CO 3:	Connect Web Application to A DBMS To Perform Insert, Update and Delete Operations.
CO 4:	Convert the String And Parse Using JSON Objects.
CO 5:	Use Bootstrap, Angular JS, React JS, Node JS To Construct Modern Website

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	PO 9	*PO 10*	*PO 11*
CO 1	*										
CO 2	*			*							
CO 3	*		*		*						
CO 4	*			*							
CO 5	*			*	*						

Content	
Unit 1:	

Introduction to Internet and Web Technology	Find out the problem, to provide the solution using web development (C3).
Unit 2:	
HTML	Develop a web page using semantic tags (C4). Create a web page using form, add validation using patterns(C4).
Unit 3:	
CSS3	Develop different types of layout using css (C4) Develop responsive web page (C4) Develop web page using drop down menu(C4)
Unit 4:	
JavaScript	Validate form using JavaScript pattern matching, develop an application using Ajax. (C3)
Unit 5:	
XML vs JSON vs YAML	Create xml, YAML JSOM document able to parse. (C3)
Unit 6:	
Database connection	Analyse and solve various database task using PHP Parse the sting using json (C5)
Unit 7:	
BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS	Develop web page using the framework (C5)

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-

Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva
	Summative:

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	*
Assignment/Presentation		*	*		
Laboratory Examination	*	*	*		*

Feedback Process	• End-Semester Feedback
Reference Material	1. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004. 2. Jamsa Krishna, "Introduction to web development using HTML5", 2014. 3. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010. 4. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014. 5. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. 6. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008.

	7. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009. 8. Brian Totty, David Gourley, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy, "HTTP: The Definitive Guide", O'Reilly Media, 2009.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	IT Project Management Lab
Course Code: CSE-631L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Familiarity in developing application using any high level language

Synopsis:	This Course provides insight on 1. The concept of software development process and project management 2. Illustrates the difference between a lab assignment and group project 3. Help the students to understand the finer points of Project management 4. Bring awareness about the processes, tools and techniques involved in the field of IT project management.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Practice the project development through project planning.
CO 2:	Understand the finer points of Project management.
CO 3:	Bring awareness about the processes, tools and techniques involved in the field of IT project management.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1			*	*							
CO 2					*				*		
CO 3			*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Software Project Planning	

Understand the Project Needs, Create the Project Plan, Diagnosing Project Planning Problems.	1. Discussion on tools needed for project management (C3)
Unit 2: Estimation	
Elements of a Successful Estimate, Wideband Delphi Estimation, Other Estimation Techniques, Diagnosing Estimation Problems.	1. Download and demonstrate the tools typically used for UML design. (C3)
Unit 3: Project Schedules	
Building the Project Schedule, Managing Multiple Projects, Use the Schedule to Manage Commitments, Diagnosing Scheduling Problems.	1. Design the application through the UML tool practiced (C4) 2. Develop the team with different roles assigned to each member – namely project manager, developer, tester and assign appropriate tasks (C4)
Unit 4: Reviews	
Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming, Use Inspections to Manage Commitments, Diagnosing Review Problems.	1. Develop basic set of programs and to illustrate the unit tests (C2)
Unit 5: Software Requirements	
Requirements Elicitation, Use Cases, Software Requirements Specification, Change Control, Introduce Software Requirements Carefully, Diagnosing Software Requirements Problems	1. Field visit to develop and practice the requirement elicitation (C3)
Unit 6: Design and Programming	
Review the Design, Version Control with Subversion, Refactoring, Unit Testing, Use Automation, Be Careful	1. Illustrate the key steps in design and programming phase. Version control and unit testing significance (C3)

with Existing Projects, Diagnosing Design and Programming Problems	2. Review of various artefacts generated by project and revise the project management methodology to the team (C5)
Unit 7: Software Testing	
Test Plans and Test Cases, Test Execution, Defect Tracking and Triage, Test Environment and Performance Testing, Smoke Tests, Test Automation, Postmortem Reports, Using Software Testing Effectively, Diagnosing Software Testing Problems	1. Inter team testing set up based on requirement document(C5)
Unit 8: Understanding Change	
Why Change Fails, How to Make Change Succeed	1. Illustrate the necessity of Change management system – SVN hands on (C3).
Unit 9: Management and Leadership	
Take Responsibility, Do Everything Out in the Open, Manage the Organization, Manage Your Team	1. Discussion on the topic with the help of case study (C3)
Unit 10: Managing an Outsourced Project	
Prevent Major Sources of Project Failure, Management Issues in Outsourced Projects, Collaborate with the Vendor	2. Discussion on the topic with the help of case study (C3)
Unit 11: Process Improvement	
Life Without a Software Process, Software Process Improvement, Moving Forward	1. Post-mortem report generation of respective project by each team – review of the report and suggest areas of improvement (C4)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2			*
Assignment/Presentation	*		
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Applied Software Project Management" By Jennifer Greene, Andrew Stellman (O'Reilly Publications) 2005.

	2. "The Art of Project Management" By Scott Berkun (O'Reilly Publications) 2005.

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Mini Project - 2
Course Code: HDA 696	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 4	**Prerequisites:** Any programming language and circuit basics

Synopsis:	Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the objectives of the project work and provide an adequate background with a detailed literature survey
CO 2:	Breakdown the project into sub blocks with sufficient details to allow the work to be reproduced by an independent researcher
CO 3:	Compose hardware/software design, algorithms, flowchart, methodology, and block diagram
CO 4:	Evaluate the results
CO 5:	Summarize the work carried out

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1				*							
CO 2					*			*			
CO 3							*			*	
CO 4						*					*
CO5:							*				

Course content and outcomes:

Content	***Competencies***
Phase 1	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2) 3. Prepare the outline (C3) 4. Describe the status of the project (C2) 5. Prepare a mid-term project presentation report (C3) 6. Prepare and present mid-term project presentation slides (C3, C5) 7. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	48	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-

Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	03	-
TOTAL	**51**	**09**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Seminar - 2
Course Code: HDA 698	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Communication Skill

Synopsis:	1. To select, search and learn technical literature. 2. To Identify a current and relevant research topic. 3. To prepare a topic and deliver a presentation. 4. To develop the skill to write a technical report. 5. Develop ability to work in groups to review and modify technical content.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Show competence in identifying relevant information, defining and explaining topics under discussion.
CO 2:	Show competence in working with a methodology, structuring their oral work, and synthesizing information.
CO 3:	Use appropriate registers and vocabulary, and will demonstrate command of voice modulation, voice projection, and pacing.
CO 4:	Demonstrate that they have paid close attention to what others say and can respond constructively.
CO 5:	Develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*							*	*		*
CO 2	*							*	*		*
CO 3	*							*	*		*
CO 4	*							*	*		*

CO5:	*							*	*		*

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:	
Formative:	**Summative:**
Seminar Topic Selection	
Synopsys review	
PPT Review	

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen Seminar

MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Name of the Program:	Master of Engineering - ME (Healthcare Data Analytics)
Course Title:	Project Work
Course Code: HDA 696	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** Second Year, Semester 3, 4
No of Credits: 25	**Prerequisites:** SDLC, Communication Skills, technical skills.

Synopsis:	• The project work aims to challenge analytical, creative ability and to allow students to synthesize, apply the expertise and insight learned in the core discipline. • Students build self-confidence, demonstrate independence, and develop professionalism on successfully completion of the project.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	To be acquainted with working environment and processes that in place at the relevant Industries.
CO 2:	To familiarize the challenges as relevant professionals.
CO 3:	Review the literature and develop solutions for real time onboard projects.
CO 4:	Write technical report and deliver presentation.
CO 5:	Apply engineering and management principles to achieve project goal.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1						*	*	*	*	*	*
CO 2					*						
CO 3	*	*	*	*	*						
CO 4	*	*	*	*							
CO5:						*	*	*	*	*	*

Course content and outcomes:

Content	***Competencies***
Phase 1:	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2) 3. Prepare the outline (C3) 4. Prepare a mid-term project presentation report (C3) 5. Prepare and present mid-term project presentation slides (C3, C5) 6. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-

Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

PROGRAM OUTCOMES (POS) AND COURSE OUTCMES (COS) MAPPING

Sl.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	BDA 601	Fundamentals of Machine Learning	3	*	*	*	*							
2	MCL 601	Applied Probability and Statistics	3	*	*	*	*		*		*		*	
3	HDA 601	Healthcare Data Management	3	*	*	*	*	*	*	*				
4	HDA 602	Digital Image Processing	3	*	*	*								
5	BDA-610	Principles of Data Visualization	3	*	*	*	*	*	*		*			
6	HDA-605	Data Structures and Data Interpretation with Python (For electrical stream students)	3	*	*	*	*	*						
7	BDA 601L	Fundamentals of Machine Learning Lab	1	*	*	*	*							
8	MCL 601L	Applied Probability and Statistics Lab	1	*	*	*	*	*	*		*		*	
9	HAD 601L	Healthcare Data Management Lab	1			*		*	*	*				
10	HDA 602L	Digital Image Processing Lab	1		*	*		*						
11	BDA-610L	Principles of Data Visualization	1	*	*	*	*	*	*		*	*	*	
12	HDA-605L	Data Structures and Data Interpretation with Python (For electrical stream students)	1		*	*	*	*						
13	HDA 695	Mini Project - 1	4				*	*	*	*	*	*	*	*
14	HDA 697	Seminar - 1	1	*							*	*		*
15	BDA 605	Machine Learning for Big Data	3	*	*	*	*							
16	MCL 602	Advanced Applications of Probability and Statistics	3	*	*	*	*	*	*		*			

17	HDA 603	Big Data in Healthcare	3	*	*	*	*							
18	HDA 604	Medical Imaging Systems	3	*	*	*	*							
19	ENP-601	Entrepreneurship	3	*		*	*		*		*		*	
20	HDA-606	Text Analytics in Healthcare	3	*	*	*		*						
21	HDA-607	Block chain Technology	3	*	*	*	*	*						
22	IOT-605	Responsive Web Application Development	3	*	*	*	*	*						
23	CSE-631	IT Project Management	3	*	*	*								
24	BDA 605L	Machine Learning for Big Data Lab	1	*	*	*	*							
25	MCL 602L	Advanced Applications of Probability and Statistics Lab	1	*	*	*	*	*	*		*			
26	HDA 603L	Big Data in Healthcare Lab	1			*		*	*					
27	HDA 604L	Medical Imaging Systems Lab	1	*	*			*	*					
28	ENP-601L	Entrepreneurship Lab	1	*					*		*		*	
29	HDA-606L	Text Analytics in Healthcare Lab	1		*	*	*	*						
30	HDA-607L	Block chain Technology Lab	1	*	*	*		*						
31	IOT-605L	Responsive Web Application Development Lab	1	*		*	*	*						
32	CSE-631L	IT Project Management Lab	1			*	*	*				*		
33	HDA 696	Mini Project - 2	4			*	*	*				*		
34	HAD 698	Seminar 2	1	*							*	*		*
35	HDA 799	Project Work	25	*	*	*	*	*	*	*	*	*	*	*