Janardan Bhagat Shikshan Prasarak Sanstha's

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

(Approved in the Academic council meeting dated 27/06/2023)

M. Sc. Information Technology

Revised as per
NEP 2020
Choice Based Credit System (60:40)
w.e.f. Academic Year 2023-2024
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 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 work effectively as a part of a team to achieve a common stated goal.
- 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.
- To develop an aptitude to engage in continuing professional development.

Examination Scheme

Choice Based Credit System (CBCS)

- **Revised Scheme of Examination**

The performance of the learners shall be evaluated into two components. The learner's Performance shall be assessed by Internal Assessment with 40% marks in the first component by conducting the Semester End Examinations with 60% marks in the second component. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

A) Internal Assessment: 40 % 40 Marks

Sr. No.	Particular		Marks
01	One periodical class test examination to be conducted in the given semester		20 Marks
02	One case study/ project with presentation based on curriculum to be assessed by the teacher concerned		15 Marks
	Presentation	10 Marks	
	Written Document	05 Marks	
03	Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities		05 Marks

- Maximum Marks: 20
- Duration: 40 Minutes

Particular	Marks
Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

Question Paper Pattern for Semester End Examination

- Duration: The examination shall be of 2.5 hours duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be five questions each of 12 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

➢ **Passing Standard**

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Question Paper Pattern for Practical Examination

Sr. No	Particular		Marks
01	Practical		50 Marks
	Practical Question	40 Marks	
	Journal	5 Marks	
	Viva	5 Marks	

Sr. No.	Heading	Particulars
1	Title of Course	Information Technology
2	Eligibility for Admission	(a) Student securing minimum 45% marks at the three years B.Sc. (IT) degree in Information Technology of University of Mumbai or any recognized university are eligible. OR (b) 1. B.E. in IT with minimum 45% marks 2. B.E. in Electronics with minimum 45% marks 3. B.E. in Electronics and Telecommunication with minimum 45% marks. 4. B.E. in Computer with minimum 45% marks 5. B.Sc. in Computer Science with minimum 45% marks 6. B.Sc. Maths with minimum 45% marks 7. B.Sc. Physics with minimum 45% marks 8. B.Sc. Statistics with minimum 45% marks 9. B.C.A. with minimum 45% marks
3	Passing marks	40%
4	Ordinances/Regulations (if any)	
5	No. of Semesters	Two
6	Level	P.G.
7	Pattern	Semester (60:40)
8	Status	New
9	To be implemented from Academic year	2023-2024

Choice Based Credit System (CBCS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2023-2024

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	Big Data Analytics	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 Big Data Analytics + 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 Ethical Hacking	02	5	Microservices Architecture Data Security	02
6	Practical: Practical of Cloud Computing + Practical of Soft Computing Technique	02	6	Practical : Practical of Microservices Architecture + Practical of Natural Language Processing	02
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 Subject I	Data Science	04
PIT1IPT	Major Subject II	Image Processing	04
PIT1SCT	Major Subject III	Soft Computing Techniques	04
PIT1PR1	Major Practical	Practical : Practical of Data Science + Practical of Image Processing	02
PIT1CCT	Elective 1	Cloud Computing	02
PIT1EHT	Elective 2	Ethical Hacking	
PIT1PR2	Elective Practical	Practical: Practical of Cloud Computing + Practical of Soft Computing Techniques	02
PIT1RMT	Minor Subject	Research Methodology	04
		Total Credits	**22**

Choice Based Credit System (CBCS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2023-2024
SEMESTER II

Course Code	Course Type	Course Title	Credit
PIT2BDA	Major Subject I	Big Data Analytics	04
PIT2MNT	Major Subject II	Modern Networking	04
PIT2NLT	Major Subject III	Natural Language Processing	04
PIT2PR1	Major Subject II Practical	Practical: Practical of Big Data Analytics + Practical of Modern Networking	02
PIT2MAT	Elective I	Microservices Architecture	02
PIT2DST	Elective II	Data Security	
PIT2PR2	Elective Practical	Practical : Practical of Microservices Architecture + Practical of Natural Language Processing	02
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 ,Spark, Mesos, Akka , Cassandra, Kafka, Elastic Search, R ,Scala, Python, MQTT. **Layered Framework:** Definition of Data Science Framework, Cross Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top	15hrs

	Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering , Business Layer, Utility Layer: **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, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject,	15hrs

	and Bandpass Filters from Lowpass Filters, Combining 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, Selective Filtering, 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, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections Wavelet and 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, Morphological Operations on Binary Images, Grayscale Morphology	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 Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, 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	15hrs

	Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	

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. **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	15hrs

	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, **Hybrid soft computing techniques** – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	15hrs

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

Major IV

Course Description: M.Sc.(Information Technology)	
Semester	**I**
Course Name	**Practical of Data Science + Practical of Image Processing**
Course Code	**PIT1PR1**
Credit	**1**
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	A) Text Delimited CSV to HORUS Format B) XML to HORUS format	2hrs
2	A) JSON to HORUS Format	2hrs

	B) AUDIO to HORUS Format	
3	Fixing Utilities	2hrs
4	A) Data Binning or Bucketing B) Averaging of data	2hrs
5	Assessing Data	2hrs
6	Build the time hub, links and satellites	2hrs
7	Transforming Data	2hrs
8	Data Visualization with Power BI	2hrs
9	Gray Level Slicing and Bit Plane Slicing	2hrs
10	Histogram and histogram equalization.	2hrs
11	Smoothing and sharpening of an image.	2hrs
12	Median Filtering of an Image.	2hrs
13	Homomorphic Filtering of an image.	2hrs
14	Edge Detection of an image	2hrs
15	Program to perform threshold on an image.	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 I

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, 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, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	15hrs
II	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud	15hrs

	Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **Fundamental Cloud Architectures:** Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.	
III	**Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Cloud Management Mechanisms:** Remote administration system, Resource Management System, SLA Management System, Billing Management System **Cloud Security Mechanisms:** Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images.	15hrs
IV	**Advanced Cloud Architectures**: Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture. **Cloud Delivery Model Considerations:** Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective	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 II

Course Description: B.Sc. (Information Technology)	
Semester	**I**
Course Name	**Ethical Hacking**
Course Code	**PIT1EHT**
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) Define information security and types of malware.
	2) Classify the types of attacks and their common prevention mechanisms.
	3) Explain enterprise strategy and ethical hacking patterns.
	4) Examine application hacking and malware analysis.

Module/ Unit	**Course Description**	**Hrs**.
I	**Information Security** : Attacks and Vulnerabilities Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle **Types of malware :**Worms, viruses, Trojans, Spyware, Rootkits Types of vulnerabilities : OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation, broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database	15hrs

II	**Types of attacks and their common prevention mechanisms** : Keystroke Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs Case-studies : Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit **Ethical Hacking – I** (Introduction and pre-attack) Introduction: Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?, Signing NDA, Compliance and Regulatory 15L concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing. Approach : Planning - Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report	15hrs
III	**Enterprise strategy** : Repeated PT, approval by security testing team, Continuous Application Security Testing, Phases: Reconnaissance/foot-printing/Enumeration, Phases: Scanning, Sniffing **Ethical Hacking :Enterprise Security Phases** : Gaining and Maintaining Access : Systems hacking – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPSpoofing, SYN Flooding, Smurf attack,	15hrs
IV	**Applications hacking** : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security **Malware analysis** : Netcat Trojan, wrapping definition, reverse engineering Phases : Covering your tracks : Steganography, Event Logs alteration Additional Security Mechanisms : IDS/IPS, Honeypots	15hrs

	and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines)	

References:

1. Ethical Hacking Review Guide, Kimberly Graves, Wiley Publishing
2. Ethical Hacking, AnkitFadia, 2nd Edition, Macmillan India Ltd,2006.
3. Insider Computer Fraud, Kenneth C. Brancik, 2008, Auerbach Publications.
4. Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016

Course Description: M.Sc.(Information Technology)	
Semester	**I**
Course Name	**Practical : Practical of Cloud Computing + Practical of Soft Computing Techniques**
Course Code	**PIT1PR2**
Credit	**1**
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	Write a program for implementing Client Server communication model using TCP. A client server based program using TCP to find if the number entered is prime.	2Hrs

2	Write a program for implementing Client Server communication model using TCP. A client server TCP based chatting application.	2Hrs
3	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
4	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
5	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
6	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
7	Implement virtualization using VMWare ESXi Server and managing with vCenter.	2Hrs
8	Design a simple linear neural network model.	2hrs
9	Calculate the output of neural net using both binary and bipolar sigmoidal function	2hrs
10	Generate AND/NOT function using McCulloch Pitts neural net	2hrs
11	Write a program to implement Hebb's rule	2hrs
12	Write a program to implement Delta rule	2hrs
13	Write a program for Back Propagation Algorithm	2hrs
14	Solve the ratios using fuzzy logic	2hrs
15	Implementation of Simple 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

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	**Big Data Analytics**
Course Code	**PIT2BDA**
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.

Course Outcomes	**After completing the course, Student will be able to:**
	1) Explain concept of Data and Big Data
	2) Explain clustering and association algorithm
	3) Solve problem based on classification methods
	4) Elaborate Data Products and Patterns with Hadoop in Data science

Module/ Unit	**Course Description**	Hrs
I	**Introduction to Big Data** Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. **Big Data Analytics:** Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Analytics Life Cycle	15hrs

II	**Analytical Theory and Methods:** Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models	15hrs
III	Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text,Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments. Data Product, Building Data Products at Scale with Hadoop Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system, Working with Distributed Computation, Framework for Python and Hadoop Streaming, Hadoop Streaming, MapReduce with Python, Advanced MapReduce. In-Memory Computing with Spark,Spark Basics, Interactive Spark with PySpark, Writing Spark Applications,	15hrs
IV	**Distributed Analysis and Patterns**: Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Injesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs..	15hrs

References:

1. Big Data and Analytics: Subhashini Chellappan Seema Acharya, Wiley, First
2. Data Analytics with Hadoop An Introduction for Data Scientists: Benjamin Bengfort and Jenny Kim, O'Reilly, 2016
3. Big Data and Hadoop: V.K Jain, Khanna Publishing, First, 2018

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 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	15Hrs

	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 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,	15Hrs

	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	**PIT2NLP**
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 Training Corpus; Unknown Words: Open versus closed vocabulary tasks; Evaluating N-grams: Perplexity;Smoothing: Laplace Smoothing, Good-Turing Discounting;	15hrs

	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

Major IV

Course Description: M.Sc.(Information Technology)	
Semester	**II**
Course Name	**Practical of Big Data Analytics + Practical of Modern Networking**
Course Code	**PIT2PR1**
Credit	**1**
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) Build hadoop and HDFS & develop application in MongoDB
	2) Construct a program using MapReduce & design an application in Hive
	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	Install and configure Hadoop.	2Hrs
2	Run Hadoop and HDFS ad explore HDFS.	2Hrs

3	Implement Decision tree classification techniques.	2Hrs
4	Implement SVM classification techniques	2Hrs
5	CLASSIFICATION MODEL a. Install relevant package for classification. b. Choose classifier for classification problem	2Hrs
6	CLASSIFICATION MODEL: Evaluate the performance of classifier.	2Hrs
7	CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.	2Hrs
8	Configure RIP Routing Protocol.	2Hrs
9	Configure IP SLA Tracking and Path Control Topology	2Hrs
10	Configure Path Control Topology	2Hrs
11	Configure EIGRP Routing Protocol	2Hrs
12	Using the AS_PATH Attribute	2Hrs
13	Configure BGP Commands	2Hrs
14	Configuring IBGP and EBGP Sessions,	2Hrs
15	Inter-VLAN Routing	2Hrs

References:

1. Big Data and Analytics: Subhashini Chellappan Seema Acharya, Wiley, First
2. Data Analytics with Hadoop An Introduction for Data Scientists: Benjamin Bengfort and Jenny Kim, O'Reilly, 2016
3. Big Data and Hadoop: V.K Jain, Khanna Publishing, First, 2018
4. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud William Stallings AddisonWesley
5. Network Functions Virtualization (NFV) with a Touch of SDN Rajendra Chayapathi Syed Farrukh Hassan AddisonWesley

Elective I

Course Description: M.Sc. (Information Technology)	
Semester	**II**
Course Name	**Microservices Architecture**
Course Code	**PIT2MAT**
Credit	**4**
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. **Service Design:** Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and	15Hrs

	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
III	**Building Microservice with ASP.NET Core:** Microservice, Team Service, API First Development, Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. Backing Services: Microservices Ecosystems, Building the location Service, Enhancing Team Service **Building an ASP.NET Core Web Application**: ASP.NET Core Basics, Building Cloud-Native Web Applications.	15Hrs
IV	**Creating Data Service**: Choosing a Data Store, Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise	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 II

Course Description: B.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:**
	5) Define Data security and cryptographic techniques.
	6) Classify the types of attacks and their common prevention mechanisms.
	7) Explain program security and time to time checkups.
	8) 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	15hrs
II	Symmetric and Asymmetric Cryptographic Techniques : DES, AES, RSA algorithms Authentication and Digital Signatures : Use of Cryptography for authentication	15hrs
III	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	15hrs
IV	Security in Networks : Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong	15hrs

	Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls	

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.

Course Description: M.Sc.(Information Technology)	
Semester	**II**
Course Name	**Practical of Microservices Architectures + Practical of Natural Language Processing**
Course Code	**PIT2PR2**
Credit	**1**
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. • Gain a practical understanding of.NET Core; Deploy ASP.NET Core MVC applications to the Windows Azure cloud.

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) 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	Installing Visual studio .Net	2hrs
2	Building APT.NET Core MVC Application	2hrs

3	Building ASP.NET Core REST API.	2hrs
4	Installing Docker	2hrs
5	Working with Docker, Docker Commands.	2hrs
6	Working with Docker Images and Containers.	2hrs
7	Creating Microservice with ASP.NET Core	2hrs
8	Installing Docker Toolbox	2hrs
9	Write a program to implement sentence segmentation and word Tokenization	2hrs
10	Write a program to Implement stemming and lemmatization.	2hrs
11	Write a program to Implement a tri-gram model	2hrs
12	Write a program to Implement PoS tagging using HMM & Neural Model.	2hrs
13	Write a program to Implement syntactic parsing of a given text	2hrs
14	Write a program to Implement dependency parsing of a given text.	2hrs
15	Write a program to Implement Named Entity Recognition (NER)	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