Academic Council Date – 23/04/2026

Item No : 6

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (EMPOWERED AUTONOMOUS)

Re-accredited 'A++' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: Master's in Science (M. Sc.)

Information Technology

SYLLABUS

M. Sc. Information Technology

Revised as per
NEP 2020
Choice Based Credit System (60:40)
w.e.f. Academic Year 2026-2027

MASTER'S IN SCIENCE (M. Sc.)
Programme Outcomes

SR. NO.	After completion of B.Sc. program students will acquire	Graduate Attribute
PO1	The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest.	Disciplinary knowledge
PO2	An ability to develop and conduct experiments, analyse, and interpret data and use scientific judgment to draw conclusions	Scientific reasoning
PO3	An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information.	Digital literacy
PO4	Innovative, professional, and entrepreneurial skills needed in various disciplines of science.	Life-long learning
PO5	An ability to achieve high order communication skills.	Communication skills
PO6	An ability to collect, analyse and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches	Problem solving
PO7	A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real-world settings.	Reflective thinking
PO8	An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges.	Life-long learning
PO9	A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes	Teamwork
PO10	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Leadership
PO11	An ability to understanding values, ethics, and morality in a multidisciplinary context.	Moral and ethical awareness

Program Specific Outcomes

	After completing the programme in Information Technology, Student will be able to:
PSO1	Apply IT in the field of Data Science, AI, Networking, Security and Cloud Computing.
PSO2	Design solutions for complex IT problems.
PSO3	Develop research, investigation skills and achieve professional competency in the field of I.T.

Preamble:

The M.Sc. Information Technology programme is started with an aim to make the learners employable and impart industry oriented training.

The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- To equip learners with the knowledge and skills required for successful careers in the IT industry and for pursuing higher education in related postgraduate programmes.
- To enable learners manage IT projects considering technical, social, financial, and environmental aspects.
- To work effectively as a part of a team to achieve a common stated goal.
- To instill high ethical values and adherence to professional, industry, and organizational codes of conduct.
- To communicate effectively with a range of audiences both technical and non-technical.
- To develop an aptitude to engage in continuing professional development.

Choice Based Credit System (CBCS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2026-2027

No. of Courses	Semester I	Credits	No. of Courses	Semester II	Credits
A	***Discipline Specific Course (Major)***		**A**	***Discipline Specific Course (Major)***	
1	Data Science	04	1	Advanced AI	04
2	Image processing	04	2	Modern Networking	04
3	Soft Computing Techniques	04	3	Natural Language Processing	04
4	Practical : Practical of Data Science + Practical of Image Processing	02	4	Practical: Practical of Advanced AI+ Practical of Modern Networking	02
B	***Discipline Specific Course (Elective) (Students will select any 1 out of 2)***		***B***	***Discipline Specific Course (Elective) (Students will select any 1 out of 2)***	
5	Cloud Computing	02	5	Microservices Architecture	02
	Cyber Law			Data Security	
6	Practical: Practical of Cloud Computing + Practical of Soft Computing Technique	02	6	Practical : Practical of Microservices Architecture + Practical of Natural Language Processing	02
	Practical: Practical of Cyber Law + Practical of Soft Computing Technique			Practical : Practical of Data Security + Practical of Natural Language Processing	
C	***Discipline Specific Course(Minor)***		***C***	***Discipline Specific Course(Minor)***	
7	Research Methodology	04		-	
			D	***OJT/FP/CEP/RP***	
			7	On Job Training/ Research Project	04
	Total Credits	22		Total Credits	22

SEMESTER I

Course Code	Course Type	Course Title	Credit
PIT1DST	Major I	Data Science	04
PIT1IPT	Major II	Image Processing	04
PIT1SCT	Major III	Soft Computing Techniques	04
PIT1PR1	Practical I	Practical : Practical of Data Science + Practical of Image Processing	02
PIT1CCT	Elective	Cloud Computing	02
PIT1CLT	Elective	Cyber Law	
PIT1PR2	Practical II	Practical: Practical of Cloud Computing + Practical of Soft Computing Techniques	02
		Practical: Practical of Cyber Law + Practical of Soft Computing Technique	
PIT1RMT	Minor Subject	Research Methodology	04
		Total Credits	**22**

SEMESTER II

Course Code	Course Type	Course Title	Credit
PIT2AIT	Major I	Advanced AI	04
PIT2MNT	Major II	Modern Networking	04
PIT2NLT	Major III	Natural Language Processing	04
PIT2PR1	Practical I	Practical: Practical of Advanced AI + Practical of Modern Networking	02
PIT2MAT	Elective	Microservices Architecture	02
PIT2DST	Elective	Data Security	
PIT2PR2	Practical II	Practical : Practical of Microservices Architecture + Practical of Natural Language Processing	02
		Practical : Practical of Data Security + Practical of Natural Language Processing	
PIT2OJT	OJT/RP	On Job Training / Research Project	04
		Total Credits	**22**

Semester I
Major I

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Data Science**
Course Code	**PIT1DST**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain layered framework and technology stack in data science.
	2) Elaborate management layers in data science.
	3) Explain assess supersteps in data science.
	4) Utilize transform and report supersteps.

Module/ Unit	**Course Description**	**Hrs.**
I	**Data Science Technology Stack:** Data Science Storage Tools, Data Lake, Data Vault, Data Science Processing Tools. **Layered Framework:** Definition of Data Science Framework, Cross Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering , Business Layer, Utility Layer:	15hrs

	Three Management Layers: Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Yoke Solution, Cause-and-Effect, Analysis System, Functional Layer, Data Science Process.	
II	**Retrieve Superstep :** Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources. **Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep,	15hrs
III	**Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test.	15hrs
IV	**Transform Superstep**: Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data,Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow. **Organize and Report Supersteps** : Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference	15hrs

References:

1. Principles of Data Science Sinan Ozdemir PACKT 2016.
2. Data Science from Scratch first Principle in python Joel Grus Shroff Publishers 201

Major II

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Image Processing**
Course Code	**PIT1IPT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	To Understand the fundamental concepts of a digital image processing system by analysing images in the frequency domain using various transforms.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain basic fundamental concepts of digital image processing.
	2) Examine the images in the frequency domain using various transforms.
	3) Evaluate the techniques for image enhancement, restoration & Categorise of various compression techniques.
	4) Interpret Image compression, image segmentation, and representation techniques.

Module/ Unit	**Course Description**	**Hrs.**
I	Introduction: Digital Image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, Intensity Transformations and Spatial Filtering: Basics, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining	15hrs

	Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering	
II	Filtering in the Frequency Domain: Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of the 2-D DFT and IDFT, Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using Highpass Filters, Fast Fourier Transform Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only----- Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Other Image Transforms: Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms	15hrs
III	Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images, Color Image Compression. Image Compression and Watermarking: Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking, Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction.	15hrs
IV	Image Segmentation I: Edge Detection, Thresholding, and Region Detection: Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentatio n Using Graph Cuts, Use of Motion in Segmentation Image Segmentation II: Active Contours: Snakes and Level Sets: Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. Feature Extraction: Background, Boundary Preprocessing, Boundary Feature Descriptors, Region, Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	15hrs

Reference Books:

1. Digital Image Processing, Gonzalez and Woods, Pearson/Prentice Hall
2. Fundamentals of Digital Image Processing, A K. Jain, PHI
3. The Image Processing Handbook, J. C. Russ, CRC

Major III

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Soft Computing Techniques**
Course Code	**PIT1SCT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	Soft computing concepts like fuzzy logic, neural networks and genetic algorithm, where Artificial Intelligence is the mother branch of all. All these techniques will be more effective to solve the problem efficiently.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain soft computing techniques and their roles in building intelligent machines.
	2) Determine the use of Artificial Intelligence, Fuzzy logic & Genetic algorithms.
	3) Make use of Fussy Logic Network for classification and regression problems.
	4) Evaluate soft computing approaches and solutions for a genetic algorithm & given problem

Module/ Unit	**Course Description**	**Hrs.**
I	Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.	15hrs

	Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network. **Supervised Learning Network**: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. **Associative Memory Networks**: Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.	
II	**UnSupervised Learning Networks:** Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model. **Reinforcement Learning Networks:** Policy, Reward function, Value function, Model of the environment.	15hrs
III	**Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets:** Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Membership Function: features of the membership functions, fuzzification, methods of membership value assignments. Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals. **Fuzzy Rule base and Approximate reasoning:** Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System.	15hrs
IV	**Genetic Algorithm**: Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simple genetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of genetic algorithm.Differential Evolution Algorithm,	15hrs

	Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	

References:

1. Artificial Intelligence and Soft Computing, Anandita Battacharya Das, SPD 3rd 2018
2. Principles of soft computing, S.N.Sivanandam & S.N.Deepa, Wiley 3 rd 2019
3. Neuro-Fuzzy Computing and Soft, J.S.R.Jang, C.T.Sun and E.Mizutani, Prentice Hall of India 2004
4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications S.Rajasekaran, G. A. Vijayalakshami Prentice Hall of India 2004
5. Fuzzy Logic with Engineering Applications, Timothy J.Ross McGrawHill 1997 15
6. Genetic Algorithms: Search, Optimization and Machine Learning Davis E.Goldberg Addison Wesley 1989
7. Introduction to AI and Expert System, Dan W. Patterson Prentice, Hall of India 2009

Practical I

Course Description: M.Sc.(Information Technology)	
Semester	**I**
Course Name	**Practical of Data Science + Practical of Image Processing**
Course Code	**PIT1PR1**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	• Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences. • To understand how to analyse images in the frequency domain using various transforms for image enhancement and image restoration, image compression, segmentation and representation techniques in a mathematical way using Matlab/Scilab/Python.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Construct program using utilities,auditing and data visualization in data science.
	2) Build a program to retrieve, assess, process, transform and organise the data in data science.
	3) Design a program for image transformation.
	4) Design a program for Color Image Processing.

Module/ Unit	Course Description	Hrs
1	Creating Data Model using Cassandra.	2hrs
2	A) Text Delimited CSV to HORUS Format B) XML to HORUS format	2hrs
3	A) JSON to HORUS Format B) AUDIO to HORUS Format	2hrs
4	A) VIDEO to HOURS Format B) HOURS to Picture(JPEG)	2hrs
5	Fixing Utilities	2hrs
6	Retrieving Data	2hrs
7	A) Data Binning or Bucketing B) Averaging of data	2hrs
8	Assessing Data	2hrs
9	Processing Data	2hrs
10	Build the time hub, links and satellites	2hrs
11	Transforming Data	2hrs
12	Organising Data	2hrs
13	Generating Reports	2hrs
14	Data Visualization with Power BI	2hrs
15	Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis.	2hrs
16	Gray Level Slicing and Bit Plane Slicing	2hrs
17	Histogram and histogram equalization.	2hrs
18	Smoothing and sharpening of an image.	2hrs
19	Median Filtering of an Image.	2hrs

20	Homomorphic Filtering of an image.	2hrs
21	Edge Detection of an image	2hrs
22	Program to perform threshold on an image.	2hrs
23	Program to calculate number of samples required for an image.	2hrs
24	Program to study the effects of reducing the spatial resolution of a digital image.	2hrs
25	Program to study the effects of varying the number of intensity levels in a digital image	2hrs
26	Program to compare images using subtraction for enhancing the difference between images.	2hrs
27	Basic Intensity Transformation functions i. Program to perform Image negation ii. Program to perform threshold on an image.	2hrs
28	Basic Intensity Transformation functions i. Program to perform Log transformation ii. Power-law transformations	2hrs
29	Program to plot the histogram of an image and categorise 2. Program to apply histogram equalization.	2hrs
30	Write a program to perform convolution and correlation.	2hrs

References:

1. Principles of Data Science Sinan Ozdemir PACKT 2016.
2. Data Science from Scratch first Principle in python Joel Grus Shroff Publishers 201
3. Digital Image Processing, Gonzalez and Woods, Pearson/Prentice Hall
4. Fundamentals of Digital Image Processing, A K. Jain, PHI
5 The Image Processing Handbook, J. C. Russ, CRC

Elective

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Cloud Computing**
Course Code	**PIT1CCT**
Credit	**2**
Hours	**4 Hrs per week**

Course Objectives	To learn how to use Cloud Services, implement Virtualization, implement Task Scheduling algorithms. To Apply Map-Reduce concept to applications, build Private Cloud & Broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Define cloud computing and various virtualization technique.
	2) Classify the types of cloud and cloud computing architecture.
	3) Explain cloud security mechanism.
	4) Elaborate advanced architecture and cloud delivery model.

Module/ Unit	**Course Description**	**Hrs.**
I	**Introduction to Cloud Computing**: Introduction, Historical developments, Building Cloud Computing Environments.	15hrs

	Principles of Parallel and Distributed Computing: Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. **Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Logical Network Perimeter, Virtual Server, Cloud Storage Device, Resource replication, Ready-made environment. **Fundamental Cloud Architectures:** Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Redundant Storage Architecture.	
II	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges, Hypervisor clustering Architecture, Load Balanced virtual Server Instances architecture. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments**: Amazon Web Services, Google App Engine, Microsoft Azure.	15hrs

References:

1. Distributed and Cloud Computing, From Parallel Processing to the Internet of ThingsKai Hwang, Jack Dongarra, Geoffrey Fox MK Publishers -- 2012VMware and Microsoft Platform in the Virtual Data center, 2006,Auerbach.
2. Cloud Computing: A Practical Approach , Anthony T. Velte, Toby J. Velte, Ph.D. Robert Elsenpeter.

Elective

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Cyber Law**
Course Code	**PIT1CLT**
Credit	**2**
Hours	**4 Hrs per week**

Course Objectives	To understand the ethics, legality, methodologies and techniques of hacking.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain the fundamentals of cyber law, cyberspace, and key provisions of the Information Technology Act, 2000.
	2) Identify and analyse various types of cybercrimes and evaluate applicable legal remedies under Indian law.
	3) Apply concepts of data protection, privacy, and cyber security to assess legal and ethical issues in digital systems.
	4) Evaluate digital evidence, cyber forensic practices, and emerging legal challenges in areas such as AI, blockchain, and global cyber regulations.

Module/ Unit	**Course Description**	**Hrs.**
I	**Fundamentals of Cyber Law & Cyber Crimes:** Introduction to Cyber Law, Meaning, scope, and importance of cyber law, Evolution of cyber law, **Cyberspace:** concept and legal challenges, Legal Framework in India, Overview of the Information Technology Act, 2000, Key provisions and amendments, Digital signatures and electronic records, Role of Certifying Authorities **Cyber Crimes**: Types: hacking, phishing, identity theft, cyber stalking, cyber terrorism, Cyber fraud and online scams, Relevant provisions under IT Act and IPC,	15hrs

	E-Commerce & Legal Issues: Electronic contracts (e-contracts)**,** Online transactions and legal validity**,** Issues in e-commerce (fraud, taxation, jurisdiction)	
II	**Data Protection & Privacy:** Concept of privacy in cyberspace**,** Data protection principles**,** Overview of global frameworks (e.g., GDPR)**,** Indian perspective on data protection **Cyber Security & Legal Aspects:** Basics of cyber security, Legal responsibilities of organizations**,** Ethical hacking and legal boundaries**,** Cyber security policies**,** **Digital Evidence & Cyber Forensics:** Meaning and types of digital evidence**,** Collection and preservation**,** Admissibility in courts**,** Chain of custody **Emerging Trends in Cyber Law:** Legal issues in AI and Blockchain, Social media regulations Cyber law challenges in cloud computing International cyber law basics	15hrs

References:

1. "Cyber Law in India" – Pavan Duggal, Third Edition, Universal Publication.
2. "Information Technology Law and Practice" – Vakul Sharma, Seema Sharma
3. "Cyber Law & Cyber Crimes", IT Act, 2000 with IT Rules, 2011 – Prashant Mali, Snowwhite Pvt. Ltd.
4. "Cybersecurity and Cyberwar" – P.W. Singer, OUP Publisher.

Practical II

Course Description: M.Sc.(Information Technology)	
Semester	**I**
Course Name	**Practical of Cloud Computing + Practical of Soft Computing Techniques**
Course Code	**PIT1PR2**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	• To provide easy, scalable access to computing resources and IT services. • To understand soft computing concepts by doing programs of fuzzy logic, neural networks and genetic algorithms. To understand how to solve the problems Mathematically by using Python Programming language efficiently.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Create web services using java application (Netbeans).
	2) Make use of virtualization using VMWare ESXi server and managing with vCenter.
	3) Design a simple linear neural network model and Back Propagation
	4) Make use of a program for in fuzzy logic and Genetic Algorithms.

Module/ Unit	**Course Description**	Hrs
1	A client server based program using TCP to find if the number entered is prime.	2Hrs
2	A client server TCP based chatting application	
3	Write a program for implementing Client Server communication model using TCP. A client server TCP based chatting application.	2Hrs
4	Write a program for implementing Client Server communication model using UDP. A program that finds the square, square root, cube and cube root of the entered number.	
5	Write a program for implementing Client Server communication model using UDP. A client server based program using UDP to find if the number entered is even or odd.	2Hrs
6	Write a program for implementing Client Server communication model using UDP. A client server based program using UDP to find the factorial of the entered number.	2Hrs
7	Write a program for implementing Client Server communication model using UDP. A program to implement simple calculator operations like addition, subtraction, multiplication and division.	2Hrs
8	Write a program to show the object communication using RMI. A RMI based application program that converts digits to words, e.g. 123 will be converted to one two three.	2Hrs
9	A RMI based application program to display current date and time.	
10	Implement Distributed System on Windows and Linux	
11	Implement virtualization using VMWare ESXi Server and managing with vCenter.	2Hrs
12	Show the implementation of web services.	2Hrs
13	Implement Xen virtualization and manage with Xen Center	2Hrs

14	Implement Windows Hyper V virtualization	2Hrs
15	Develop application for Microsoft Azure.	2Hrs
16	Design a simple linear neural network model.	2hrs
17	Calculate the output of neural net using both binary and bipolar sigmoidal function	2hrs
18	Generate AND/NOT function using McCulloch Pitts neural net	2hrs
19	Write a program to implement Hebb's rule	2hrs
20	Write a program to implement Delta rule	2hrs
21	Write a program for Back Propagation Algorithm	2hrs
22	Write a program for error Back propagation algorithm.	2hrs
23	Write a program for Kohonen Self organizing map.	2hrs
24	Write a program for Linear separation.	2hrs
25	Write a program for Membership and Identity Operators | in, not in.	2hrs
26	Write a program for Membership and Identity Operators is, is not.	2hrs
27	Solve the ratios using fuzzy logic	2hrs
28	Solve Tipping problem using fuzzy logic	2hrs
29	Implementation of Simple genetic algorithm.	2hrs
30	Create two classes: City and Fitness using Genetic algorithm.	2hrs

References:

1. Distributed and Cloud Computing, From Parallel Processing to the Internet of ThingsKai Hwang, Jack Dongarra, Geoffrey Fox MK Publishers -- 2012VMware and Microsoft Platform in the Virtual Data center, 2006,Auerbach.
2. Cloud Computing: A Practical Approach , Anthony T. Velte, Toby J. Velte, Ph.D. Robert Elsenpeter.
3. Artificial Intelligence and Soft Computing, Anandita Battacharya Das, SPD 3rd 2018
4. Principles of soft computing, S.N.Sivanandam & S.N.Deepa, Wiley 3 rd 2019
5. Neuro-Fuzzy Computing and Soft, J.S.R.Jang, C.T.Sun and E.Mizutani, Prentice Hall of

India 2004

6. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications S.Rajasekaran, G. A. Vijayalakshami Prentice Hall of India 2004
7. Fuzzy Logic with Engineering Applications, Timothy J.Ross McGrawHill 1997 15
8. Genetic Algorithms: Search, Optimization and Machine Learning Davis E.Goldberg Addison Wesley 1989
9. Introduction to AI and Expert System, Dan W. Patterson Prentice, Hall of India 2009

Course Description: M.Sc.(Information Technology)	
Semester	**I**
Course Name	**Practical of Cyber Law+ Practical of Soft Computing Techniques**
Course Code	**PIT1PR2**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	• To gain practical exposure to legal aspects of digital technologies such as e-contracts, digital signatures, and electronic records. • To understand soft computing concepts by doing programs of fuzzy logic, neural networks and genetic algorithms. To understand how to solve the problems mathematically by using Python Programming language efficiently.

Course Outcomes	**After completing the course, Student will be able to:**
	1. Apply legal provisions to real-world scenarios involving cybercrimes, e-commerce transactions, and digital evidence.
	2. Analyse cybercrime cases, legal issues in e-commerce, and data protection challenges, and differentiate between lawful and unlawful digital activities.
	3. Design a simple linear neural network model and Back Propagation
	4. Make use of a program for in fuzzy logic and Genetic Algorithms.

Module/ Unit	**Course Description**	Hrs
1	Analyze the evolution of cyber law in India with reference to the Information Technology Act, 2000	2Hrs
2	Study a real or hypothetical cross-border cyber dispute	2Hrs
3	Identify and summarize important sections (e.g., Sec 43, 66, 72)	2Hrs
4	Analyze of hacking, phishing, identity theft, and cyber stalking cases.	2Hrs
5	Prepare of FIR copy for cyber fraud or cyber stalking cases.	2Hrs
6	Analysis of online agreements and elements of valid electronic contracts.	2Hrs
7	Case study on fraud, taxation, and jurisdiction in online transactions.	2Hrs
8	Study/report on legal issues in AI, blockchain, social media, and cloud computing.	2Hrs
9	Comparative study of Indian data protection framework and global standards.	2Hrs
10	Study of collection, preservation, and admissibility of digital evidence.	2Hrs
11	Study/report on legal issues in AI, blockchain, social media, and cloud computing.	2Hrs
12	Study the role and legal responsibilities of intermediaries under the Information Technology Act, 2000	2Hrs
13	Analyze provisions related to content regulation, takedown policies, and safe harbour rules	2Hrs
14	Case study of social media platforms and legal compliance	2Hrs
15	Comparative study of Indian cyber law with international standards	2Hrs
16	Design a simple linear neural network model.	2hrs
17	Calculate the output of neural net using both binary and bipolar sigmoidal function	2hrs
18	Generate AND/NOT function using McCulloch Pitts neural net	2hrs
19	Write a program to implement Hebb's rule	2hrs
20	Write a program to implement Delta rule	2hrs

21	Write a program for Back Propagation Algorithm	2hrs
22	Write a program for error Back propagation algorithm.	2hrs
23	Write a program for Kohonen Self organizing map.	2hrs
24	Write a program for Linear separation.	2hrs
25	Write a program for Membership and Identity Operators | in, not in.	2hrs
26	Write a program for Membership and Identity Operators is, is not.	2hrs
27	Solve the ratios using fuzzy logic	2hrs
28	Solve Tipping problem using fuzzy logic	2hrs
29	Implementation of Simple genetic algorithm.	2hrs
30	Create two classes: City and Fitness using Genetic algorithm.	2hrs

References:

1. "Cyber Law in India" – Pavan Duggal, Third Edition, Universal Publication.
2. "Information Technology Law and Practice" – Vakul Sharma, Seema Sharma
3. "Cyber Law & Cyber Crimes", IT Act, 2000 with IT Rules, 2011 – Prashant Mali, Snowwhite Pvt. Ltd.
4. "Cybersecurity and Cyberwar" – P.W. Singer, OUP Publisher.

Minor

Course Description: M.Sc. (Information Technology)	
Semester	**I**
Course Name	**Research Methodology**
Course Code	**PIT1RMT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	Understand some basic concepts of research and its methodologies. Select and define appropriate research problem and parameters. Organize and conduct research in a more appropriate manner. Write a research report and thesis

Course Outcomes	**After completing the course, Student will be able to:**
	1) Define the role business research
	2) Classify stages of the research and Measurement Sampling and Field work
	3) Distinguish different research methods and measurement concepts.
	4) Explain Different concepts of data analysis

Module/ Unit	**Course Description**	**Hrs.**
I	Introduction: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues **Beginning Stages of Research Process:** Problem definition, Qualitative research tools, Secondary data research	15hrs

II	**Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental Research.	15hrs
III	**Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size.	15hrs
IV	**Data Analysis and Presentation:** Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis	15hrs

References:

1) Business Research Method ,William G.Zikmund, B.J Babin, J.C. Carr, Cengage, 8e, 2016.
2) Research Methods for Business Students Fifth Edition, Mark Saunders2011
3) Multivariate Data Analysis, Hair7e

Semester- II

Major I

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Advanced AI**
Course Code	**PIT2AIT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	To enable students to have skills that will help them to solve complex real world problems for decision support. To provide an overview of an exciting growing field of big data analytics.

CO No.	**COs Statement**
	After completing the Master of Science Program, students will be able to-
CO-1	Define the fundamental concepts of Advanced AI and its applications.
CO-2	Explain various machine learning algorithms to solve real-world problems.
CO-3	Determine the process of image formation and the role of camera parameters.
CO-4	Elaborate Q-learning algorithm and Robotic application Domain.

Module/ Unit	**Course Description**	Hrs
I	**Review of AI:** History, foundation and Applications. Traditional AI vs Advanced AI	15hrs

	Expert System and Applications: Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth Maintenance System, Application of Expert Systems, Shells and Tools. **Solving Problems by Searching:** Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.	
II	**Probability Theory:** joint probability, conditional probability, Bayes's theorem, probabilities in rules and facts of rule based system, rule based system and Bayesian method. **Machine Learning Concepts, Techniques, and Applications:** Machine Learning basics, Applications of ML, Data Mining Vs Machine Learning Vs Big Data Analytics, Supervised and unsupervised learning, inductive learning, deductive learning, clustering, support vector machines, case based reasoning and learning	15hrs
III	**AI and Computer Vision:** Computer Vision, History of Computer Vision, Image Processing Techniques, Object Detection and Recognition, Image Classification and segmentation, Deep Learning in Computer Vision, Advanced Computer Vision Techniques, Computer Vision with GenAI, Applications of Computer Vision AI. **Intelligent Agents:** Agents vs software programs, classification of agents, working of an agent, single agent and multi agent systems, performance evaluation, architecture, agent communication language, applications.	15hrs
IV	**Foundation of Natural Language Processing**: Language Models, Text Classification, Information Retrieval, Information Extraction **Reinforcement Learning**: Elements of Reinforcement Learning, Limitations and Scope, Q-learning algorithm, History of Reinforcement Learning **Robotics:** Introduction, Robot Hardware, Robotic Perception, Planning to Move, Planning Uncertain Movements, Robotic Application Domains.	15hrs

References:

1. Artificial Intelligence: A Modern Approach, A. Russel, Peter Norvig.
2. Artificial Intelligence, Saroj Kaushik, Cengage, 1st Edition, 2019
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer
4. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, Second edition

Major II

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Modern Networking**
Course Code	**PIT2MNT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	• To understand the state-of-the-art in network protocols, architectures and applications. • Analyze existing network protocols and networks. • Develop new protocols in networking

Course Outcomes	**After completing the course, Student will be able to:**
	1) List the elements of Modern Networking
	2) Classify different levels of Software Define Network
	3) Explain Network Virtualization Function and VLAN
	4) Summarizing Quality of Service, Quality of Experience & Modern Network Architecture.

Module/ Unit	**Course Description**	**Hrs.**
I	Modern Networking Elements of Modern Networking The Networking Ecosystem ,Example Network Architectures,Global Network Architecture,A Typical Network Hierarchy Ethernet Applications of Ethernet Standards Ethernet Data Rates Wi-Fi Applications of Wi-Fi,Standards Wi-Fi Data Rates 4G/5G Cellular First Generation Second Generation, Third Generation Fourth	15Hrs

	Generation Fifth Generation, Cloud Computing Cloud Computing Concepts The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things Things on the Internet of Things, Evolution Layers of the Internet of Things, Network Convergence Unified Communications, Requirements and Technology Types of Network and Internet Traffic, Elastic Traffic, Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud Computing, and Mobile TrafficBig Data Cloud Computing, Mobile Traffic, Requirements: QoS and QoE,,Quality of Service, Quality of Experience, Routing Characteristics, Packet Forwarding, Congestion Control ,Effects of Congestion, Congestion Control Techniques, SDN and NFV Software Defined Networking, Network Functions Virtualization Modern Networking Elements	
II	Software-Defined Networks SDN: Background and Motivation, Evolving Network Requirements Demand Is Increasing, Supply Is Increasing Traffic Patterns Are More Complex Traditional Network Architectures are Inadequate, The SDN Approach Requirements SDN Architecture Characteristics of Software12 20 Defined Networking, SDN- and NFV-Related Standards Standards Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and OpenFlow SDN Data Plane, Data Plane Functions Data Plane Protocols OpenFlow Logical Network Device Flow Table Structure Flow Table Pipeline, The Use of Multiple Tables Group Table OpenFlow Protocol, SDN Control Plane SDN Control Plane Architecture Control Plane Functions, Southbound Interface Northbound InterfaceRouting, ITU-T Model, OpenDaylight OpenDaylight Architecture OpenDaylight Helium, REST REST Constraints Example REST API, Cooperation and Coordination Among Controllers, Centralized Versus Distributed Controllers, HighAvailability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management IETF SDNi OpenDaylight SNDi SDN Application Plane SDN Application Plane Architecture Northbound Interface Network Services Abstraction Layer Network Applications, User Interface, Network Services Abstraction Layer Abstractions in SDN, Frenetic Traffic Engineering PolicyCop Measurement and Monitoring Security OpenDaylight DDoS Application Data Center Networking, Big Data over SDN Cloud Networking over SDN Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer	15Hrs
III	Virtualization, Network Functions Virtualization: Concepts and Architecture, Background and Motivation for NFV, Virtual	15Hrs

	Machines The Virtual Machine Monitor, Architectural Approaches Container Virtualization, NFV Concepts Simple Example of the Use of NFV, NFV Principles High-Level NFV Framework, NFV Benefits and Requirements NFV Benefits, NFV Requirements, NFV Reference Architecture NFV Management and Orchestration, Reference Points Implementation, NFV Functionality, NFV Infrastructure,Container Interface, Deployment of NFVI Containers,Logical Structure of NFVI Domains, ComputeDomain, Hypervisor Domain, Infrastructure Network Domain, Virtualized Network Functions, VNF Interfaces, VNFC to VNFC Communication, VNF Scaling, NFV Management and Orchestration, Virtualized Infrastructure Manager, Virtual Network Function Manager, NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV Network ware Defined Storage, SDI Architecture	
IV	Virtualization, Virtual LANs ,The Use of Virtual LANs, Defining VLANs, Communicating VLAN Membership ,IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support, Virtual Private Networks, IPsec VPNs, MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, OpenDaylight's Virtual Tenant Network, Software Defined Infrastructure, Soft	15hrs

References:

1. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud William Stallings AddisonWesley
2. Network Functions Virtualization (NFV) with a Touch of SDN Rajendra Chayapathi Syed Farrukh Hassan AddisonWesley

Major III

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Natural Language Processing**
Course Code	**PIT2NLT**
Credit	**4**
Hours	**4 Hrs per week**

Course Objectives	To define natural language processing and to learn various stages of natural language processing.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain the field of natural language processing
	2) design various POS tagging techniques and parsers
	3) Design and test algorithms for semantic and pragmatic analysis.
	4) Apply NLP techniques to design real world NLP applications.

Module/ Unit	**Course Description**	**Hrs.**
I	**Introduction to NLP Origin & History of NLP**; Language, Knowledge and Grammar in language processing; Stages in NLP;Ambiguities and its types in English and Indian Regional Llanguages; Challenges of NLP;Applications of NLP Self-Learning topics: Variety types of tools for regional languages pre-processing and other functionalities Word Level Analysis Basic Terms: Tokenization, Stemming, Lemmatization; Survey of English Morphology, Inflectional Morphology, Derivational Morphology; Regular expression with types; Morphological Models: Dictionary lookup, finite state morphology; Morphological parsing with FST (Finite State Transducer);Lexicon free FST Porter Stemmer algorithm; Grams and its variation: Bigram, Trigram; Simple (Unsmoothed) N-grams;N-gram Sensitivity to the	15hrs

	Training Corpus; Unknown Words: Open versus closed vocabulary tasks; Evaluating N-grams: Perplexity;Smoothing: Laplace Smoothing, Good-Turing Discounting; Self-Learning topics: Noisy channel models, various edit distance, Advance Issues in Language Modelling	
II	Syntax analysis Part-Of-Speech tagging(POS); Tag set for English (Upenn Treebank); Difficulties /Challenges in POS tagging; Rule-based, Stochastic and Transformation-based tagging; Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging; Discriminative Model: Maximum Entropy model, Conditional random Field (CRF);Parsers: Top down and Bottom up; Modelling constituency; Bottom Up Parser: CYK, PCFG (Probabilistic Context Free Grammar), Shift Reduce Parser; Top Down Parser: Early Parser, Predictive Parser Self-Learning topics: Evaluating parsers, Parsers based language modelling, Regional languages POS tree banks	15hrs
III	Semantic Analysis Introduction, meaning representation; Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet; Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy; Semantic Ambiguity; Word Sense Disambiguation (WSD); Knowledge based approach(Lesk's Algorithm), Supervised (Naïve Bayes, Decision List),Introduction to Semi-supervised method (Yarowsky) Unsupervised (Hyperlex) Self-Learning topics: Dictionaries for regional languages, Distributional Semantics, Topic Models	15hrs
IV	Pragmatic & Discourse Processing Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence; Anaphora Resolution using Hobbs and Cantering Algorithm Self-Learning topics: Discourse segmentation, Conference resolution Applications of NLP Case studies on (preferable in regional language):Machine translation; Text Summarization; Sentiment analysis; Information retrieval; Question Answering system Self-Learning topics: Applications based on Deep Neural Network with NLP such as LSTM network, Recurrent Neural network etc.	15hrs

References:

1. Sentiment Analysis and Opinion Mining, Bing Liu, Morgan & Claypool Publishers, May 2012.
2. Speech and Language Processing (3rd ed. draft) Dan Jurafsky and James H. Martin
3. Natural Language Understanding 2nd Edition, James Allen (Author), Pearson

Practical I

Course Description: M.Sc.(Information Technology)	
Semester	**II**
Course Name	**Practical of Advanced AI+ Practical of Modern Networking**
Course Code	**PIT2PR1**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	1) To understand implementation of clustering, regression ,classification model .To install , configure Hadoop and explore HDFS for handling huge volume of data 2) To understand and analyze the state-of-the-art in network protocols, architectures and applications.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain the types of python libraries going to be used in AI Algorithms.
	2) Develop a program to retrieve precise output by using Learning methods
	3) Build IP SLA Tracking & Path Control & create AS-PATH attribute,
	4) Construct IBGP & EBGP Session & develop Inter VLAN Routing

Module/ Unit	Course Description	Hrs
1	Design an Expert system using AIML.	2Hrs
2	Implement Bayes Theorem using Python.	2Hrs
3	Implement Conditional Probability and joint probability using Python.	2Hrs
4	Write a Program to implement BFS algorithm.	2Hrs
5	Write a Program to implement DFS algorithm	
6	Implementation of Python basic Libraries such as Math, Numpy and Scipy, Pandas and Matplotlib	2Hrs
7	Implement Linear Regression: Using scikit-learn, implement and train a linear regression model on a simple dataset.	2Hrs
8	Implement K-Means Clustering: Using scikit-learn, implement k-means clustering and visualize the results on a sample dataset.	2Hrs
9	Write an application to implement Clustering algorithm	2Hrs
10	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	2Hrs
11	Write a program to implement Decision Tree and Random forest with Prediction, Test Score and Confusion Matrix.	2Hrs
12	Perform Data Loading, Feature selection (Principal Component analysis) and Feature Scoring and Ranking.	2Hrs
13	Implement the classification model using clustering for the following techniques with hierarchical clustering with Prediction, Test Score and Confusion Matrix	2Hrs
14	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2Hrs
15	Perform Text per-processing, Text clustering, classification with Prediction, Test Score and Confusion Matrix.	2Hrs
16	Configure RIP Routing Protocol.	2Hrs
17	Configure IP SLA Tracking and Path Control Topology	2Hrs

18	Configuring IBGP and EBGP Sessions.	2Hrs
19	Configuring Local Preference, and MED.	2Hrs
20	Secure the Management Plane	2Hrs
21	Configure Path Control Topology	2Hrs
22	P Service Level Agreements and Remote SPAN in a Campus Environment	2Hrs
23	Configure EIGRP Routing Protocol	2Hrs
24	Using the AS_PATH Attribute	2Hrs
25	Configure BGP Commands	2Hrs
26	Configuring IBGP and EBGP Sessions,	2Hrs
27	Inter-VLAN Routing	2Hrs
28	Simulating MPLS environment	2Hrs
29	Simulating VRF	2Hrs
30	Simulating SDN with • OpenDaylight SDN Controller with the Mininet Network Emulator • OFNet SDN network emulator	2Hrs

References:

1. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud William Stallings AddisonWesley.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer
3. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, Tata McGrawhill, 3rd Edition
4. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman, Springer Publication 2nd Edition, 2012.

Elective

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Microservices Architecture**
Course Code	**PIT2MAT**
Credit	**2**
Hours	**4 Hrs per week**

Course Objectives	Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC; Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio Persist data with XML Serialization and ADO.NET with SQL Server Create HTTP services using ASP.NET Core Web API

Course Outcomes	**After completing the course, Student will be able to:**
	1) Define Micro services Architecture & Micro services Boundaries. Elaborate Service Design and Micro Services in Practice.
	2) Explain ASP.Net Core, Docker and Continuous Integration.
	3) Explain Data Services & Micro Services Ecosystems.
	4) Create Data Services.

Module/ Unit	**Course Description**	**Hrs.**
I	**Microservices:** Understanding Microservices, Adopting Microservices, The Microservices Way. Microservices Value Proposition: Deriving Business Value, defining a Goal Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. Designing Microservice Systems: The Systems Approach to Microservices, A Microservices Design Process, Establishing a Foundation: Goals and Principles, Platforms, Culture.	15Hrs

	Service Design: Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies	
II	**System Design and Operations**: Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting. Adopting Microservices in Practice: Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance. **Building Microservices with ASP.NET Core**: Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App. Delivering Continuously: Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub.	15Hrs

References:

1. Building Microservices with ASP.NET Core ,Kevin Hoffman ,O'Reilly
2. Building Microservices: Designing Fine-Grained Systems, Sam Newman ,O'Reilly
3. Production-ready Microservices, Susan J. Fowler, O'Reilly

Elective

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Data Security**
Course Code	**PIT2DST**
Credit	**2**
Hours	**4 Hrs per week**

Course Objectives	To understand the secure storage, control access and prevent unauthorized processing, transfer, or deletion of data.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Define Data security and cryptographic techniques.
	2) Classify the types of attacks and their common prevention mechanisms.
	3) Explain program security and time to time checkups.
	4) Examine security in networks & firewalls.

Module/ Unit	**Course Description**	**Hrs.**
I	Introduction to Data Security : Attacks, Vulnerability, Security Goals, Security Services and mechanisms Conventional Cryptographic Techniques : Conventional substitution and ransposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography Symmetric and Asymmetric Cryptographic Techniques : DES, AES, RSA algorithms Authentication and Digital Signatures : Use of Cryptography for authentication	15hrs

II	Program Security : Nonmalicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of-use Errors, Viruses, Trapdoors, Salami attack, Man-in-the-middle attacks, Covert channels Security in Networks : Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls	15hrs

References:

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
3. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
4. Network Security, Essentials: Applications and Standards, by William Stallings.

Practical II

Course Description: M.Sc.(Information Technology)	
Semester	**II**
Course Name	**Practical of Microservice Architecture + Practical of Natural Language Processing**
Course Code	**PIT2PR2**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	• To understand Natural Language Processing concepts by doing programs on basic concepts and algorithmic description of Morphology, Syntax, Semantics, and Pragmatics & Discourse analysis. • To understand and implement fundamental concepts of data security**,** including cryptographic techniques, security mechanisms, and common vulnerabilities.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Define Micro services Architecture & Micro services Boundaries , Elaborate Service Design and Micro Services in Practice
	2) Explain ASP.Net Core, Docker and Continuous Integration
	1) Apply conventional and modern cryptographic techniques (such as DES, AES, RSA) for secure data communication.
	2) Analyze and identify security threats and vulnerabilities in programs and networks, including attacks like buffer overflow and man-in-the-middle.

Module/ Unit	Course Description	Hrs
1	Installing Visual studio .Net	2hrs
2	Building ASP.NET Core MVC Application	2hrs
3	Building a console App using .NET Core	2hrs
4	Building ASP.NET Core REST API.	2hrs
5	Installing Docker	2hrs
6	Working with Docker	2hrs
7	Docker Commands	2hrs
8	Working with Docker Images and Containers	2hrs
9	Creating Microservice with ASP.NET Core	2hrs
10	Installing Docker Toolbox	2hrs
11	Working with Docker Swaram	2hrs
12	Working with circle CI for continuous integration	2hrs
13	Working with Kubernetes	2hrs
14	Creating Backing Service with ASP.NET Core	2hrs
15	Building real-time Microservice with ASP.NET Core	2hrs
16	Write a program to implement sentence segmentation and word Tokenization	2hrs
17	Write a program to Implement stemming and lemmatization.	2hrs
18	Write a program to Implement a tri-gram model	2hrs
19	Write a program to Implement PoS tagging using HMM.	2hrs
20	Write a program to Implement PoS tagging using Neural Model.	2hrs
21	Write a program to Implement syntactic parsing of a given text	2hrs
22	Write a program to Implement dependency parsing of a given text.	2hrs
23	Write a program to Implement Named Entity Recognition (NER)	2hrs
24	Write a program to build a system that translates text form one language to another.	2hrs

25	Write a program to predict the next word in a given sequence of words, enabling task like autocomplete or text generation.	2hrs
26	Write a program to classify the sentiment of a given text as positive, negative or neutral.	2hrs
27	Write a program to implement Text summarization for the given sample text.	2hrs
28	Write a program to convert speech to text and text to speech.	2hrs
29	Write a program to Implement syntactic parsing of a given text	2hrs
30	Write a program to implement Naïve Bayes, Decision List.	2hrs

References:

1. Sentiment Analysis and Opinion Mining, Bing Liu, Morgan & Claypool Publishers, May 2012.
2. Speech and Language Processing (3rd ed. draft) Dan Jurafsky and James H. Martin
3. Natural Language Understanding 2nd Edition, James Allen (Author), Pearson
4. Building Microservices with ASP.NET Core ,Kevin Hoffman ,O'Reilly
5. Building Microservices: Designing Fine-Grained Systems, Sam Newman ,O'Reilly
6. Production-ready Microservices, Susan J. Fowler, O'Reilly

Course Description: M.Sc.(Information Technology)	
Semester	**II**
Course Name	**Practical of Data Security + Practical of Natural Language Processing**
Course Code	**PIT2PR2**
Credit	**2**
Hours	**2 Hrs per week**

Course Objectives	• To understand Natural Language Processing concepts by doing programs on basic concepts and algorithmic description of Morphology, Syntax, Semantics, and Pragmatics & Discourse analysis. • To understand and implement fundamental concepts of data security**,** including cryptographic techniques, security mechanisms, and common vulnerabilities.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Apply conventional and modern cryptographic techniques (such as DES, AES, RSA) for secure data communication.
	2) Analyze and identify security threats and vulnerabilities in programs and networks, including attacks like buffer overflow and man-in-the-middle.
	3) Apply various text pre-processing techniques and N-Gram Model for any given text.
	4) Develop morphological analysis, grammar checker word generation and different POS taggers.

Module/ Unit	Course Description	Hrs
1	Identify and demonstrate attacks like phishing, DoS, and brute force using simulation tools.	2hrs
2	Use tools (like OpenVAS or Nessus demo) to scan a system for vulnerabilities.	2hrs
3	Demonstrate Confidentiality, Integrity, and Availability (CIA triad) using simple examples.	2hrs
4	Write a program for Caesar Cipher and Monoalphabetic Cipher.	2hrs
5	Perform encryption and decryption using Rail Fence and Columnar Transposition techniques.	2hrs
6	Implement One-Time Pad and analyze its security strength.	2hrs
7	Write programs demonstrating block cipher (fixed size input) and stream cipher (bit-by-bit encryption).	2hrs
8	Hide a message inside an image using LSB (Least Significant Bit) technique.	2hrs
9	Simulate Data Encryption Standard using any programming language or tool.	2hrs
10	Encrypt and decrypt data using AES (using Python or OpenSSL).	2hrs
11	Generate public/private keys and encrypt/decrypt a message.	2hrs
12	Use RSA to generate and verify digital signatures.	2hrs
13	Develop a simple login system with password hashing (e.g., SHA-256).	2hrs
14	**Buffer Overflow Demonstration** Simulate buffer overflow vulnerability using C program.	2hrs
15	**Man-in-the-Middle Attack Simulation** Demonstrate MITM attack using a controlled lab setup (e.g., ARP spoofing tools).	2hrs
16	Write a program to implement sentence segmentation and word Tokenization	2hrs
17	Write a program to Implement stemming and lemmatization.	2hrs
18	Write a program to Implement a tri-gram model	2hrs
19	Write a program to Implement PoS tagging using HMM.	2hrs
20	Write a program to Implement PoS tagging using Neural Model.	2hrs
21	Write a program to Implement syntactic parsing of a given text	2hrs
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24	Write a program to build a system that translates text form one language to another.	2hrs
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26	Write a program to classify the sentiment of a given text as positive, negative or neutral	
27	Write a program to implement Text summarization for the given sample text.	
28	Write a program to convert speech to text and text to speech	
29	Write a program to Implement syntactic parsing of a given text	
30	Write a program to implement Naïve Bayes, Decision List.	

References:

1. Sentiment Analysis and Opinion Mining, Bing Liu, Morgan & Claypool Publishers, May 2012.
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5. Building Microservices: Designing Fine-Grained Systems, Sam Newman ,O'Reilly
6. Production-ready Microservices, Susan J. Fowler, O'Reilly
7. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
8. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson

Academic Council Date – June 13, 2024
Item No. – 04

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

As per National Education Policy - 2020

M. Sc. in Information Technology

(Faculty of Science)

Syllabus for M. Sc. (Information Technology)

Semester III and IV

(With effect from the academic year 2024-25)

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	M.Sc. (Information Technology) Part II
2	**Eligibility**	A candidate for being eligible for admission to the M.Sc. I.T. Part-II, shall have passed M.Sc. I.T. Part-I and should have secured minimum 40%.
3	**Duration of program**	2 Years
4	**Intake Capacity**	20
5	**Scheme of Examination**	60:40
6	**Standards of Passing**	40%
7	**Semesters**	4 Semesters
8	**Program Academic Level**	P.G
9	**Pattern**	Semester
10	**Status**	New
11	**To be implemented from Academic Year**	Academic Year 2024-25

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Preamble

1) Introduction:

The M.Sc. Information Technology programme is started with an aim to make the learners employable and impart industry oriented training.

2) Aims and Objectives :

The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programmes.
- To be capable of managing complex IT projects with consideration of the human, financial and environmental factors.
- To equip postgraduate students with an integrated set of skills that will allow them to develop their professional careers in Information Technology.
- To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- To communicate effectively with a range of audiences both technical and non-technical.
- Skills to work with higher end applications in internet technologies; also managerial ability to analyze, design, develop and to maintain software development.

3) Learning Outcomes

- Learners will be able to apply the knowledge of mathematics, science and computing in the core information technologies.
- Learners will be able to develop the ability to analyze complex problems in information technology and apply appropriate solutions using critical thinking and problem-solving skills.
- Learners will be able to apply the knowledge of engineering and management principles to manage projects effectively in diverse environments as a member or a leader in the team.
- Learners will be able to Engage in independent and life-long learning for continued professional development.

Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course

Program Outcomes (POs)

PO No.	POs Statement **After completing the Master of Science Program, students will be able to-**	Knowledge and Skill
PO-1	The ability to identify and describe broadly accepted methodologies of science, and different modes of reasoning.	Disciplinary knowledge
PO-2	An ability to demonstrate proficiency in various instrumentation, modern tools, and advanced techniques to meet industrial expectations and research outputs	Disciplinary knowledge
PO-3	Ability to identify problems, formulates, and prove hypotheses by applying theoretical knowledge and skills relevant to the discipline.	Problem-solving
PO-4	The ability to articulate thoughts, research ideas, information, scientific outcomes in oral and in written presentation to range of audience.	Communication skills
PO-5	A capacity for independent, conceptual, and creative thinking, and critical analysis through the existing methods of enquiry.	Critical thinking
PO6	Acquisition of skills required for cutting edge research, investigations, field study, documentation, networking, and ability to build logical arguments using scholarly evidence.	Research skills
PO7	An ability to portray good interpersonal skills with the ability to work collaboratively as part of a team undertaking a range of different team roles.	Teamwork
PO8	The ability to understand ethical responsibilities and impact of scientific solutions in global, societal, and environmental context and contribute to sustainable development.	Moral and ethical awareness/ multicultural competence
PO9	An openness to and interest in, life-long learning through directed and self-directed study.	self-directed learning
PO10	The ability to translate the knowledge and demonstrate the skills required to be employed and successful professional development.	Life-long learning

Program Specific Outcomes (PSOs)

PSO No.	PSOs Statement **After completing the programme in Information Technology, Student will be able to:**	Knowledge and Skill
PSO-1	Apply IT in the field of Data Science, AI, Networking, Security and Cloud Computing.	Disciplinary knowledge
PSO-2	Design solutions for complex IT problems.	Problem-solving
PSO-3	Develop research, investigation skills and achieve professional competency in the field of I.T.	Research skills

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for M. Sc. (Information Technology) Semester III and IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2024-2025)

Course Structure

No. of Courses	Semester III	Credits	No. of Courses	Semester IV	Credits
A	***Discipline Specific Course (Major)***		**A**	***Discipline Specific Course (Major)***	
1	Advanced AI	04	1	Blockchain	04
2	Machine Learning	04	2	Robotic Process Automation	04
3	Cyber Forensics	04	3	Deep Learning	04
4	Practical: Practical of Advanced AI + Practical of Machine Learning	02	4	Practical: Practical of Blockchain + Practical of Robotic Process Automation+ Practical of Deep Learning	02
B	***Discipline Specific Course (Elective) (Students will select any 1 out of 2)***		***B***	***Discipline Specific Course (Elective) (Students will select any 1 out of 2)***	
5	Security Breaches and Countermeasures Technical Writing and Entrepreneurship Development	02	5	Human Computer Interaction Security Operations Center	02
6	Practical: Practical of Cyber Forensics + Practical of Security Breaches and Countermeasures Practical: Practical of Cyber Forensics + Practical of Technical Writing and Entrepreneurship Development	02	6	- -	-
C	***Discipline Specific Course(Minor)***		***C***	***Discipline Specific Course(Minor)***	
7	Research Project	04		Project Implementation and Viva	06
	Total Credits	22		Total Credits	22

Semester - III
[Under CBCS Scheme]

Course Code	Course Type	Course Title	Credit
PIT3AIT	Major Subject I	Advanced AI	04
PIT3MLT	Major Subject II	Machine Learning	04
PIT3CFT	Major Subject III	Cyber Forensics	04
PIT3PR1	Major Practical	Practical: Practical of Advanced AI + Practical of Machine Learning	02
PIT3SBT	Elective	Elective 1: Security Breaches and Countermeasures	02
PIT3TWT		Elective 2: Technical Writing and Entrepreneurship Development	
PIT3PR2	Elective Practical	Elective Practical 1: Practical of Cyber Forensics + Practical of Security Breaches and Countermeasures	02
PIT3PR3		Elective Practical 1: Practical of Cyber Forensics + Practical of Technical Writing and Entrepreneurship Development	
PIT3RPP	Research Project	Research Project	04
		Total Credits	**22**

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for M. Sc. (Information Technology) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2024-2025)

Major-I

Course Code: PIT3AIT

Course Title: Advanced AI

Course Type: Major-I **No. of Credits: 04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Define the fundamental concepts of Advanced AI and its applications.
CO-2	Explain various machine learning algorithms to solve real-world problems.
CO-3	Determine the process of image formation and the role of camera parameters.
CO-4	Elaborate Q-learning algorithm and Robotic application Domain.

Syllabus for M. Sc. (Information Technology) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: PIT3AIT

Course Title: Advanced AI

Unit I:

Review of AI: History, foundation and Applications. Traditional AI vs Advanced AI

Expert System and Applications: Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth Maintenance System, Application of Expert Systems, Shells and Tools.

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Unit II:

Probability Theory: joint probability, conditional probability, Bayes's theorem, probabilities in rules and facts of rule based system, rule based system and Bayesian method.

Machine Learning: Machine Learning basics, Applications of ML, Data Mining Vs Machine Learning Vs Big Data Analytics, Supervised and unsupervised learning, inductive learning, deductive learning, clustering, support vector machines, case based reasoning and learning

Unit III:

AI and Computer Vision: Computer Vision, History of Computer Vision, Image Processing Techniques, Object Detection and Recognition, Image Classification and segmentation, Deep Learning in Computer Vision, Advanced Computer Vision Techniques, Computer Vision with GenAI, Applications of Computer Vision AI.

Intelligent Agents: Agents vs software programs, classification of agents, working of an agent, single agent and multiagent systems, performance evaluation, architecture, agent communication language, applications.

Unit IV:

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction

Reinforcement Learning: Elements of Reinforcement Learning, Limitations and Scope, Q-learning algorithm, History of Reinforcement Learning

Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to Move, Planning Uncertain Movements, Robotic Application Domains.

Reference Books:

1. Artificial Intelligence: A Modern Approach, A. Russel, Peter Norvig.
2. Artificial Intelligence, Saroj Kaushik, Cengage, 1st Edition, 2019
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer
4. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, Second edition

Major II

Course Code: PIT3MLT

Course Title: Machine Learning

Course Type: Major II **No. of Credits: 04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Understand the key issues in Machine Learning and its associated applications in intelligent business and scientific computing.
CO-2	Acquire the knowledge about classification and regression techniques where a learner will be able to explore his skill to generate data base knowledge.
CO-3	Understand and implement the techniques for extracting the knowledge using machine learning methods.
CO-4	Apply the algorithms to a real-world problem, optimize the models learned

Syllabus for M. Sc. (Information Technology) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code: PIT3MLT

Course Title: Machine Learning

Unit I:

Introduction: Machine learning, Examples of Machine Learning Problems, Structure of Learning, learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, and Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.

Unit II:

Classification and Regression: Classification: Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification. **Regression:** Assessing performance of Regression- Error measures, Overfitting- Catalysts for Overfitting, Case study of Polynomial Regression.
Theory of Generalization: Effective number of hypothesis, Bounding the Growth function, VC Dimensions, Regularization theory.

Unit III:

Linear Models: Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.

Unit IV:

Logic Based and Algebraic Model: Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models: Rule learning for subgroup discovery, Association rule mining.
Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees.
Trends In Machine Learning: Model and Symbols-Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.

Reference Books:

1. Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge University Press, 2012.
2. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman, Springer Publication 2nd Edition, 2012.
3. Introduction to Machine Learning, Ethem Alpaydin, PHI Publication, 2nd Edition,2013

Major III

Course Code: PIT3CFT

Course Title: Cyber Forensics

Course Type: Major III **No. of Credits: 04**

Course Outcomes (Cos)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Explain the cyber forensics with standard operating procedures.
CO-2	Elaborate recovery of the data from the hard disk with legal procedure.
CO-3	Explain recovery and analyse the data using forensics tool
CO-4	Adapt the knowledge of network analysis and use it for analysing the internet attacks.

Syllabus for M. Sc. (Information Technology) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code: PIT3CFT

Course Title: Cyber Forensics

Unit I:
Computer Forensics: The present Scenario, The Investigation Process, Computers – Searching and Seizing, Electronic Evidence, Procedures to be followed by the first responder.

Unit II:
Setting up a lab for Computer Forensics, Hard Disks and File Systems, Forensics on Windows Machine, Acquire and Duplicate Data

Unit III:
Recovery of deleted files and partitions, Using Access Data FTK and Encase for forensics Investigation, Forensic analysis of Steganography and Image files, Cracking Application passwords.

Unit IV:
Capturing logs and correlating to the events, Network Forensics – Investigating logs and Network traffic, Investigating Wireless and Web Attacks. Email Tracking and Email Crime investigation.

Reference Books:

1. EC-Council CHFIv10 Study Guide EC-Council 2018
2. The official CHFI Exam 312-49 study Guide Dave Kleiman SYNGRESS 2007
3. Digital Forensics and Incident Response Gerard Johansen Packt Publishing 2020
4. Practical Cyber Forensics Niranjan Reddy Apress 2019

Major IV

Course Code: PIT3PR1

Course Title: Practical: Practical of Advanced AI + Practical of Machine Learning

Course Type: Major IV Practical **No. of Credits:02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Explain the types of python libraries going to be used in AI Algorithms.
CO-2	Develop a program to retrieve precise output by using Learning methods
CO-3	Develop machine learning models.
CO-4	Estimate a program to retrieve precise output by using ANN.

Module/ Unit	Course Description	Hrs.
1	Design an Expert system using AIML.	**2hrs**
2	Design a bot using AIML.	**2hrs**
3	Implement Bayes Theorem using Python.	**2hrs**
4	Implement Conditional Probability and joint probability using Python.	**2hrs**
5	Write program to implement Rule Based System.	**2hrs**
6	Write an application to simulate supervised and un-supervised learning model.	**2hrs**
7	Write an application to implement Clustering algorithm	**2hrs**
8	Write a Program to implement BFS algorithm.	**2hrs**
9	Write a Program to implement DFS algorithm.	**2hrs**
10	Implementation of Python basic Libraries such as Math, Numpy and Scipy, Pandas and Matplotlib	**2hrs**
11	Implement Linear Regression: Using scikit-learn, implement and train a linear regression model on a simple dataset.	**2hrs**
12	Implement K-Means Clustering: Using scikit-learn, implement k-means clustering and visualize the results on a sample dataset.	**2hrs**
13	Use NLTK or spaCy to preprocess text data (tokenization, stemming, lemmatization). Implement a sentiment analysis classifier using TF-IDF and logistic regression.	**2hrs**
14	Implement a CNN for image classification using a custom dataset with TensorFlow/Keras.	**2hrs**
15	Implement a Q-Learning algorithm for a gridworld environment.	**2hrs**
16	Design a simple machine learning model to train the training instances and test the same.	**2hrs**
17	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file	**2hrs**
18	Perform Data Loading, Feature selection (Principal Component analysis) and Feature Scoring and Ranking.	**2hrs**
19	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**2hrs**
20	Write a program to implement Decision Tree and Random forest with Prediction, Test Score and Confusion Matrix.	**2hrs**
21	a. For a given set of training data examples stored in a .CSV file implement Least Square Regression algorithm. b. For a given set of training data examples stored in a.CSV file implement Logistic Regression algorithm	**2hrs**

22	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set.	**2hrs**
23	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	**2hrs**
24	Implement the different Distance methods (Euclidean) with Prediction, Test Score and Confusion Matrix.	**2hrs**
25	Implement the classification model using clustering for the following techniques with hierarchical clustering with Prediction, Test Score and Confusion Matrix	**2hrs**
26	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.	**2hrs**
27	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	**2hrs**
28	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**2hrs**
29	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	**2hrs**
30	Perform Text per-processing, Text clustering, classification with Prediction, Test Score and Confusion Matrix.	**2hrs**

Reference Books:

1. Artificial Intelligence: A Modern Approach, A. Russel, Peter Norvig.
2. Artificial Intelligence, Saroj Kaushik, Cengage, 1st Edition, 2019
3. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, Tata McGrawhill, 3rd Edition
4. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman, Springer Publication 2nd Edition, 2012.

Elective

Course Code: PIT3SBT

Course Title: Security Breaches and Countermeasures

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Classify different security breaches that can occur.
CO-2	Identify vulnerabilities in the systems; breach the security of the system, and threats due to malware.
CO-3	Develop social engineering and educate people to be Careful from attacks due to it.
CO-4	Evaluate vulnerabilities in the Web Servers, Applications and newer technologies like mobiles, IoT and computing.

Syllabus for M. Sc. (Information Technology) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: PIT3SBT

Course Title: Security Breaches and Countermeasures

Unit I:

Introduction to Security Breaching: Overview of Information Security, Threats and Attack vectors, Concepts of Hacking – Ethical and Unethical, Information Security Controls, Concepts of penetration Testing, Information Security Laws and Standards.

Evaluation Security of IT Organisation: Concepts, Methodology, Tools, Countermeasures, Penetration Testing.

Network Scanning: Concepts, Scanning beyond IDS and firewalls, Tools, Banner Grabbing, Scanning Techniques, Network Diagrams, penetration testing.

Enumeration: Concepts, Different types of enumeration: Netbios, SNMP, LDAP, NTP, SMTP, DNS, other enumeration techniques, Countermeasures, Penetration Testing.

Unit II:

Analysis of Vulnerability: Concepts, Assessment Solutions, Scoring Systems, Assessment Tools, Assessment Reports.

Breaching System Security: Concepts, Cracking passwords, Escalating privileges, Executing Applications, Hiding files, covering tracks, penetration testing.

Threats due to malware: Concepts, Malware Analysis, Trojan concepts, countermeasures, Virus and worm concepts, anti-malware software, penetration testing.

Network Sniffing: Concepts, countermeasures, sniffing techniques, detection techniques, tools, penetration testing.

Reference Books:

1. CEHv10, Certified Ethical Hacker Study Guide Ric Messier Sybex - Wiley - 2019
2. All in One, Certified Ethical Hacker Matt Walker Tata McGraw Hill - 2012
3. CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide I.P. Specialist IPSPECIALIST – 2018.

Elective II

Course Code: PIT3TWT

Course Title: Technical Writing and Entrepreneurship Development

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Develop technical documents that meet the requirements with standard guidelines.
CO-2	Write Better Quality Content Which Ranks faster at Search Engines.
CO-3	Evaluate the essentials parameters of effective Social Media Pages.
CO-4	Understand importance of innovation and entrepreneurship.

Syllabus for M. Sc. (Information Technology) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: PIT3TWT

Course Title: Technical Writing and Entrepreneurship Development

Unit I:

Introduction to Technical Communication: What Is Technical Communication? The Challenges of Producing Technical Communication, Characteristics of a Technical Document, Measures of Excellence in Technical Documents, Skills and Qualities Shared by Successful Workplace Communicators, How Communication Skills and Qualities Affect Your Career?

Writing Technical Documents: Planning, Drafting, Revising, Editing, Proofreading **Writing Collaboratively:** Advantages and Disadvantages of Collaboration, Managing Projects, Conducting Meetings, Using Social Media and Other Electronic Tools in Collaboration, Importance of Word Press Website, Gender and Collaboration, Culture and Collaboration.

Introduction to Content Writing: Types of Content, Exploring Content Publication Channels. Distribution of your content across various channels.

Researching Your Subject: Understanding the Differences Between Academic and Workplace Research, Understanding the Research Process, Conducting Secondary Research, Conducting Primary Research,

Research and Documentation: Literature Reviews, Interviewing for Information, Documenting Sources, Copyright, Paraphrasing, Questionnaires.

Report Components: Abstracts, Introductions, Tables of Contents, Executive Summaries, Feasibility Reports, Investigative Reports, Laboratory Reports, Test Reports, Trip Reports, Trouble Reports.

Unit II:

Writing Proposals: Understanding the Process of Writing Proposals, The Logistics of Proposals, The "Deliverables" of Proposals, Persuasion and Proposals, Writing a Proposal, The Structure of the Proposal.

Plagiarism: What is Plagiarism? How to avoid writing plagiarism content?

Innovation management: an introduction: The importance of innovation, Models of innovation, Innovation as a management process. **Market adoption and technology diffusion:** Time lag between innovation and useable product, Innovation and the market , Innovation and market vision ,Analysing internet search data to help adoption and forecasting sales ,Innovative new products and consumption patterns, Crowd sourcing for new product ideas, Frugal innovation and ideas from everywhere, Innovation diffusion theories

Managing intellectual property: Intellectual property, Trade secrets, An introduction to patents, Trademarks, Brand names, Copyright

Management of research and development: What is research and development?, R&D management and the industrial context, R&D investment and company success, Classifying R&D, R&D management and its link with business strategy, Strategic pressures on R&D, Which business to support and how?, Allocation of funds to R&D, Level of R&D expenditure

Reference Books:

1. Technical Communication, Mike Markel, Bedford/St. Martin's publication, 11th edition, 2014.
2. Innovation Management and New Product Development, Paul Trott, Pearson publication, 6th edition, 2017.
3. Innovation and Entrepreneurship, Peter Drucker, Harper Business Publication, 3rd edition, 2009.
4. Handbook of Technical Writing, Gerald J. Alred , Charles T. Brusaw , Walter E. Oliu Bedford/St. Martin's publication, 09th edition, 2008

Course Code: PIT3PR2

Course Title: Practical: Practical of Cyber Forensics + Practical of Security Breaches and Countermeasures

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Elaborate recovery of the data from the hard disk with legal procedure.
CO-2	Explain recovery and analyse the data using forensics tool
CO-3	Make use of tools to perform foot printing and reconnaissance
CO-4	Determine use of Enumeration and network scanning tools

Module/Unit	Course Description	Hrs.
1	Use the following tools to perform footprinting and reconnaissance i. Recon-ng (Using Kali Linux) ii. FOCA Tool iii. Windows Command Line Utilities • Ping • Tracert using Ping • Tracert • NSLookup iv. Website Copier Tool – HTTrack v. Metasploit (for information gathering) vi. Whois Lookup Tools for Mobile – DNS Tools, Whois, Ultra Tools Mobile vii. Smart Whois viii. eMailTracker Pro ix. Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool	**2hrs**
2	Scan the network using the following tools: i. Hping2 / Hping3 ii. Advanced IP Scanner iii. Angry IP Scanner iv. Masscan v. NEET vi. CurrPorts vii. Colasoft Packet Builder viii. The Dude	**2hrs**
3	b. Scan the network using the following tools: i. Hping2 / Hping3 ii. Advanced IP Scanner iii. Angry IP Scanner iv. Masscan v. NEET vi. CurrPorts vii. Colasoft Packet Builder	**2hrs**
4	c. Use Proxy Workbench to see the data passing through it and save the data to file. d. Perform Network Discovery using the following tools: i. Solar Wind Network Topology Mapper ii. OpManager iii. Network View iv. LANState Pro e. Use the following censorship circumvention tools: i. Alkasir ii. Tails OS f. Use Scanning Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool	**2hrs**
5	e. Use the following censorship circumvention tools: i. Alkasir	**2hrs**

	ii. Tails OS f. Use Scanning Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool.	
6	a. Perform Enumeration using the following tools: i. Nmap ii. NetBIOS Enumeration Tool iii. SuperScan Software iv. Hyena v. SoftPerfect Network Scanner Tool vi. OpUtils vii. SolarWinds Engineer's Toolset viii. Wireshark b. Perform the vulnerability analysis using the following tools: i. Nessus ii. OpenVas	**2hrs**
7	Perform mobile network scanning using NESSUS.	**2hrs**
8	b. Perform the System Hacking using the following tools: i. Winrtgen ii. PWDump iii. Ophcrack iv. Flexispy v. NTFS Stream Manipulation vi. ADS Spy vii. Snow viii. Quickstego ix. Clearing Audit Policies x. Clearing Logs	**2hrs**
9	a. Use wireshark to sniff the network. b. Use SMAC for MAC Spoofing. c. Use Caspa Network Analyser. d. Use Omnipeek Network Analyzer	**2hrs**
10	a. Use Social Engineering Toolkit on Kali Linux to perform Social Engineering using Kali Linux. b. Perform the DDOS attack using the following tools: i. HOIC ii. LOIC iii. HULK iv. Metasploit c. Using Burp Suite to inspect and modify traffic between the browser and target application.	**2hrs**
11	a. Perform Web App Scanning using OWASP Zed Proxy. b. Use droid sheep on mobile for session hijacking c. Demonstrate the use of the following firewalls: i. Zonealarm and analyse using Firewall Analyzer. ii. Comodo Firewall. d. Use HoneyBOT to capture malicious network traffic.	**2hrs**
12	Use the following tools to protect attacks on the web servers: i. ID Server.	**2hrs**

	ii. Microsoft Baseline Security Analyser. iii. Syhunt Hybrid.	
13	a. Protect the Web Application using dotDefender. b. Demonstrate the following tools to perform SQL Injection: i. Tyrant SQL ii. Havij iii. BBQSQL	**2hrs**
14	Use Aircrack-ng suite for wireless hacking and countermeasures.	**2hrs**
15	Use the following tools for cryptography HashCalc Advanced Encryption Package MD5 Calculator TrueCrypt CrypTool	**2hrs**
16	File System Analysis using The SleuthKit (Autospy, fsstat, istat, fls and img_stat)	**2hrs**
17	Explore Windows forensic tools (OSForensics)	**2hrs**
18	Forensics Investigation Using Encase	**2hrs**
19	Using Forensic Toolkit(FTK) &Writing report usingFTK (AccessData FTK)	**2hrs**
20	Using File Recovery Tools [FTK Imager] Creating Image	**2hrs**
21	Using Web attack detectiontools [Wireshark]	**2hrs**
22	Using Log & Traffic Capturing & Analysis Tools [Wireshark]	**2hrs**
23	Using Data Acquisition Tools [ProDiscover Pro]	**2hrs**
24	Using Steganography Tools [S-Tools]	**2hrs**
25	Performing Password Cracking [Cain & Abel]	**2hrs**
26	Performing Sniffing [Cain & Abel]	**2hrs**
27	a. Managing Remote Registry, Network Enumeration, Services, s. IDs [Cain & Abel]	**2hrs**
28	Scan Registry using RegScanner	**2hrs**
29	Network Forensic Analysis Tool (NetworkMiner)	**2hrs**

30	Dump Memory contents using PMdump	**2hrs**

Reference Books:

1. CEHv10, Certified Ethical Hacker Study Guide Ric Messier Sybex - Wiley - 2019
2. All in One, Certified Ethical Hacker Matt Walker Tata McGraw Hill - 2012
3. CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide I.P. Specialist IPSPECIALIST – 2018.
4. EC-Council CHFIv10 Study Guide EC-Council 2018

Course Code: PIT3PR3

Course Title: Practical: Practical of Cyber Forensics + Practical of Technical Writing and Entrepreneurship Development

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Elaborate recovery of the data from the hard disk with legal procedure.
CO-2	Explain recovery and analyse the data using forensics tool
CO-3	Build effective Blogs and Social Media Pages.
CO-4	Create Resumes, Research Proposals and Research Report.

Module/Unit	Course Description	Hrs.
1	File System Analysis using The SleuthKit (Autospy, fsstat, istat, fls and img_stat)	**2hrs**
2	Explore Windows forensic tools (OSForensics)	**2hrs**
3	Forensics Investigation Using Encase	**2hrs**
4	Using Forensic Toolkit(FTK) &Writing report usingFTK (AccessData FTK)	**2hrs**
5	Using File Recovery Tools [FTK Imager] Creating Image	**2hrs**
6	Using Web attack detectiontools [Wireshark]	**2hrs**
7	Using Log & Traffic Capturing & Analysis Tools [Wireshark]	**2hrs**
8	Using Data Acquisition Tools [ProDiscover Pro]	**2hrs**
9	Using Steganography Tools [S-Tools]	**2hrs**
10	Performing Password Cracking [Cain & Abel]	**2hrs**
11	Performing Sniffing [Cain & Abel]	**2hrs**
12	a. Managing Remote Registry, Network Enumeration, Services, s. IDs [Cain & Abel]	**2hrs**
13	Scan Registry using RegScanner	**2hrs**
14	Network Forensic Analysis Tool (NetworkMiner)	**2hrs**
15	Dump Memory contents using PMdump	**2hrs**
16	Writing Articles (Business, Newsletters). Preparing advertisements for popularization of products and news writing	**2hrs**
17	Preparing and Writing different Research Proposals	**2hrs**
18	Creating Feasibility Report, Formal Reports, Trip Reports	**2hrs**
19	Creating Recommendation Reports	**2hrs**
20	Writing Acceptance and Refusal Letter, Resignation Letters	**2hrs**
21	Writing Application Letter (e.g. College Student Applying for an Internship)	**2hrs**
22	Conducting meeting – Purpose, procedure, participation, physical arrangements, recording and writing of minutes of meeting	**2hrs**
23	Creating Resumes.	**2hrs**
24	Creating Simple own Blog.	**2hrs**
25	Creating Content for Blogs and Social Media.	**2hrs**
26	Preparing and writing Abstract, Literature Review.	**2hrs**
27	Creating Questionnaire for research.	**2hrs**

28	Conducting Primary and Secondary Research.	**2hrs**
29	Conducting market survey to know the demands for different products	**2hrs**
30	Visit to entrepreneurship institute/ case study of successful entrepreneurs	**2hrs**

Reference Books:

1. 1 EC-Council CHFIv10 Study Guide EC-Council 2018
2. Handbook of Technical Writing, Gerald J. Alred , Charles T. Brusaw , Walter E. Oliu, Bedford/St. Martin's publication, 09th edition, 2008

Minor

Course Code : PIT3RPP

Course Title : Research Project

Course Type: DSC **No. of Credits: 04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Identify a problem definition.
CO-2	Estimate system requirement.
CO-3	Design data flow diagram.
CO-4	Plan the system design phase in SDLC.

Syllabus for M. Sc. (Information Technology) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: PIT3RPP

Course Title: Research Project

Course Description:

Project Implementation

Chapter 1 to 4 should be submitted in Semester III in spiral binding. These chapter have also to be included in Semester IV report. Semester IV report has to be hard bound with golden embossing. Students will be evaluated based on the dissertation in semester III and dissertation and viva voce in Semester IV.

I. OBJECTIVES

• Describe the Systems Development Life Cycle (SDLC).
• Evaluate systems requirements.
• Complete a problem definition.
• Evaluate a problem definition.
• Determine how to collect information to determine requirements.
• Perform and evaluate feasibility studies like cost-benefit analysis, technical feasibility, time feasibility and Operational feasibility for the project.
• Work on data collection methods for fact finding.
• Construct and evaluate data flow diagrams.
• Construct and evaluate data dictionaries.
• Evaluate methods of process description to include structured English, decision tables and decision trees.
• Evaluate alternative tools for the analysis process.
• Create and evaluate such alternative graphical tools as systems flow charts and state transition diagrams.
• Decide the S/W requirement specifications and H/W requirement specifications.
• Plan the systems design phase of the SDLC.
• Distinguish between logical and physical design requirements.
• Design and evaluate system outputs.
• Design and evaluate systems inputs.
• Design and evaluate validity checks for input data.
• Design and evaluate user interfaces for input.
• Design and evaluate file structures to include the use of indexes.
• Estimate storage requirements.
• Explain the various file update processes based on the standard file organizations.
• Decide various data structures.
• Construct and evaluate entity-relationship (ER) diagrams for RDBMS related projects.
• Perform normalization for the unnormalized tables for RDBMS related projects
• Decide the various processing systems to include distributed, client/server, online and others.
• Perform project cost estimates using various techniques.
• Schedule projects using both GANTT and PERT charts.
• Perform coding for the project.

• Documentation requirements and prepare and evaluate systems documentation.
• Perform various systems testing techniques/strategies to include the phases of testing.
• Systems implementation and its key problems.
• Generate various reports.
• Be able to prepare and evaluate a final report.
• Brief the maintenance procedures and the role of configuration management in operations.
• To decide the future scope and further enhancement of the system.
• Plan for several appendices to be placed in support with the project report documentation.
• Decide the various processing systems to include distributed, client/server, online and others.
• Perform project cost estimates using various techniques.
• Schedule projects using both GANTT and PERT charts.
• Perform coding for the project.
• Documentation requirements and prepare and evaluate systems documentation.
• Perform various systems testing techniques/strategies to include the phases of testing.
• Systems implementation and its key problems.
• Generate various reports.
• Be able to prepare and evaluate a final report.
• Brief the maintenance procedures and the role of configuration management in operations.
• To decide the future scope and further enhancement of the system.
• Plan for several appendices to be placed in support with the project report documentation.

• Work effectively as an individual or as a team member to produce correct, efficient, well-organized and documented programs in a reasonable time.
• Recognize problems that are amenable to computer solutions, and knowledge of the tool necessary for solving such problems.
• Develop of the ability to assess the implications of work performed.
• Get good exposure and command in one or more application areas and on the software
• Develop quality software using the software engineering principles
• Develop of the ability to communicate effectively.

II. Type of the Project

The majority of the students are expected to work on a real-life project preferably in some industry/ Research and Development Laboratories/Educational Institution/Software Company. Students are encouraged to work in the areas listed below. However, it is not mandatory for a student to work on a real-life project. The student can formulate a project problem with the help of her/his Guide and submit the project proposal of the same. Approval of the project proposal is mandatory. If approved, the student can commence working on it, and complete it. Use the latest versions of the software packages for the development of the project.

III. SOFTWARE AND BROAD AREAS OF APPLICATION FRONT END

IV. Introduction

The project report should be documented with scientific approach to the solution of the problem that the students have sought to address. The project report should be prepared in order to solve the problem in a methodical and professional manner, making due references to appropriate techniques, technologies and professional standards. The student should start the documentation process from the first phase of software development so that one can easily identify the issues to be focused upon in the ultimate project report. The student should also include the details from the project diary, in which they will record the progress of their project throughout the course. The project report should contain enough details to enable examiners to

evaluate the work. The important points should be highlighted in the body of the report, with details often referred to appendices.

1.1 PROJECT REPORT:

Title Page
Original Copy of the Approved Proforma of the Project Proposal
Certificate of Authenticated work
Role and Responsibility Form
Abstract
Acknowledgement
Table of Contents
Table of Figures
CHAPTER 1: INTRODUCTION
1.1 Background
1.2 Objectives
1.3 Purpose, Scope, and Applicability
1.3.1 Purpose
1.3.2 Scope
1.3.3 Applicability
1.4 Achievements
1.5 Organisation of Report
CHAPTER 2: SURVEY OF TECHNOLOGIES
CHAPTER 3: REQUIREMENTS AND ANALYSIS
3.1 Problem Definition
3.2 Requirements Specification
3.3 Planning and Scheduling
3.4 Software and Hardware Requirements
3.5 Preliminary Product Description
3.6 Conceptual Models
CHAPTER 4: SYSTEM DESIGN
4.1 Basic Modules
4.2 Data Design
4.2.1 Schema Design
4.2.2 Data Integrity and Constraints
4.3 Procedural Design
4.3.1 Logic Diagrams
4.3.2 Data Structures
4.3.3 Algorithms Design
4.4 User interface design
4.5 Security Issues
4.6 Test Cases Design

The documentation should use tools like star UML, Visuo for windows, and Rational Rose for design as part of Project Management Practical Course. The documentation should be spiral bound for semester III and the entire documentation should be hard bound during semester IV

Semester - IV
[Under CBCS Scheme]

Course Code	Course Type	Course Title	Credit
PIT4BCT	Major Subject I	Blockchain	04
PIT4RPT	Major Subject II	Robotic Process Automation	04
PIT4DLT	Major Subject III	Deep Learning	04
PIT4PR1	Major Practical	Practical: Practical of Blockchain + Practical of Robotic Process Automation + Practical of Deep Learning	02
PIT4HCT	Elective	Elective 1: Human Computer Interaction	02
PIT4SOT		Elective 2: Security Operations Center	
PIT4PIP	Project Implementation	Project Implementation	06
		Total Credits	**22**

Major I

Course Code: PIT4BCT

Course Title: Blockchain

Course Type: Major I **No. of Credits: 04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Define the structure of blockchain system such as bitcoin and ethereum.
CO-2	Elaborate the use of different components in Solidity Programming.
CO-3	Explain concepts of Hyper ledger, Smart Contracts & tokens, Mining Ether and crypto economics.
CO-4	Elaborate the development of blockchain, EthereumD, Dapp applications.

Syllabus for M. Sc. (Information Technology) Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code: PIT4BCT

Course Title: Blockchain

Unit I:
Blockchain: Introduction, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases.
Working of Blockchain: Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions, blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling
blockchain
Working of Bitcoin: Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets.

Unit II:
Ethereum: three parts of blockchain, Ether as currency and commodity, Building trustless systems, Smart contracts, Ethereum Virtual Machine, The Mist browser, Wallets as a Computing Metaphor, The Bank Teller Metaphor, Breaking with Banking History, How Encryption Leads to Trust, System Requirements, Using Parity with Geth, Anonymity in Cryptocurrency, Central Bank Network, Virtual Machines, EVM
Applications, State Machines, Guts of the EVM, Blocks, Mining's Place in the State Transition Function, Renting Time on the EVM, Gas, Working with Gas, Accounts, Transactions, and Messages, Transactions and Messages, Estimating Gas Fees for
Operations, Opcodes in the EVM.

Unit III:
Hyperledger: Overview, Fabric, composer, installing hyperledger fabric and composer, deploying, running the network, error troubleshooting.
Smart Contracts and Tokens: EVM as Back End, Assets Backed by Anything, Cryptocurrency Is a Measure of Time, Function of Collectibles in Human Systems, Platforms for High-Value Digital Collectibles, Tokens as Category of Smart Contract, Creating a Token, Deploying the Contract, Playing with Contracts.
.

Unit IV:
Cryptoecnomics: Introduction, Usefulness of cryptoeconomics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios. **Blockchain Application Development:** Decentralized Applications, Blockchain Application Development, Interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum—Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions, Public vs. Private Blockchains, Decentralized Application Architecture,
Building an EthereumDApp: The DApp, Setting Up a Private Ethereum Network, Creating the Smart Contract, Deploying the Smart Contract, Client Application.

Reference Books:

1. Beginning BlockchainA Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, GautamDhameja, PriyansuSekhar Panda Apress 2018
2. Introducing Ethereum and Solidity Chris DannenApress 2017
3. The Blockchain Developer EladElromApress 2019
4. Mastering Ethereum Andreas M. Antonopoulos Dr. Gavin Wood O'Reilly First 2018
5. Blockchain Enabled Applications Vikram Dhillon David Metcalf Max Hooper Apress 2017

Major II

Course Code : PIT4RPT

Course Title : Robotics Process Automation

Course Type: Major II **No. of Credits: 04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Define the scope and techniques of robotic process automation using UIPath Studio.
CO-2	Explain the concept of sequence, flowchart and control flow used to manipulate data.
CO-3	Make use of Exception Handling, Debugging and logging to handle user events and Assistant bots.
CO-4	Elaborate the deployment and maintenance of bot along with maintaining the code.

Syllabus for M. Sc. (Information Technology) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: PIT4RPT

Course Title: Robotics Process Automation

Unit I: Robotic Process Automation: Scope and techniques of automation, About UiPath **Record and Play:** UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.

Unit II: Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow
Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example)

Unit III: Taking Control of the Controls : Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points
Tame that Application with Plugins and Extensions: Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Web integration, Excel and Word plugins, Credential management, Extensions – Java, Chrome, Firefox, and Silverlight

Unit IV: Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger ,Monitoring image and element triggers, An example of monitoring email, Example of monitoring a copying event and blocking it, Launching an assistant bot on a keyboard event
Exception Handling, Debugging, and Logging: Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting

Reference Books:

1. Learning Robotic Process Automation Alok Mani TripathiPackt 1st 2018
2. Robotic Process Automation Tools, Process Automation and their benefits:
3. Understanding RPA and Intelligent Automation Srikanth Merianda Createspace Independent Publishing 1st 2018

Major III

Course Code : PIT4DLT

Course Title : Deep Learning

Course Type: Major III **No. of Credits:04**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Examine basics of mathematical foundation that will help the learner to understand the concepts of Deep Learning.
CO-2	Define and describe model of deep learning
CO-3	Design and implement various deep supervised learning architectures for text & image data.
CO-4	Design and implement various deep learning models and architectures.

Syllabus for M. Sc. (Information Technology) Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code : PIT4DLT

Course Title : Deep Learning

Unit I:
Applied Math and Machine Learning Basics: Linear Algebra: Scalars, Vectors, Matrices and Tensors , Multiplying Matrices and Vectors , Identity and Inverse Matrices, Linear Dependence and Span , norms, special matrices and vectors, eigen decompositions.
Numerical Computation: Overflow and under flow, poor conditioning, Gradient Based Optimization, Constraint optimization.

Unit II:
Deep Networks: Deep feedforward network , regularization for deep learning , Optimization for Training deep models

Unit III:
Convolutional Networks, Sequence Modelling, Applications

Unit IV:
Deep Learning Research: Linear Factor Models, Autoencoders, representation learning

Reference Books:

1. Deep Learning Ian Goodfellow, Yoshua Bengio, Aaron Courvile an MIT Press book 1st 2016
2. Fundamentals of Deep Learning Nikhil Buduma O'Reilly 1st 2017
3. Deep Learning: Methods and Applications Deng & Yu Now Publishers 1st 2013
4. Deep Learning CookBook Douwe Osinga O'Reilly 1st 2017

Major IV

Course Code: PIT4PR1

Course Title: Practical: Practical of Blockchain + Practical of Robotic Process Automation + Practical of Deep Learning

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Design programs for blockchain in Python.
CO-2	Create blockchain and exhibit its use.
CO-3	Develop Automation of any process using recording and applications on excel file.
CO-4	Make use of tools to design various interface.

Module/Unit	Course Description	Hrs.
1	Write the following programs for Blockchain in Python: a. A simple client class that generates the private and public keys by using the built-in Python RSA algorithm and test it. A transaction class to send and receive money and test it.	**2 hrs**
2	Write the following programs for Blockchain in Python: a. Create multiple transactions and display them. Create a blockchain, a genesis block and execute it.	**2 hrs**
3	Write the following programs for Blockchain in Python: a. Create a mining function and test it. Add blocks to the miner and dump the blockchain.	**2 hrs**
4	Install and configure Go Ethereum and the Mist browser. Develop and test a sample application.	**2 hrs**
5	Implement and demonstrate the use of the following in Solidity: Variable, Operators, Loops, Decision Making, Strings, Arrays, Enums, Structs, Mappings, Conversions, Ether Units, Special Variables.	**2 hrs**
6	Implement and demonstrate the use of the following in Solidity: Functions, Function Modifiers, View functions, Pure Functions, Fallback Function, Function Overloading, Mathematical functions, Cryptographic functions.	**2 hrs**
7	Implement and demonstrate the use of the following in Solidity: Withdrawal Pattern, Restricted Access.	**2 hrs**
8	Implement and demonstrate the use of the following in Solidity: Libraries, Assembly, Events, Error handling.	**2 hrs**
9	Implement and demonstrate the use of the following in Solidity: Libraries, Assembly, Events, Error handling.	**2 hrs**
10	Install hyperledger fabric and composer. Deploy and execute the application.	**2 hrs**
11	a. Create a simple sequence based project. b. Create a flowchart-based project.	**2 hrs**
12	Create an UiPath Robot which can empty a folder in Gmail solely on basis of recording.	**2 hrs**
13	Automate UiPath Number Calculation (Subtraction, Multiplication, Division of numbers).	**2 hrs**

14	Create an automation UiPath project using different types of variables (number, datetime, Boolean, generic, array, data table)	**2 hrs**
15	Create an automation UiPath Project using decision statements.	**2 hrs**
16	Create an automation UiPath Project using looping statements.	**2 hrs**
17	a. Automate any process using basic recording. b. Automate any process using desktop recording.	**2 hrs**
18	Consider an array of names. We have to find out how many of them start with the letter "a". Create an automation where the number of names starting with "a" is counted and the result is displayed.	**2 hrs**
19	Create an application automating the read, write and append operation on excel file.	**2 hrs**
20	Automate the process to extract data from an excel file into a data table and vice versa	**2 hrs**
21	Performing matrix multiplication using TensorFlow	**2 hrs**
22	Finding eigen vectors and eigen values using TensorFlow	**2 hrs**
23	Solving XOR problem using deep feed forward network.	**2 hrs**
24	Implementing deep neural network for performing binary classification task.	**2 hrs**
25	Using deep feed forward network with two hidden layers for performing multiclass classification and predicting the class.	**2 hrs**
26	Using a deep feed forward network with two hidden layers for performing classification and predicting the probability of class.	**2 hrs**
27	Using a deep feed forward network with two hidden layers for performing linear regression and predicting values.	**2 hrs**
28	Evaluating feed forward deep network for regression using KFold cross validation.	**2 hrs**

29	Evaluating feed forward deep network for multiclass Classification using KFold cross-validation.	**2 hrs**
30	Implementing regularization to avoid overfitting in binary classification.	**2 hrs**

Reference Books:

1. Beginning BlockchainA Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, GautamDhameja, PriyansuSekhar Panda Apress 2018
2. Introducing Ethereum and Solidity Chris DannenApress 2017
3. The Blockchain Developer EladElromApress 2019
4. Mastering Ethereum Andreas M. Antonopoulos Dr. Gavin Wood O'Reilly First 2018
5. Blockchain Enabled Applications Vikram Dhillon David Metcalf Max Hooper Apress 2017
6. Learning Robotic Process Automation Alok Mani TripathiPackt 1st 2018
7. Fundamentals of Deep Learning Nikhil Buduma O'Reilly 1st 2017
8. Deep Learning: Methods and Applications Deng & Yu Now Publishers 1st 2013

Discipline Specific Course (Elective)

Course Code : PIT4HCT

Course Title : Human Computer Interaction

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Define HCI principles that influence a system's interface design.
CO-2	Explain techniques used for any of the proposed systems.
CO-3	Explain the different design implementation systems.
CO-4	Elaborate different evaluation techniques.

Syllabus for M. Sc. (Information Technology) Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code : PIT4HCT

Course Title : Human Computer Interaction

Unit I :
The Interaction: Models of interaction, Design Focus, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity **Paradigms:** Introduction, Paradigms for interaction.
Interaction design basics: What is design? The process of design, User focus, Cultural probes, Navigation design, the big button trap, Modes, Screen design and layout, Alignment and layout matters, Checking screen colours, Iteration and prototyping
HCI in the software process: The software life cycle, Usability engineering, Iterative design and prototyping, Prototyping in practice, Design rationale.

Unit II :
Design: Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns **Implementation support:** Elements of windowing systems, Programming the application, Going with the grain, Using toolkits, User interface management systems
Evaluation techniques: What is evaluation? Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method.

Reference Books:

1. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.

Discipline Specific Course (Elective)

Course Code: PIT4SOT

Course Title: Security Operations Center

Course Type: DSC **No. of Credits: 02**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Master of Science Program, students will be able to-
CO-1	Classify different security breaches that can occur.
CO-2	Identify vulnerabilities in the systems, breach the security of the system, and threats due to malware.
CO-3	Develop social engineering and educate people to be Careful from attacks due to it.
CO-4	Evaluate vulnerabilities in the Web Servers, Applications and newer technologies like mobiles, IoT and computing.

Syllabus for M. Sc. (Information Technology) Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020

Course Code : PIT4SOT

Course Title : Security Operations Center

Unit I:
Introduction to Security Operations Management: Foundation Topics Introduction to Identity and Access Management, Phases of the Identity and Access Lifecycle ,Registration and Identity Validation ,Privileges Provisioning, Access Review, Access Revocation, Password Management, Password Creation , **of Cryptography and Public Key Infrastructure** (PKI): Cryptography Ciphers and Keys Ciphers Keys Block and Stream Ciphers Symmetric and Asymmetric Algorithms
Introduction to Virtual Private Networks (VPNs) What Are VPNs? Site-to-site vs. Remote-Access VPNs
Endpoint Security Technologies: Antimalware and Antivirus Software Host-Based Firewalls and Host-Based Intrusion Prevention
Threat Analysis: What Is the CIA Triad: Confidentiality, Integrity, and Availability?
Threat Modeling Defining and Analyzing the Attack
Vector The Attack Scope Exam Preparation Tasks
Forensics: Introduction to Cybersecurity Forensics The Role of Attribution in a Cybersecurity Investigation
Fundamentals of Intrusion Analysis: Common Artifact Elements and Sources of Security Events False Positives, False Negatives, True Positives, and True Negatives, Understanding Regular Expressions Protocols

Unit II :
Introduction to Incident Response and the Incident Handling Process Introduction to Incident Response: What Are Events and Incidents? The Incident Response Plan The Incident Response Process ,The Preparation Phase The Detection and Analysis Phase **Incident Response Teams:** Computer Security Incident Response Teams (CSIRTs), Product Security Incident Response Teams
Compliance Frameworks: Payment Card Industry Data Security Standard (PCI DSS)
Network and Host Profiling: Network Profiling Throughput Measuring Throughput Used Ports Session Duration Critical Asset
The Art of Data and Event Analysis: Normalizing Data Interpreting Common Data Values into a Universal Format Using the 5-Tuple Correlation to Respond to Security Incidents **Intrusion Event Categories** Diamond Model of Intrusion Cyber Kill Chain Model Reconnaissance **Types of Attacks and Vulnerabilities:**
Security Evasion Techniques: Key Encryption and Tunneling Concepts Resource Exhaustion

Reference Books:
1. CCNA Cyber Ops SECOPS 210-255 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1st 2017
2. CCNA Cyber Ops SECFND 210-250 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1st 2017
3. CCNA Cyber security Operations Companion Guide CISCO 1st 2018

Project Implementation

Course Code: PIT4PIP

Course Title: Project Implementation

Course Type: Project Implementation **No. of Credits: 06**

Course Outcomes (COs)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Design user interface for input
CO-2	Develop coding for the system
CO-3	Examine various system testing.
CO-4	Predict the future scope of project

Syllabus for M. Sc. (Information Technology) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : PIT4PIP

Course Title : Project Implementation

Course Description:

Goals of the course Project Documentation and Viva-Voce
The student should:

- be able to apply relevant knowledge and abilities, within the main field of study, to a given
- problem
- within given constraints, even with limited information, independently analyse and discuss
- complex inquiries/problems and handle larger problems on the advanced level within the
- main field of study
- reflect on, evaluate and critically review one's own and others' scientific results
- be able to document and present one's own work with strict requirements on structure,
- format, and language usage
- be able to identify one's need for further knowledge and continuously develop one's own knowledge.

To start the project:

- Start thinking early in the programme about suitable projects.
- Read the instructions for the project.
- Attend and listen to other student´s final oral presentations.
- Look at the finished reports.
- Talk to senior master students.
- Attend possible information events (workshops / seminars / conferences etc.) about the related topics.

Application and approval:

- Read all the detailed information about project.
- Finalise finding a place and supervisor.
- Check with the coordinator about subject/project, place and supervisor.
- Write the project proposal and plan along with the supervisor.
- Fill out the application together with the supervisor.
- Hand over the complete application, proposal and plan to the coordinator.
- Get an acknowledgement and approval from the coordinator to start the project.

During the project:

- Search, gather and read information and literature about the theory.

- Document well the practical work and your results.
- Take part in seminars and the running follow-ups/supervision.
- Think early on about disposition and writing of the final report.
- Discuss your thoughts with the supervisor and others.
- Read the SOP and the rest you need again.
- Plan for and do the mid-term reporting to the coordinator/examiner.
- Do a mid-term report also at the work-place (can be a requirement in some work-places).
- Write the first draft of the final report and rewrite it based on feedback from the supervisor and possibly others.
- Plan for the final presentation of the report.

Finishing the project:

- Finish the report and obtain an OK from the supervisor.
- Ask the supervisor to send the certificate and feedback form to the coordinator.
- Attend the pre-final oral presentation arranged by the Coordinator.
- Rewrite the final report again based on feedback from the opponents and possibly others.
- Prepare a title page and a popular science summary for your report.
- Send the completed final report to the coordinator (via plagiarism software)
- Rewrite the report based on possible feedback from the coordinator.
- Appear for the final exam.

Project Proposal/research plan

- The student should spend the first 1-2 weeks writing a 1-2 pages project plan containing:
    - Short background of the project
    - Aims of the project
    - Short description of methods that will be used
    - Estimated time schedule for the project
- The research plan should be handed in to the supervisor and the coordinator.
- Writing the project plan will help you plan your project work and get you started in finding
- information and understanding of methods needed to perform the project.

Project Documentation The documentation should contain:

- Introduction - that should contain a technical and social (when possible) motivation of the project topic.
- Description of the problems/topics.
- Status of the research/knowledge in the field and literature review.
- Description of the methodology/approach. (The actual structure of the chapters here depends on the topic of the documentation.)
- Results - must always contain analyses of results and associated uncertainties.
- Conclusions and proposals for the future work.
- Appendices (when needed).
- Bibliography - references and links.

For the master's documentation, the chapters cannot be dictated, they may vary according to the type of project. However, in Semester III Project Documentation and Viva Voce must contain at least 4 chapters

(Introduction, Review of Literature,

Methodology / Approach, Proposed Design / UI design, etc. depending on the type of project.)
The Semester III report should be spiral bound.
In Semester IV, the remaining Chapters should be included (which should include Experiments performed, Results and discussion, Conclusions and proposals for future work, Appendices) and Bibliography - references and links. Semester IV report should include all the chapters and should be hardbound.