



Hindi Vidya Prachar Samiti's  
**Ramniranjan Jhunjhunwala College**  
of Arts, Science & Commerce  
**(Empowered Autonomous College)**

Affiliated to  
**UNIVERSITY OF MUMBAI**

**Syllabus for M.Sc. in Information Technology Part I**  
**Program: M.Sc. IT**  
**Program Code: RJSPIT**

**National Education Policy (NEP 2020)**  
**Level 6.0**

**(CBCS 2023-24)**

# **The Preamble**

## ***Why IT?***

The world around us is rapidly changing! The change is carried by technology. Information Technology has become the fourth basic need of humans after food, shelter and clothing. Be it buying essentials online; connecting to friends and family; online learning or entertainment; IT is an integral part of normal life. The increasing popularity and luxury turning into necessity has created a large number of opportunities in the field of Information Technology. Information Technology is an application-oriented program where students learn core technologies and apply their skills in developing solutions for different problems in a variety of domains. The applications may lead students to master a niche skill and bag a unique career opportunity.

## ***Why IT at R J College?***

The Department of IT was established in the year 2007-08. Since its inception, the department has been centering attention of the college with vibrant activities and several success stories of the students. Strength of the department is talented, experienced faculty members, state of the art laboratories, a resource departmental library, hardworking students and a very strong industrial connection. The PG program started in the year 2016 and has received excellent response. In the journey of 17 years, students of the department of IT secured top rank in university examinations in both UG and PG programs. Department of Biotechnology (DBT), New Delhi has granted the DBT star scheme grant to the department of Information Technology jointly with the department of Computer Science. At RJIT, a special attention is given to the overall grooming of the students and making them industry ready.

TechConnect is an initiative of the department where expert alumni members share their expertise and experiences with the students. Communication skills of the students are polished through various activities including presentations of case studies and project work. RJIT hosts an intercollegiate TechFest, “Symposium” every alternate year, where students get a good opportunity to develop leadership qualities, organizing skills and showcase their talent. Faculty members regularly undergo training on different new technologies to keep up with ever changing, dynamic IT fields.

## ***Our Curriculum Your Strength***

As part of the Autonomous Institution, the Department of Information Technology has revised the syllabus of M.Sc. IT as per the Choice Based Credit System (CBCS) and industry, academic and research requirements to be implemented from the academic year 2023-24. It is believed that the proposed syllabus will offer the Post Graduates an enriched learning experience, quality skills, ability to

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

create solutions to real world problems and understand the effects of computer systems on the people and society. The major areas that are focused throughout the program are Computational Research, Data Science, Artificial Intelligence, Virtualization, Cloud Computing, Networking, Big Data Analytics, Computer Forensics and Blockchain technologies. The syllabus additionally gives flexibility to the students for choosing a few credits according to their learning interest.

To see how theoretical aspects learned in classes are integrated into the practical world, we facilitate experiential learning in the form of Case Study and Project. Fresh graduates will benefit from this by gaining on-floor experience. The skills acquired during the program would help post graduates to land a decent job in an IT sector, Software Development, Cloud Computing and Data Science. The students would also be encouraged to write a research paper and improve the presentation and leading skills every semester and earn credits for the same. We make it a priority to train our students with the greatest instructions possible so they can understand the subject and launch a successful career in the various fields. Furthermore, continuous assessment is an integral part of the evaluation, which will facilitate systematic and thorough learning towards a better understanding of the subject to the students.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Program Outcomes**

Students of all Post graduate degree program on completion of the program will be able to \_

***Convey the concept clearly***

Students would have clarity and complete domain knowledge. Shall be able to analyze solve, innovate and convey the concept clearly by utilizing effective communication skills

***Social Interaction***

Respect each other and should be able to resolve conflicts and help in reaching an amicable solution. They should be able to work in diverse teams. They should be able to distinguish when and what is socially acceptable. Students would perform functions that demand higher competence in national/international organizations with positive spirit and cooperate with peer. Provide leadership and be mentors.

***Responsible citizen***

Contribute to Nation development through social service. Being empathetic and sympathetic to fellow beings.

***Honesty and Integrity, Ethics***

Recognize different values and systems and respect them. In decision making moral values should be given prime importance. Students should be aware of ethical issues and regulatory considerations while addressing society needs for growth with honesty.

***Environmental and Sustainability***

Environmental issues would be considered and problem solving with sustainable development would be chosen.

***LifeLong learning and Global thinking***

Enjoy learning in every situation and should have skills for adapting in any part of the world and contribute to nation building globally.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Program Specific Outcomes**

The increasing popularity and luxury turning into necessity has created a large number of opportunities in the field of Information Technology. Information Technology is an application-oriented program where students learn core technologies and apply their skills in developing solutions for different problems in a variety of domains.

The syllabus is designed, keeping in mind the latest trends and tools used in the industry. The syllabus offers the Post Graduates an enriched learning experience, quality skills, ability to create solutions to real world problems and understand the effects of computer systems on the people and society. All the courses in the program are carefully designed to equip the students for professional certifications and competitive exams like aptitudes, GATE, NET, SET etc. and to write research proposals for grants.

To see how theoretical aspects learned in classes are integrated into the practical world, we facilitate experiential learning in the form of Case Study and Project. This will help fresh pass out students in gaining on-floor experience.

***Program Specific Outcomes:***

<b>PSO1</b>	Demonstrate understanding of the current technical concepts and practices of information technologies like Computational Research, Data Science, Artificial Intelligence, Virtualization, Cloud Computing, Networking, Big Data Analytics, Computer Forensics and Blockchain technologies.
<b>PSO2</b>	<b>Demonstrate</b> and <b>Implement</b> the theoretical concepts using various methodologies, tools and techniques.
<b>PSO3</b>	Demonstrating proficiency in design, analysis, and implementation of domain knowledge in <b>developing applications</b> to find solutions for the real world problems.
<b>PSO4</b>	To explore and Apply domain knowledge and expertise for enhancing research capability to transform innovative ideas into reality in the specialized/emerging areas.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Credit Structure**

**Semester I**

Papers	Number of Papers	Credits	Total Credits
Major Mandatory Theory	2	3	6
	1	2	2
Major Mandatory Practical	3	2	6
Major Elective Theory	1 - Elective I or Elective II	2	2
Major Elective Practical	1 - Elective I or Elective II	2	2
Other Elective	1	4	4
<b>Total</b>			<b>22</b>

**Semester II**

Papers	Number of Papers	Credits	Total Credits
Major Mandatory Theory	2	3	6
	1	2	2
Major Mandatory Practical	3	2	6
Major Elective Theory	1 - Elective I or Elective II	2	2
Major Elective Practical	1 - Elective I or Elective II	2	2
On-Job Training	1	4	4
<b>Total</b>			<b>22</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Syllabus Grid**

Level	Sem ester	Major		Minor	OE	VSC SEC	AES, VES, IKS	OJT,FP, CEP, CC, RP	Cim. Credit Per Sem	Degree /Cum. Cr.
		<b>Mandatory</b>	<b>Elective</b>							
6.0	I	Fundamentals of Cloud Computing (3+2) Microservice Architecture Fundamentals (3+2) Introduction to Data Science (2+2)	Security Breaches and Countermeasures (2+2)  Artificial Intelligence (2+2)		Research Methodology (4)				22	
	II	Server Virtualization (3+2) Big Data with Hadoop and Spark(3+2) Theory and Applications of Blockchain (2+2)	Foundation of Modern Networking (2+2)  Image Processing (2+2)					On Job Training (4)	22	
Total Credits										44

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Semester I**

Course Code	Course Name	Credits	Duration
RJSPIT101	Fundamentals of Cloud Computing	3	40 Hours
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To illustrate the fundamentals of Cloud Computing, analyzing different virtualization techniques and their role in enabling the cloud computing system model.</li> <li>2. To assess cloud characteristics and service attributes, for compliance with enterprise objectives and exposure to various cloud services.</li> <li>3. To address the core issues of cloud computing such as security, portability and interoperability.</li> </ol>			

Course Outcomes	Description: (After successful completion of this course, student will be able to __)	Bloom's Levels	PSO Addressed
CO1	Understand the core concepts of the cloud computing paradigm, its characteristics, advantages and Analyze the various models and services in cloud computing.	1,2,3,4	PSO1, PSO2
CO2	Applying suitable Virtualization platform with Cloud management Resources and Explore the frontier areas of Cloud Computing Architecture with various Cloud Management Mechanisms.	1,2,3,4	PSO1, PSO2
CO3	Understanding and Solving Portability, Interoperability and security issues in the cloud.	1,2,3	PSO1, PSO2

Unit	Topics	Hours
I	<b>Introduction:</b> Limitations of the Traditional Computing Approaches, Three Layers of Computing, Three Layers in Traditional Computing, The End of Traditional Computing.	10



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p><b>Evolution and Enabling Technologies:</b> The Evolution of Cloud Computing, How Philosophies Converged into Cloud Computing, Comparison between Cluster, Grid and Cloud Computing.</p> <p><b>Benefits and Challenges:</b> Origin of the Term 'Cloud Computing', Early Initiatives, Utility Computing, Metering and Billing in cloud, Separation of Data Center Operation, Benefits of Cloud Computing, Challenges of Cloud Computing, How Cloud Computing Addresses Business Challenges, Ethical Issues in Cloud Computing, Cloud Computing: Network as Computer, Role of Web Service, Role of API, Ubiquitous Cloud, Confusion Between Cloud and Internet.</p> <p><b>Cloud Computing Model:</b> Standard Cloud Model, Cloud Deployment Models, Choosing the Appropriate Deployment Model.</p>	
<b>II</b>	<p><b>Cloud Computing Services:</b> Service Delivery Models, Service Abstraction, The SPI Model, A Traditional System vs Cloud System Model, All applications delivered using web-services are not SaaS, SaaS and PaaS: Salesforce.com and Force.com, Other Category of Cloud Services, Open Cloud Services.</p> <p><b>Resource Virtualization:</b> What is Virtualization, Virtualizing Physical computing Resources, Understanding Abstraction, Business Benefits of Virtualization, Machine or Server Level Virtualization, Exploring Hypervisor or Virtual Machine Monitor.</p> <p><b>Operating System Level Virtualization:</b> Removal of the hypervisor, Major Server Virtualization Products and Vendors, High-Level Language Virtual Machine, Emulation, Some Other Types of Virtualizations, Advantages of Virtualization, Downsides of Virtualization, Virtualization Security Threats, Virtualization Security Recommendations, Virtualization and Cloud Computing.</p> <p><b>Resource Pooling, Sharing and Provisioning:</b> Resource Pooling, Commoditization of the Data Center, Standardization, Automation and Optimization, Resource Sharing, Resource Provisioning.</p>	<b>10</b>
<b>III</b>	<p><b>Scaling in the Cloud:</b> What is Scaling, Scaling in Traditional Computing, Scaling in Cloud Computing, Foundation of Cloud Scaling, Scalable</p>	<b>10`</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p>Application, Scaling Strategies in Cloud, Auto-Scaling in Cloud, Types of Scaling, Horizontal Scaling is More Cloud-Native Approach, Performance and Scalability, The Resource Contention Problem, Cloud Bursting: A Scenario of Flexible Scaling, Scalability is a Business Concern.</p> <p><b>Capacity Planning:</b> What is Capacity Planning, Capacity Planning in Computing, Capacity Planning in Cloud Computing, Cloud Capacity: Consumers' View vs Providers' View, Capacity Planning: Then and Now, Approaches for Maintaining Sufficient Capacity, Role of Auto-Scaling in Capacity Planning, Capacity and Performance: Two Important System Attributes, Steps for Capacity Planning.</p> <p><b>Load Balancing:</b> Load Balancing, Importance of Load Balancing in Cloud Computing, How Load Balancing is done in Cloud, Goals of Load Balancing, Categories of Load Balancing, Parameters for Consideration, Load Balancing Algorithms, The Persistence Issue, Application Delivery Controller, Case Study: Google Cloud, Case Study: Amazon Elastic Compute Cloud (EC2).</p>	
<b>IV</b>	<p><b>Security Reference Model:</b> The Security Concern in Cloud, Cloud Security Working Groups, Elements of Cloud Security Model, Cloud Security Reference Model, Examining Cloud Security against Traditional Computing, Security Policy, Trusted Cloud Computing.</p> <p><b>Security Issues:</b> Cloud Security, Threats to Cloud Security, Infrastructure Security, Information Security, Identity Management and Access Control, Cloud Security Design Principles, Cloud Security Management Frameworks, Security-as-a-Service.</p> <p><b>Portability and Interoperability Issues:</b> Challenges in the Cloud, The Issues in Traditional Computing, Addressing Portability and Interoperability in Cloud, Portability and Interoperability Scenarios, Machine Imaging or Virtual Machine Image, Virtual Appliance, Difference between Virtual Machine Image and Virtual Appliance, Open Virtualization Format (OVF).</p> <p><b>Popular Cloud Services:</b> Amazon Web Services, Microsoft Azure, Google Cloud, A Comparison among AWS, Azure and Google Cloud.</p>	<b>10</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**References:**

1. Sandeep Bhowmik, "Cloud Computing", Cambridge University Press, 2017.
2. Thomas Erl , Zaigham Mahood, Ricardo Puttini, "Cloud Computing, Concept, Technology and Architecture", Prentice Hall, 2013.
3. Dr. Sunilkumar Manvi, Dr. Gopal K. Shyam, "Cloud Computing Concepts and Technologies", CRC Press, First Edition, 2021.
4. Douglas E. Comer, "The Cloud Computing Book The Future Of Computing Explained", CRC Press, First Edition, 2021.
5. Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishing, 2011.

Course Code	Course Name	Credits	Duration
RJSPIT101P	Fundamentals of Cloud Computing Practical	2	20

**Learning Objectives:**

1. To impart knowledge and gain insight into the implementation of various Virtualization technologies.
2. To understand and implement Cloud based services through various cloud tools.
3. To design and deploy web applications in a PaaS environment.
4. To design clusters and Implement web services to provide cloud based solutions.

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO Addressed
CO1	Understand and Demonstrate client server interaction using TCP ,UDP and RMI protocol. Design Cluster configuration, Deploy and Implement Web Services.	1,2,3,4,5,6	PSO1, PSO2, PSO3
CO2	Understand and Configure virtualization in ESXi Server and Hyper V platforms. Configure and Demonstrate cloud services using	1,2,3,4,5,6	PSO1, PSO2, PSO3

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	cloudsim and OpenNebula cloud platform.		
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Practical No.	Details
1.	Implementation of Client Server communication model using TCP.
2.	Implementation of Client Server communication model using UDP.
3.	Implementation of Client Server communication using RMI.
4.	Implementation of web services.
5.	Implementation of cluster on Windows Server.
6.	Developing application for Google App Engine.
7.	Implementation of virtualization using VMWare ESXi Server and managing with vSphere Client.
8.	Implementation of simple cloud simulation in cloudsim.
9.	Implementation of virtualization using Hyper-V.
10.	Configuring IAAS using OpenNebula.

Course Code	Course Name	Credits	Duration
RJSPIT102	Microservices Architecture Fundamentals	3	40 Hours
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To examine the principle, practices and culture that define microservice architecture.</li> <li>2. To gain a thorough understanding of the architecture of Web applications using ASP.NET Core MVC.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be	Bloom's Levels	PSO Addressed
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**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	able to __)		
CO1	Understand the fundamental design concepts of microservices.	2	PSO1
CO2	Identify, Understand and Apply the operational elements of microservice architecture, including container and service discovery.	2, 3	PSO1, PSO2
CO3	Understand and Create ASP.NET Core web API and MVC application.	2, 6	PSO1, PSO3

Unit	Topics	Hours
<b>I</b>	<p><b>Microservices:</b> Understanding Microservices, Adopting Microservices, The Microservices Way.</p> <p><b>Microservices Value Proposition:</b> Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach.</p> <p><b>Designing Microservice Systems:</b> The Systems Approach to Microservices.</p> <p><b>Establishing a Foundation:</b> Goals and Principles, Platforms, Culture.</p>	<b>10</b>
<b>II</b>	<p><b>Service Design:</b> API design, Data and Microservices, Distributed Transactions and Sagas.</p> <p><b>System Design and Operations:</b> Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting.</p> <p><b>Adopting Microservices in Practice:</b> Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.</p>	<b>10</b>
<b>III</b>	<p><b>ASP.NET Core Primer:</b> Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App.</p> <p><b>Delivering Continuously:</b> Introduction to Docker, Continuous integration</p>	<b>10</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p>with Wrecker, Continuous Integration with CircleCI, Deploying to Docker Hub.</p> <p><b>Building Microservice with ASP.NET Core:</b> Microservice, Team Service, API First Development, Test First Controller, creating a CI pipeline, Integration Testing, Running the team service Docker Image.</p>	
<b>IV</b>	<p><b>Backing Services:</b> Microservices Ecosystems, Building the location Service, Enhancing Team Service.</p> <p><b>Creating Data Service :</b> Choosing a Data Store, Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service.</p> <p><b>Event Sourcing and CQRS:</b> Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples.</p> <p><b>Building an ASP.NET Core Web Application:</b> ASP.NET Core Basics, Adding ASP.NET MVC Middleware, Adding a Controller, Model and View, Invoking REST APIs from JavaScript.</p>	<b>10</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen, "Microservice Architecture: Aligning Principles, Practices, and Culture", O'Reilly, First Edition, 2016.</li> <li>2. Kevin Hoffman, "Building Microservices with ASP.NET Core", O'Reilly, First Edition, 2017.</li> <li>3. Sam Newman, "Building Microservices: Designing Fine-Grained Systems", O'Reilly, First Edition.</li> <li>4. Susan J. Fowler, "Building Microservices: Designing Fine-Grained Systems", O'Reilly, First Edition,</li> <li>5. Susan J. Fowler, "Production-ready Microservices", O'Reilly, 2016.</li> </ol>		

Course Code	Course Name	Credits	Duration
<b>RJSPIT102P</b>	<b>Microservices Architecture Fundamentals Practical</b>	<b>2</b>	<b>20</b>
<b>Learning Objectives:</b>			

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

1. To acquire a working knowledge of Web application development using ASP.NET Core MVC and Visual Studio.
2. To deploy applications on different containers.

<b>Course Outcomes</b>	<b>Description</b> (Upon completion of this course, the students will be able to __)	<b>Bloom's Levels</b>	<b>PSO Addressed</b>
CO1	Understand and Demonstrate ASP.NET core application. Create HTTP services using ASP.NET Core Web API.	1,2,3	PSO1, PSO2, PSO3
CO2	Apply and Deploy microservices using MVC architecture on containers.	1,2,3,4,5,6	PSO1, PSO2, PSO3
CO3	Install and configure container and deploy images on it	1,2,3,4,5,6	PSO1, PSO2, PSO3

<b>Practical No.</b>	<b>Details</b>
1.	Creating console based ASP.NET core applications.
2.	Creating ASP.NET core application using Microservice.
3.	Creating MVC Project using ASP.NET core.
4.	Usage of Docker <ol style="list-style-type: none"> <li>a. Build and run an image as a container.</li> <li>b. Share images using Docker Hub.</li> <li>c. Deploy Docker applications using multiple containers with a database.</li> </ol>
5.	Working with CircleCI for continuous integration.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

6.	Building ASP.NET core REST API.
7.	Creating backing services with ASP.NET core.
8.	Creating team service API.
9.	Working with Docker Swarm.
10.	Working with Kubernetes.

Course Code	Course Name	Credits	Duration
<b>RJSPIT103</b>	<b>Introduction to Data Science</b>	<b>2</b>	<b>30</b>
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To gain a thorough understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics.</li> <li>2. To understand the problem and find the probable solutions.</li> <li>3. To learn programming languages and big data tools and data science process of preparing the data and passing it to statistical models and to analyze the results.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO Addressed
CO1	Apply the principles of data science to the analysis of business problems.	1,2,3	PSO1, PSO2, PSO3
CO2	Analyze the problem and apply statistical models and data analysis techniques to the real-world business problems, communicate findings and effectively present results using the various languages and tools.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Understanding the process of building the models,	1,2,3,4,5,6	PSO1,



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	analyzing and evaluating the result of statistical models and taking the data management and business decisions. Demonstrate use of teamwork, leadership skills, decision making and organization theory.		PSO2, PSO3
CO4	Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.	1,2,3,4	PSO1, PSO2, PSO3

Unit	Topics	Hours
<b>I</b>	<p><b>Data Science Technology Stack:</b> Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools, Spark, Mesos, Akka, Cassandra, Kafka, Elastic Search, R, Scala, Python.</p> <p><b>Layered Framework:</b> Definition of Data Science Framework, CrossIndustry 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.</p> <p><b>Business Layer:</b> Business Layer, Engineering a Practical Business Layer.</p>	<b>8</b>
<b>II</b>	<p><b>Utility Layer:</b> Basic Utility Design, Engineering a Practical Utility Layer.</p> <p><b>Three Management Layers:</b> Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Control, Yoke Solution, Cause-and-Effect, Analysis System, Functional Layer, Data Science Process.</p> <p><b>Retrieve Superstep:</b> 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.</p>	<b>8</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

<b>III</b>	<p><b>Assess Superstep:</b> Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep.</p> <p><b>Process Superstep:</b> Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science.</p>	<b>7</b>
<b>IV</b>	<p><b>Transform Superstep:</b> Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Random Forests.</p>	<b>7</b>

**References:**

1. Andreas François Vermeulen, "Practical Data Science A Guide to Building the Technology Stack for Turning Data Lakes into Business Assets", Apress, 2018.
2. Sinan Ozdemir, "Principles of Data Science", PACKT, 2016
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Science", O'Reilly, 2017.
4. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython", O'Reilly, 2nd Edition.
5. Allen B. Downey, "Think Stats : Probability and Statistics for Programmers", Green Tea Press.
6. Jose Unpingco, "Python for Probability, Statistics and Machine Learning", Springer.

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>	<b>Duration</b>
<b>RJSPIT103P</b>	<b>Introduction to Data Science Practical</b>	<b>2</b>	<b>20</b>

**Learning Objectives:**

1. To use big data tools for processing data and apply machine learning techniques.
2. To develop problem solving and decision-making skills for business oriented problems.

<b>Course</b>	<b>Description</b>	<b>Bloom's</b>	<b>PSO</b>
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**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Outcomes	(Upon completion of this course, the students will be able to __)	Levels	Addressed
CO1	Analyze the problem and apply statistical models and machine learning techniques and find the solution to the real-world problem, communicate findings and present the results using the big data tools. Apply the principles of data science to the analysis of business problems.  Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.	1,2,3,4	PSO1, PSO2, PSO3
CO2	Build the statistical models, analyzing and evaluating the result of models and taking the business decisions for the small scale business problems.	1,2,3,4,5,6	PSO1, PSO2, PSO3

Practical No.	Details
1.	NumPy, Pandas, Matplotlib and Seaborn Basics.
2.	Collecting and loading structured and unstructured data.
3.	Using Data Wrangling processes: Data discovery, data pre-processing, data validation etc. for various types of data.
4.	Basic utility design, Data auditing and Exploratory Data Analysis.
5.	Retrieve Superstep.
6.	Access Superstep.
7.	Processing Data.
8.	Transforming Data: Using Machine Learning Algorithms.
9.	Organizing and Generating data.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

10.	Data Visualization.
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Course Code	Course Name	Credits	Duration
RJSPITE101	Security Breaches and Countermeasures	2	30
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To know the countermeasures that can be taken to prevent attacks on computing systems.</li> <li>2. To test the software against the various attacks.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Describe and Execute the concepts of Ethical and Unethical Hacking, penetration Testing and Countermeasures.  Describe, Execute and Apply the concepts of Network Scanning and Enumeration.	1,2,3,4,5	PSO1, PSO2, PSO3
CO2	Describe, Execute and Apply the concepts of Sniffing, Evasion and Attacking a System.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Describe, Execute and Apply the concepts of Wireless Network Hacking, Malware Attacks.  Describe Social Engineering and Physical Security and Evaluate Computer-Based Attacks, Mobile-Based Attacks, Physical Security.	1,2,3,4	PSO1, PSO2, PSO3

Unit	Topics	Hours
I	<b>Essential Knowledge about Security:</b> Security, Essentials, Security Basics, Introduction to Ethical Hacking, Hacking Terminology, The	8

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p>Ethical Hacker.</p> <p><b>Reconnaissance: Information Gathering for the Ethical Hacker :</b> Footprinting, Passive Footprinting, Active Footprinting, Footprinting Methods and Tools, Search Engines, Website and Email Footprinting, DNS Footprinting, Network Footprinting, Other Tools.</p> <p><b>Scanning and Enumeration :</b> Fundamentals, TCP/IP Networking, Subnetting, Scanning Methodology, Identifying Targets, Port Scanning, Evasion, Vulnerability Scanning, Enumeration, Windows System,Basics, Enumeration Techniques.</p>	
<b>II</b>	<p><b>Sniffing and Evasion:</b> Essentials, Network Knowledge for Sniffing, Active and Passive, Sniffing, Sniffing Tools and Techniques, Techniques, Tools, Evasion, Devices Aligned Against You, Evasion Technique.</p> <p><b>Attacking a System:</b> Getting Started, Windows Security Architecture,Linux Security Architecture, Methodology, Hacking Steps,Authentication and Passwords, Privilege Escalation and Executing Applications, Hiding Files and Covering Tracks.</p>	<b>8</b>
<b>III</b>	<p><b>Web-Based Hacking: Servers and Applications:</b> Web Servers, Web Organizations, Attack Methodology, Web Server Architecture, Web Server Attacks, Attacking Web Applications, Application Attacks, Countermeasures.</p> <p><b>Wireless Network Hacking:</b> Wireless Networking, Wireless Terminology, Architecture and Standards, Wireless Hacking.</p>	<b>7</b>
<b>IV</b>	<p><b>Trojans and Other Attacks:</b> The “Malware” Attacks, Trojans, Viruses and Worms, Remaining Attacks, Denial of Service, Session Hijacking.</p> <p><b>Social Engineering and Physical Security:</b> Social Engineering, Human-Based Attacks, Computer-Based Attacks, Mobile-Based Attacks, Physical Security, Physical Security 101.</p>	<b>7</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Matt Walker, “All in One, Certified Ethical Hacker”, Tata McGraw Hill, 2012. Ric</li> <li>2. Messier, “CEHv10, Certified Ethical Hacker Study Guide”, Sybex – Wiley, 2019</li> <li>3. I.P. Specialist, “CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide”, IPSPECIALIST, 2018.</li> </ol>		

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Course Code	Course Name	Credits	Duration
RJSPITE101P	Security Breaches and Countermeasures Practical	2	20

**Learning Objectives:**

1. To identify vulnerability, security breaches, loopholes in the system, web server and mobile devices.
2. To evaluate the security measures of an organization.
3. To perform social engineering and educate people to be careful from attacks like DoS, DDoS attacks, hijacking and many more.

Course Outcomes	Description	Levels	PSO addressed
CO1	Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.	1,2,3,4,5	PSO1, PSO2, PSO3
CO2	Identify and explain the various types of vulnerabilities (design and/or implementation weaknesses); their underlying causes; their identifying characteristics.	1,2,3,4,5	PSO1, PSO2, PSO3

Practical No.	Details
1	Use the following tools to perform footprinting and reconnaissance <ol style="list-style-type: none"> <li>i. Recon-ng (Using Kali Linux)</li> <li>ii. FOCA Tool</li> <li>iii. Windows Command Line Utilities               <ul style="list-style-type: none"> <li>● Ping</li> <li>● Tracert using Ping</li> <li>● Tracert</li> <li>● NSLookup</li> </ul> </li> </ol>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<ul style="list-style-type: none"> <li>iv. Website Copier Tool - HTTrack</li> <li>v. Metasploit (for information gathering)</li> <li>vi. Whois Lookup Tools for Mobile - DNS Tools, Whois, Ultra Tools Mobile</li> <li>vii. Smart Whois</li> <li>viii. eMailTrackerPro</li> <li>ix. Tools for Mobile - Network Scanner, Fing - Network Tool, Network Discovery Tool, Port Droid Tool</li> </ul>
2.	<p>Scan the network using the following tools:</p> <ul style="list-style-type: none"> <li>i. Hping2 / Hping3 (Kali Linux)</li> <li>ii. Advanced IP Scanner (windows)</li> <li>iii. Angry IP Scanner (windows)</li> <li>iv. Masscan (Kali Linux)</li> <li>v. NEET</li> <li>vi. CurrPorts</li> <li>vii. Colasoft Packet Builder</li> <li>viii. The Dude</li> </ul>
3	<ul style="list-style-type: none"> <li>a. Use Proxy Workbench to see the data passing through it and save the data to file.</li> <li>b. Use the following censorship circumvention tools: <ul style="list-style-type: none"> <li>i. Alkasir</li> <li>ii. Tails OS</li> </ul> </li> <li>c. Perform Network Discovery using the following tools: <ul style="list-style-type: none"> <li>i. Solar Wind Network Topology Mapper</li> <li>ii. OpManager</li> <li>iii. Network View</li> <li>iv. LANState Pro</li> </ul> </li> <li>d. Use Scanning Tools for Mobile – Network Scanner, Fing – Network Tool, Network Discovery Tool, Port Droid Tool</li> </ul>
4	<ul style="list-style-type: none"> <li>a. Perform Enumeration using the following tools:</li> </ul>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<ul style="list-style-type: none"> <li>i. Nmap</li> <li>ii. NetBIOS Enumeration Tool</li> <li>iii. SuperScan Software</li> <li>iv. Hyena</li> <li>v. SoftPerfect Network Scanner Tool</li> <li>vi. OpUtils</li> <li>vii. SolarWinds Engineer's Toolset</li> <li>viii. Wireshark</li> </ul>
5.	<ul style="list-style-type: none"> <li>a. Perform mobile network scanning using NISSUS.</li> <li>b. Perform the System Hacking using the following tools:                             <ul style="list-style-type: none"> <li>i. Winrtgen</li> <li>ii. PWDump</li> <li>iii. Ophcrack</li> <li>iv. Flexispy</li> <li>v. NTFS Stream Manipulation</li> <li>vi. ADS Spy</li> <li>vii. Snow</li> <li>viii. Quickstego</li> <li>ix. Clearing Audit Policies</li> <li>x. Clearing Logs</li> </ul> </li> </ul>
6.	<ul style="list-style-type: none"> <li>a. Use wireshark to sniff the network.</li> <li>b. Use SMAC for MAC Spoofing.</li> <li>c. Use Caspa Network Analyser.</li> <li>d. Use Omnippeek Network Analyzer</li> </ul>
7.	<ul style="list-style-type: none"> <li>a. Use Social Engineering Toolkit on Kali Linux to perform Social Engineering using Kali Linux.</li> <li>b. Perform the DDOS attack using the following tools:                             <ul style="list-style-type: none"> <li>i. HOIC</li> <li>ii. LOIC</li> <li>iii. ULK</li> <li>iv. Metasploit</li> </ul> </li> </ul>



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	c. Using Burp Suite to inspect and modify traffic between the browser and target application.
8.	<ul style="list-style-type: none"> <li>a. Perform Web App Scanning using OWASP Zed Proxy.</li> <li>b. Use droidsheep on mobile for session hijacking</li> <li>c. Demonstrate the use of the following firewalls: <ul style="list-style-type: none"> <li>i. Zonealarm and analyze using Firewall Analyzer.</li> <li>ii. Comodo Firewall</li> </ul> </li> <li>d. Use HoneyBOT to capture malicious network traffic.</li> <li>e. Use the following tools to protect attacks on the web servers: <ul style="list-style-type: none"> <li>i. D Server</li> <li>ii. Microsoft Baseline Security Analyzer</li> <li>iii. Syhunt Hybrid</li> </ul> </li> </ul>
9.	<ul style="list-style-type: none"> <li>a. Protect the Web Application using dotDefender.</li> <li>b. Demonstrate the following tools to perform SQL Injection: <ul style="list-style-type: none"> <li>i. Tyrant SQL</li> <li>ii. Havij</li> <li>iii. BBQSQL</li> </ul> </li> </ul>
10.	<p>Use the following tools for cryptography</p> <ul style="list-style-type: none"> <li>a. HashCalc</li> <li>b. Advanced Encryption Package</li> <li>c. MD5 Calculator</li> <li>d. TrueCrypt</li> <li>e. CrypTool</li> </ul>

Course Code	Course Name	Credits	Duration
RJSPITE102	Artificial Intelligence	2	30
<b>Learning Objectives:</b> <ul style="list-style-type: none"> <li>1. To study the fundamental concepts of Artificial Intelligence.</li> <li>2. To learn the methods of solving problems using various strategies using informed and uninformed search in Artificial Intelligence.</li> </ul>			

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

3. To learn the knowledge representation techniques, uncertainty and probabilistic reasoning and Knowing the application of fuzzy logic in intelligent systems.

Course Outcomes	Description	Bloom's Levels	PSO Addressed
CO1	Identify agents and problems where artificial intelligence techniques are applicable. Understanding and application of uninformed search techniques.	1, 2, 3	PSO1, PSO2
CO2	Understand and apply the heuristic and advanced search techniques for problem solving. Analyzing problems based on Constraint satisfaction.	1,2,3,4,5,6	PSO1, PSO2, PSO3
CO3	Understand the different methods of representing knowledge. Understand predicate logic and probabilistic reasoning.	1,2,3,4,5,6	PSO1, PSO3

Unit	Topics	Hours
<b>I</b>	<b>Introduction to Artificial Intelligence:</b> Introduction to AI and AI problems, The Foundations of AI: Philosophy, Mathematics, Economics, Neuroscience, Psychology, Computer Engineering, AI Applications. <b>Intelligent Agents:</b> Agents and Environments, The concept of rationality, The Nature of Environments, The structure of Agents.	<b>8</b>
<b>II</b>	<b>Uninformed Search Strategies:</b> Breadth-first, Depth-first, Uniform-cost search, Iterative deepening depth-first search, Bidirectional search. <b>Informed (Heuristic) Search Techniques:</b> Heuristic Function, Best-first Search, Greedy best-first search, Generate-and-Test, Local Search Algorithm-Hill-climbing search, Simulated annealing, And-OR Search, A* search: Minimizing the total estimated solution cost, Problem Reduction.	<b>8</b>
<b>III</b>	<b>Constraint Satisfaction problem:</b> Map Coloring, cryptarithmic problem.	<b>7</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<b>Adversarial Search:</b> Games, Optimal Decision in Games, Alpha-Beta Pruning Minimax Search Procedure, Adding Alpha-beta Cut-offs, Iterative Deepening.	
<b>IV</b>	<b>Knowledge Representation, Reasoning, and Planning:</b> Logic: Propositional Logic, Propositional Theorem Proving, First Order Logic: Predicate Logic, Inference in First-Order Logic, Forward chaining, Backward chaining, Resolution.  <b>Uncertain Knowledge and Probabilistic reasoning:</b> Quantifying uncertainty: Acting under uncertainty Basic probability notation, Inference using full joint distributions, independence, Bayes' rule and its use, fuzzy logic.	<b>7</b>
<b>References:</b> <ol style="list-style-type: none"> <li>1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.</li> <li>2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, Third Edition, McGraw Hill.</li> </ol>		

Course Code	Course Name	Credits	Duration
<b>RJSPITE102P</b>	<b>Artificial Intelligence Practical</b>	<b>2</b>	<b>20</b>
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To learn and apply informed and uninformed search techniques.</li> <li>2. To implement problem space search in solving game problems.</li> <li>3. To implement probabilistic reasoning in real life problems.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Understand the informed and uninformed problem types and apply search strategies to solve them.	2, 3, 4	PSO2, PSO3

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

CO2	Apply real life problems in a state space representation so as to solve them using AI techniques like searching and game playing	1,2, 3, 4	PSO2, PSO3
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Practical No.	Details
1.	Implementation of Heuristic search algorithms: <ul style="list-style-type: none"> <li>a. Breadth First Search</li> <li>b. Depth First Search</li> <li>c. Bidirectional search</li> <li>d. Hill Climbing Method</li> </ul>
2.	Implementation of Heuristic search algorithms: <ul style="list-style-type: none"> <li>a. Hill Climbing search</li> <li>b. Best first search</li> <li>c. A* Search</li> </ul>
3.	Implementation of <ul style="list-style-type: none"> <li>a. Tic-Tac-Toe game problem</li> <li>b. 8-Puzzle problem</li> <li>c. Water-Jug problem</li> </ul>
4.	Implementation of the Traveling Salesman Problem using Python.
5.	Implementation of <ul style="list-style-type: none"> <li>a. Monkey Banana Problem</li> <li>b. Missionaries-Cannibals Problems</li> </ul>
6.	Implementation of N-Queens Problem.
7.	Implementation of constraint satisfaction problems using Prolog.
8.	Implementation of logic programming using Prolog.
9.	Implementation of Bayes' theorem using Python.
10.	Implementation of a fuzzy-based application using Python / R.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Course Code	Course Name	Credits	Duration
RJSPITOE101	Research Methodology	4	60
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand the research methodologies such as survey and field research, questionnaire design, content analysis, analysis of existing data, focus group, individual and group observation (including participatory observation) etc.</li> <li>2. To be able to understand the latest theories of doing research.</li> <li>3. To understand and explore the research techniques used for solving any real world or innovative problem.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Develop the ability to explore the research methodologies and techniques that are used for solving the business and innovative problems.	1,2, 3	PSO1, PSO2, PSO3
CO2	Develop the aptitude for research and the ability to explore research techniques to solve real world problems.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Formulate and design the research to find the solution of business or innovative problems. Develop the data analysis and interpret and infer the result.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4
CO4	Understand the need of reporting results and publications.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Unit	Topics	Hours
I	<p><b>Introduction to Research:</b> Meaning and Definition of Research, Purpose of Research, Scientific Method, Positivism and post-positivist approach to research, Types of Research, Beginning Stages of Research Process: Problem definition, Qualitative research, Quantitative Research, primary and Secondary data research.</p> <p><b>Business Research:</b> Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues.</p>	15
II	<p><b>Research Methods and Data Collection:</b> Survey research, communicating with respondents, Observation methods, Descriptive and experimental Research type, Inductive and deductive approach, Action research, research steps.</p> <p><b>Formulation of research problem:</b> problem selection, literature review, formulation of hypothesis.</p> <p><b>Variables:</b> dependent, independent and Intervening variables.</p>	15
III	<p><b>Data collection and sampling:</b> Probability sampling, Non probability sampling, Survey method, contact method, questioner.</p> <p><b>Selection of project domain:</b> Publication ethics, Tools and evaluation.</p> <p>Selection of tentative project area and process of literature survey – Literature survey components and procedures Basic components of a research paper – procedures and processes, Journal types, Scopus, web of science, Science Citation Index, H-index, Google citations.</p>	15
IV	<p><b>Research Paper Writing:</b></p> <p>Title selection, paragraph writing, report design, conclusion formation, diagrams and equations, citations, plagiarism, paper format, scopus indexed journals, predatory journals, digital object identifier/ISBN number and publication, research ethics.</p> <p><b>Presentation of selected project proposal:</b></p> <p>Oral presentation. Preparation of a report on the selected project proposal, Attending special invited Hours, practical orientation in searching and</p>	15

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	collecting literature through library, online tools, presenting a seminar on selected project.	
<b>References:</b> <ol style="list-style-type: none"><li>1. William G. Zikmund, B J Babin, J.C. Carr, Atanu Adhikari, M. Griffin, “Business Research Methods”, Cengage, 8e, 2016.</li><li>2. Professionals, Second Edition, New York: IEEE Press, 2002.</li><li>3. Handbook of Qualitative Research, Norman K. Denzin, Yvonna S. Lincoln</li></ol>		

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Semester II**

Course Code	Course Name	Credits	Duration
RJSPIT201	Server Virtualization	3	40
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. Understanding the basics of virtualization and vmware vSphere product suite.</li> <li>2. Identify the need for Server Virtualization</li> <li>3. Describe the components and features of vSphere 6.7 and ESXi</li> <li>4. Describe how VMware's products help solve business and technical challenges with regard to Server Virtualization.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Understand the fundamental concepts of virtualization and recognize VMware vSphere components.	1,2	PSO1,
CO2	Classify, Install and configure virtualisation toolset.	1,2,3,4,5,6	PSO1, PSO2, PSO3
CO3	Understand the importance of security and automation in VMware vSphere. Manage and monitor resources of the VMWare vSphere.	1,2,3,4,5	PSO1, PSO2, PSO3

Unit	Topics	Hours
I	<b>Understanding Virtualization:</b> Describing Virtualization, Microsoft Windows Drives Server Growth, Explaining Moore's Law. <b>Understanding Hypervisors:</b> Describing a Hypervisor, Understanding	10



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p>Type-1 Hypervisors, Understanding Type-2 Hypervisors, Understanding the Role of a Hypervisor, Holodecks and Traffic Cops, Resource Allocation.</p> <p><b>Understanding Virtual Machines:</b> Describing a Virtual Machine, Examining CPUs in a Virtual Machine, Examining Memory in a Virtual Machine, Examining Network Resources in a Virtual Machine, Examining Storage in a Virtual Machine, Understanding How a Virtual Machine Works, Working with Virtual Machines, Understanding Virtual Machine Clones, Understanding Templates, Understanding Snapshots, Understanding OVF, Understanding Containers, understanding VMware Tools.</p> <p><b>Planning and Installing VMware ESXi:</b> Planning a VMware vSphere Deployment, Deploying VMware ESXi, Performing, Post installation Configuration.</p>	
<b>II</b>	<p><b>Installing and Configuring vCenter Server:</b> Introducing vCenter Server, Planning and Designing a vCenter Server Deployment, Deploying the vCenter Server Virtual Appliance, exploring vCenter Server's Management Features, Managing vCenter Server Settings, vSphere Web Client Administration.</p> <p><b>vSphere Update Manager and the vCenter Support Tools:</b> vSphere Update Manager, Configuring vSphere Update Manager, Routine Updates, Performing an Orchestrated Upgrade, Investigating Alternative Update Options.</p> <p><b>Creating and Configuring vSphere Networks:</b> Putting Together a Virtual Network, working with vSphere Standard Switches, working with vSphere Distributed Switches, Configuring Virtual Switch Security.</p>	<b>10</b>
<b>III</b>	<p><b>Creating and Configuring Storage Devices:</b> Reviewing the Importance of Storage Design, Examining Shared Storage Fundamentals, Implementing vSphere Storage Fundamentals.</p> <p><b>Ensuring High Availability and Business Continuity:</b> Understanding the Layers of High Availability, Clustering VMs, Implementing vSphere High Availability, Introducing vSphere SMP Fault Tolerance, Planning for</p>	<b>10</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<p>Business Continuity.</p> <p><b>Using VM, Templates and vApps:</b> Creating and Managing Virtual Machines, Modifying Virtual Machines, Cloning VMs, Creating Templates and Deploying Virtual Machines, Using OVF Templates, Using Content Libraries, working with vApps, Importing Machines from Other Environments.</p> <p><b>Securing VMware vSphere:</b> Overview of vSphere Security, Securing ESXi Hosts, securing vCenter Server, Securing Virtual Machines.</p>	
<b>IV</b>	<p><b>Managing Resource Allocation:</b> Reviewing Virtual Machine Resource Allocation, Working with Virtual Machine Memory, Managing Virtual Machine CPU Utilization, Using Resource Pools, Regulating Network I/O Utilization, Controlling Storage I/O Utilization.</p> <p><b>Balancing Resource Utilization:</b> Comparing Utilization with Allocation, exploring vMotion, Using Storage vMotion, combining vMotion with Storage vMotion, Introducing Cross vCenter vMotion, Exploring vSphere Distributed Resource Scheduler, Working with Storage DRS.</p> <p><b>Monitoring VMware vSphere Performance:</b> Overview of Performance Monitoring, Using Alarms, Working with Performance Charts</p> <p><b>Automating VMware vSphere:</b> Why Use Automation? vSphere Automation Options, Automating with PowerCLI.</p>	<b>10</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Nick Marshall, Scott Lowe (Foreword by) with Grant Orchard, Josh Atwell, “Mastering VMware vSphere 6.7”, Publisher: Sybex, Wiley 2019</li> <li>2. Matthew Portnoy, “Virtualization Essentials”, 2nd Edition, Wiley India Pvt. Ltd.</li> </ol>		

Course Code	Course Name	Credits	Duration
<b>RJSPIT201P</b>	<b>Server Virtualization Practical</b>	<b>2</b>	<b>20</b>
<p><b>Learning Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To implement VMware vSphere, ESXi and vCenter Server.</li> <li>2. To apply various functionality of VMware vSphere components.</li> </ol>			

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

3. To implement and manage server virtualization.

<b>Course Outcomes</b>	<b>Description</b> (Upon completion of this course, students will be able to--)	<b>Bloom's Levels</b>	<b>PSO Addressed</b>
CO1	Understand, Create and Deploy ESXi server, Virtual Machine(VM) on vCenter Server.	1,2,3,4,5, 6	PSO1, PSO2, PSO3
CO2	Understand, Implement and Manage various features of vSphere on ESXi server, VM and vCenter Server.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Install and Manage XenServer using XenClient and demonstrate Hyper-V server virtualization.	1,2,3,4	PSO1, PSO2, PSO3

<b>Practical No.</b>	<b>Details</b>
1.	Implement VMwareESXi for server virtualization. a. Install VMwareESXi server and vSphere client. b. Install vCenter Single Sign-On as Part of a vCenter Server Simple Install.
2.	Manage VMwareESXi server with vCentre server. a. Create a virtual machine in vmwareESXi Server. b. Migrate the virtual machine from one ESXi server to another ESXi server.
3.	Create a Template in the vSphere Client. a. Convert a Virtual Machine to a Template in the vSphere Client. b. Clone a Template in the vSphere Client. c. Clone Virtual Machine to Template in the vSphere Client.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

4.	Manage the storage and Security of VMware ESXi server. a. Add Virtual storage in VMware ESXi Server with vSphere Client. b. Create a one user account of VMware ESXi server using vSphere WebClient application. c. Prevent Users from Spying on Remote Console Sessions.
5.	Upgrade the VMware ESXi server 6.7 to 7.0 using simple installation.
6.	Implement the NFS with the vCenter Server.
7.	Implement and Manage the network of VMware ESXi server. a. Create vSphere Standard switch b. Create vSphere Distributed switch
8.	Perform vSphere Monitoring and Performance a. Monitoring Inventory Objects with different Performance Charts b. Monitoring Guest Operating System Performance c. View Performance Statistics for Windows Guest Operating Systems
9.	Manage Xenserver with Xen center.
10.	Implement Hyper-V server virtualization.

Course Code	Course Name	Credits	Duration
<b>RJSPIT202</b>	<b>Big Data Analytics with Hadoop and Spark</b>	<b>3</b>	<b>40</b>

**Learning Objectives:**

1. To understand the key issues in big data management and analysis.
2. To learn architecture and big data systems.
3. To Analyze data by utilizing various statistical and data mining techniques/algorithms, Perform analytics on real-time streaming data and Understand the various NoSQL alternative database models.
4. Use the Big Data Frameworks Hadoop, Map Reduce and NO SQL for big data analytics as well.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

<b>Course Outcomes</b>	<b>Description</b> (Upon completion of this course, the students will be able to __)	<b>Bloom's Levels</b>	<b>PSO addressed</b>
CO1	Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.	1,2	PSO1, PSO2, PSO3
CO2	Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.	1,2,3	PSO1, PSO2, PSO3
CO3	Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.	1,2,3,4	PSO1, PSO2, PSO3
CO4	Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.	1,2,3,4	PSO1, PSO2, PSO3

<b>Unit</b>	<b>Topics</b>	<b>Hours</b>
<b>I</b>	<p><b>Overview of Big Data:</b> Introduction to Big Data, Growth of and Digitization of Global Information Storage Capacity: Data Warehouse, Data Mining, Data Lakes, Big Data and Business Intelligence, Big Data Types: Structures, Semi-structured and Unstructured Data, Analytics: Predictive Analytics, Descriptive Analytics and Prescriptive Analytics, Big Data and Data Risk, Big Data Technologies, Selecting a Big Data Technology, The Benefits of Big Data, Analytics and the Cloud, Challenges of Big Data, Data Analytics Lifecycle, Introduction to NoSQL.</p> <p><b>An Operating System for Big Data:</b> Basic Concepts, Hadoop Architecture, Working with a Distributed File System, Working with Distributed Computation, Submitting a MapReduce Job to YARN.</p> <p><b>A Framework for Python and Hadoop Streaming:</b> Hadoop Streaming, A Framework for MapReduce with Python, Advanced MapReduce.</p>	<b>10</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

<b>II</b>	<p><b>In-Memory Computing with Spark:</b> Spark Basics, Interactive Spark with PySpark, Writing Spark Applications.</p> <p><b>Distributed Analysis and Patterns:</b> Computing with Keys, Design Patterns, Towards Last-Mile Analytics.</p>	<b>10</b>
<b>III</b>	<p><b>Data Mining and Warehousing:</b> Structured Data Queries with Hive, HBase.</p> <p><b>Data Ingestion:</b> Importing Relational Data with Sqoop, Ingesting Streaming Data with Flume.</p> <p><b>Analytics with Higher-Level APIs:</b> Pig, PigLatin, Spark's Higher -Level APIs: Spark SQL, DataFrames.</p>	<b>10</b>
<b>IV</b>	<p><b>In-Database Analytics:</b> SQL Essentials, In-Database Text Analysis, Advanced SQL</p> <p><b>Machine Learning:</b> Scalable Machine Learning with Spark: Collaborative Filtering, Regression, Classification, Clustering, Time Series Analysis, Text Analysis, Categorizing Documents by Topics, Determining Sentiments.</p>	<b>10</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. V.K Jain, "Big Data and Hadoop ", Khanna Publishing, First 2018.</li> <li>2. EMC Education Services, "Data Science &amp; Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data", Wiley.</li> <li>3. Benjamin Bengfort and Jenny Kim, "Data Analytics with Hadoop: An Introduction for Data Scientists", O'Reilly 2016.</li> <li>4. Andreas François Vermeulen, "Practical Data Science: A Guide to Building the Technology Stack for Turning Data Lakes into Business Assets", Apress.</li> <li>5. Bill Chambers and Matei Zaharia, "Spark: The Definitive Guide : Big Data Processing Made Simple", O'Reilly.</li> </ol>		

Course Code	Course Name	Credits	Duration
<b>RJSPIT202P</b>	<b>Big Data with Hadoop and Spark Practical</b>	<b>2</b>	<b>20</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Learning Objectives:**

1. To Analyze data by utilizing various statistical and data mining techniques/algorithms, Perform analytics on real-time streaming data.
2. To create alternative database models and load data into it and querying data.
3. Use the Big Data Frameworks Hadoop, Map Reduce and NOSQL for big data analytics as well as various applications like recommender systems, social media applications etc.

<b>Course Outcomes</b>	<b>Description</b> (Upon completion of this course, the students will be able to __)	<b>Bloom's Levels</b>	<b>PSO addressed</b>
CO1	Analyze data by utilizing various statistical and data mining techniques/algorithms, Perform analytics on real-time streaming data.	1,2,3,4	PSO1, PSO2, PSO3
CO2	Create alternative database models and load data into it and query the data.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Use the Big Data Frameworks Hadoop, Map Reduce and NOSQL for big data analytics as well as various applications like recommender systems, social media applications etc.	1,2,3,4,5,6	PSO1, PSO2, PSO3

<b>Practical No.</b>	<b>Details</b>
1.	Distributed Analysis and Patterns: Map Reduce application.
2.	In-Memory Computing with Spark: Interactive Spark with PySpark, Writing Spark Applications.
3.	Data Mining and Warehousing: Structured Data Queries with Hive, HBase.
4.	Data Ingestion: Importing Relational Data with Sqoop, Ingesting Streaming Data with Flume.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

5.	Analytics with Higher-Level APIs: Pig, PigLatin, Spark's Higher -Level APIs: Spark SQL, DataFrames
6.	Analytics with Higher-Level APIs: Spark's Higher -Level APIs: Spark SQL, DataFrames
7.	In-Database Text Analysis
8.	Creating Machine learning models: egression, CClassification and Clustering.
9.	Time Series analysis.
10.	Text analysis and applications.

Course Code	Course Name	Credits	Duration
RJSPIT203	Theory and Applications of Blockchain	2	30

**Learning Objectives:**

1. To understand the fundamentals of Blockchain Technology, its distributed data structure functionality and architecture type.
2. To acquire knowledge about blockchain platform, smart contract programming and its capabilities.
3. To acquire knowledge about Decentralized App development, Blockchain application areas and current practices.

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Levels	PSO addressed
CO1	Describe the basic concept of Blockchain and Distributed Ledger Technology.	1,2	PSO1
CO2	Understand Smart contract programming and Develop block chain based solutions using Ethereum Framework.	1,2,3,4,5	PSO1, PSO2, PSO3



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

CO3	Analyze the use of Blockchain in various domains.	1,2,3,4	PSO1, PSO2,
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Unit	Topics	Hours
<b>I</b>	<p><b>Blockchain:</b> The growth of blockchain technology, Distributed systems, The history of blockchain and Bitcoin, Blockchain, Types of blockchain, Consensus, CAP theorem and blockchain.</p> <p><b>Decentralization:</b> Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized Organizations, Platforms for decentralization, Symmetric Key Cryptography, Asymmetric Cryptography.</p> <p><b>Working of Bitcoin:</b> Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets.</p>	<b>8</b>
<b>II</b>	<p><b>How Ethereum Works:</b> From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem, Swarm, Whisper, DApp.</p> <p><b>Solidity Programming:</b> Introduction, Global Banking Made Real, Complementary Currency, Programming the EVM, Design Rationale, Importance of Formal Proofs, Automated Proofs, Testing, Formatting Solidity Files, Reading Code, Statements and Expressions in Solidity, Value Types, Global Special Variables, Units and Functions.</p>	<b>8</b>
<b>III</b>	<p><b>Smart Contracts and Tokens:</b> 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.</p>	<b>7</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<b>Blockchain Application Development:</b> 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.	
<b>IV</b>	<p><b>DApp deployment:</b> Seven Ways to Think About Smart Contracts, Dapp Contract Data Models, EVM back-end and front-end communication, JSON-RPC, Web3, JavaScript API, Using Meteor with the EVM, Executing Contracts in the Console, Recommendations for Prototyping, Third-Party Deployment Libraries.</p> <p><b>Use Cases:</b> Chains Everywhere, The Internet of Ethereum Things, Retail and E-Commerce Community and Government Financing, Human and Organizational Behavior, Financial and Insurance Applications, Inventory and Accounting Systems Software Development, Gaming, Gambling, and Investing.</p>	<b>7</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.</li> <li>2. Bikramaditya Singhal, Gautam Dhameja, Priyanshu Sekhar Panda "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", Apress publication, 2018.</li> <li>3. Chris Dannen, "Introducing Ethereum and Solidity", Apress publication, 2017.</li> <li>4. Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", 1st Edition.</li> <li>5. Elad Elrom, The Blockchain Developer, Apress publication, 2019.</li> <li>6. Mastering Bitcoin: Programming The Open Blockchain, Andreas M. Antonopoulos, O'Reilly, 2017.</li> </ol>		

Course Code	Course Name	Credits	Duration
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**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

<b>RJSPIT203P</b>	<b>Theory and Applications of Blockchain Practical</b>	<b>2</b>	<b>20</b>
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand the working of metamask and various cryptographic algorithms.</li> <li>2. To learn the basic programming concepts of solidity.</li> <li>3. To design and develop smart contract applications using Solidity.</li> </ol>			

<b>Course Outcomes</b>	<b>Description</b> (Upon completion of this course, the students will be able to __)	<b>Bloom's Levels</b>	<b>PSO addressed</b>
CO1	Demonstrate the use of Metamask wallet for blockchain interaction. Understand and apply the cryptography algorithms	1,2,3	PSO1, PSO2
CO2	Extend Python programming to develop blockchain Understand and apply smart contract programming concepts with solidity. Write and deploy smart contracts using Remix IDE.	1, 2, 3, 4, 5, 6	PSO1, PSO2, PSO3

<b>Practical No.</b>	<b>Details</b>
1.	Demonstrate Working with MetaMask <ol style="list-style-type: none"> <li>a. Install Metamask ,Create account ,Deposit Ether</li> <li>b. Transfer ether in between accounts and observe the transaction details</li> </ol>
2.	Implementing cryptography Algorithm in Python: <ol style="list-style-type: none"> <li>a. DES</li> <li>b. SHA Message Digest</li> </ol>
3.	Write the following programs for Blockchain in Python : <ol style="list-style-type: none"> <li>a. A simple client class that generates the private and public keys by using the built in Python RSA algorithm and test it</li> </ol>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	b. A transaction class to send and receive money and test it .
4.	Write the following programs for Blockchain in Python : a. Create multiple transactions and display them . b. Create a blockchain, a genesis block and execute it .
5.	Write the following programs for Blockchain in Python : a. Create a mining function and test it. b. Add blocks to the miner and dump the blockchain.
6.	Write the solidity Code and demonstrate the following: a. Variable b. Operators c. Decision Making - if, if else, if else if d. Loops - for, while, and do while
7.	Write the solidity Code and demonstrate the following: a. Functions b. View Functions c. Pure Functions d. Cryptographic Function
8.	Write the solidity Code and demonstrate the following: a. Contracts b. Inheritance c. Constructors d. Interfaces
9.	Program a Simple contract that can get, increment and decrement the count store in the contract.
10.	Write a simple smart contract to calculate the 'number of ethers' for the transaction of gas limit for the given scenario.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Course Code	Course Name	Credits	Duration
RJSPITE201	Foundation of Modern Networking	2	30
<b>Course Objectives</b> <ol style="list-style-type: none"> <li>1. To understand the state-of-the-art in network protocols, architectures and applications.</li> <li>2. To analyze various networks and network protocols.</li> <li>3. To explore the various methods of networking research.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO Addressed
CO1	Understand and Describe the basic concepts of Modern Networking	1, 2	PSO1
CO2	Recognise, Understand and Explore the Concepts, Architectures, Functionality and Applications of Network Function Virtualization (NFV), QoE Describe the key concept of QOS support, ISA.	1,2,3	PSO1, PSO2,
CO3	Understand and Analyze SDN concepts, applications and standards across data, control and application plane	1,2,3,4,5,6	PSO1, PSO2, PSO3

Unit	Topics	Hours
<b>I</b>	<b>Elements of Modern Networking:</b> 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	<b>8</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	Storage. <b>Requirements and Technology:</b> Types of Network and Internet Traffic, Elastic Traffic, Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud computing, and Mobile Traffic. Big 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.	
<b>II</b>	<b>Defining and Supporting User Needs: Quality of Service:</b> QOS Architectural Framework, Integrated Services Architecture ,ISA Approach , ISA Components, ISA Services, Service Level Agreement, Openflow QOS Support. <b>QoE: User Quality of Experience:</b> Why QOE?, Online Video Content Delivery, Definition Of Quality Of Experience, Definition of Quality ,The QoE/QoS Layered Model, Summarizing and Merging the QoE/QoS Layers, Factors Influencing QoE, Applications Of QoE	<b>8</b>
<b>III</b>	<b>The Evolution of Network Architecture:</b> Traditional Network Architecture, Introducing NFV, transition from traditional network devices to NFV, NFV Architectural Framework, Need for a Framework, Benefits of NFV, NFV Market Drivers. <b>Software Defined Networking (SDN):</b> Introduction, Basic Concepts of SDN, Traditional Network Architecture, Transition from Traditional to SDN Architecture, Advantages of SDN, Control Plane, Data Plane and OpenFlow, Control Plane, Application Plane.	<b>7</b>
<b>IV</b>	<b>SDN Controller:</b> Introduction to SDN Controller, Types of SDN controller, SDN Implementation Models, Open SDN, Hybrid SDN, SDN via APIs. <b>SDN Protocols:</b> Southbound SDN Protocols, Control Plane Protocols, Northbound Protocols, Management Plane Protocols, OpenFlow protocol.	<b>7</b>
<b>References:</b> 1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and		

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Cloud”, Addison Wesley Professional, October 2015.
2. Rajendra Chayapathi Syed Farrukh Hassan, “Network Functions Virtualization (NFV) with a Touch of SDN”, AddisonWesley.
3. Jim Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization”, Pearson Education, Inc.

Course Code	Course Name	Credits	Duration
RJSPITE201P	Foundation of Modern Networking Practical	2	20
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. Implement modern networks in a simulated environment.</li> <li>2. Gain a practical understanding of SDN concepts.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Recall and Execute different modern networking commands.	1,2,3	PSO1, PSO2, PSO3
CO2	Learn and configure IP SLA Tracking and Path Control.	1,2,3,4	PSO1, PSO2, PSO3
CO3	Install and configure SDN controllers and protocols.	1,2,3,4,5,6	PSO1, PSO2, PSO3

Practical No.	Details
1.	Command line commands for modern networking:

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<ul style="list-style-type: none"> <li>a. Networking Commands.</li> <li>b. Wi-Fi Hacking Password.</li> <li>c. Simple Packet Tracer.</li> </ul>
2.	Configure IP SLA Tracking and Path Control.
3.	Configuration with AS_PATH Attributes.
4.	Configure Cisco MPLS.
5.	Inter -Vlan Routing.
6.	Simulating SDN with: <ul style="list-style-type: none"> <li>a. OpenDaylight SDN Controller with the Mininet Network Emulator</li> <li>b. OF-Net SDN network emulator</li> </ul>
7.	Implement Open vSwitch(OVS) on the OpenDayLight(ODL) controller.
8.	Secure the Management Plane
9.	Implementation of IP Service Level Agreements and Remote SPAN in a Campus Environment.
10.	Simulating OpenFlow using Mininet.

Course Code	Course Name	Credits	Duration
RJSPITE202	Image Processing	2	30
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To study the image fundamentals and mathematical transforms necessary for image processing.</li> <li>2. To study the image enhancement techniques</li> <li>3. To study image restoration procedures. To study the image compression procedures.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be	Bloom's Levels	PSO addressed
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**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	able to __)		
CO1	Understanding image processing fundamental concepts. Understanding and Application of Image enhancement techniques to improve the quality of the image.	1, 2, 3	PSO1, PSO2
CO2	Understand the concept of restoring the degraded or distorted images and applying the concept for image restoration. Understand the concept of Image Segmentation to extract various features of the image	1, 2, 3	PSO1, PSO2
CO3	Understand and apply different morphological operations. Understand the fundamentals of color images.	1, 2, 3	PSO1, PSO2

Unit	Topics	Hours
<b>I</b>	<p><b>Introduction Digital Image Processing</b> - What is Digital Image Processing? Digital Image representation, Image Sampling and Quantization, Image Types, Elements of an Image Processing System, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Image File Formats Some Basic Relationships Between Pixels</p> <p><b>Convolution and Correlation:</b> 2D Convolution through graphical method, 2D Convolution through matrix analysis.</p>	<b>8</b>
<b>II</b>	<p><b>Image Enhancement in Spatial Domain:</b> Enhancement through point operation, Mask Operation, Histogram manipulation, Linear Gray-Level Transformation, Non-linear Gray level Transformation - Thresholding, Grey-level slicing, Logarithmic Transformation, Exponential Transformation, Gamma Correction, Local or neighborhood operations, Median filter, High boost filter, Unsharp Masking, Bit Plane Slicing, Homomorphic Filter, Zooming Operation, Image Arithmetic</p> <p><b>Image Restoration and Denoising:</b> Image degradation, Types of image</p>	<b>8</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	blur, Classification of Image restoration techniques, Image-Restoration Model, Classification of Noise in Image, Median Filters, Median filter for Color Images, Application of digital image restoration.	
<b>III</b>	<p><b>Image Segmentation:</b> Classification of Image Segmentation Techniques, Region approach to Image Segmentation, Edge Based Segmentation, Edge detection - Gradient operator, Using First- Order Derivatives, Roberts Kernel, Prewitt Kernel, Sobel Kernel, Second derivative method of detecting edges in an image, Canny Edge Detector.</p> <p><b>Image Compression:</b> Need for image compression, Redundancy in images, Run-length coding, fixed and variable length coding, Huffman coding.</p>	<b>7</b>
<b>IV</b>	<p><b>Binary Image Processing:</b> Mathematical Morphology, Structuring Elements, Morphological Image processing, Basic, Set theory, Logical operations, Standard binary morphological operations, Dilation and erosion based operations, Properties of morphological operations, Morphological algorithms - Hit and Miss, Boundary Detection, Convex Hull, Thinning, Thickening, Distance Transform.</p> <p><b>Color Image Processing:</b> Human perception of color, color models - RGB, CMY, HSI, The chromaticity diagram, Pseudo-color.</p>	<b>7</b>
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill Education Private Limited, 2009.</li> <li>2. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education.</li> <li>3. Anil K Jain, "Fundamentals of Digital Image Processing", 1st Edition, PHI.</li> </ol>		

Course Code	Course Name	Credits	Duration
<b>RJSPITE202P</b>	<b>Image Processing Practical</b>	<b>2</b>	<b>20</b>
<p><b>Learning Objectives:</b></p> <ol style="list-style-type: none"> <li>1. Understand Image transforms and their properties</li> <li>2. Understand techniques for image enhancement in the spatial domain.</li> </ol>			

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

3. Get the knowledge of image restoration and image segmentation techniques.

Course Outcomes	Description	Bloom's Levels	PSO addressed
CO1	Understand the use of openCV libraries in image processing.	2	PSO1
CO2	Apply and analyze different filters and transformation techniques on digital images.	1,2,3,4	PSO1, PSO2, PSO3

Practical No.	Details
1.	<ol style="list-style-type: none"> <li>1. Install OpenCV in python.</li> <li>2. Perform the following operation on an image using openCV - Read, Rotate, Crop and convert RGB to Gray.</li> <li>3. Scaling, Interpolations, And Re-Sizing.</li> </ol>
2.	Implement Basic Intensity transformation functions <ol style="list-style-type: none"> <li>1. Image Inverse.</li> <li>2. Log Transformation.</li> <li>3. Power-law Transformation.</li> </ol>
3.	<ol style="list-style-type: none"> <li>1. .Apply Arithmetic Operations on the Image - Addition &amp; Subtraction.</li> <li>2. Extract the Channels of an RGB Image - Split &amp; Merge.</li> </ol>
4.	Apply Image Filters (Image Smoothing and Sharpening filters) <ol style="list-style-type: none"> <li>1. Low Pass - Average, Weighted Average, Median and Gaussian.</li> <li>2. High Pass - Laplacian Filter, Sobel, Robert and Prewitt Filter.</li> </ol>
5.	Displaying text on Image in Python using OpenCV.
6.	Image Histogram- find the histogram of the image.
7.	Morphological operations based on OpenCV-

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

	<ol style="list-style-type: none"> <li>1. Erosion &amp; Dilation.</li> <li>2. Opening &amp; Closing.</li> <li>3. HIT and Miss.</li> </ol>
8.	<ol style="list-style-type: none"> <li>1. Apply Edge Detection techniques.</li> <li>2. Apply Boundary Extraction techniques.</li> </ol>
9.	<ol style="list-style-type: none"> <li>1. Remove Background from an image.</li> <li>2. Detection of specific Color from an image.</li> </ol>
10.	<ol style="list-style-type: none"> <li>1. Extracting text from Image (OCR)- use Google Tesseract-OCR.</li> <li>2. Detects and corrects text skew.</li> </ol>

Course Code	Course Name	Credits	Duration
<b>RJSPITOJT201</b>	<b>On-Job Training</b>	<b>4</b>	<b>120 Hours</b>
<b>Learning Objectives:</b> <ol style="list-style-type: none"> <li>1. To give the student an opportunity to establish an interest in industrial/commercial activities.</li> <li>2. To provide a general work experience, so that the student can apply skills previously acquired during the program and acquire new relevant skills.</li> <li>3. To provide a foundation for preparing the student for working efficiently and productively in industrial commercial establishments.</li> <li>4. To create a two-way link between the Trade &amp; Industry and the colleges of the Ministry of Manpower so that the graduates of the colleges fulfill their needs and requirements.</li> </ol>			

Course Outcomes	Description (Upon completion of this course, the students will be able to __)	Bloom's Levels	PSO addressed
CO1	Explore career alternatives prior to graduation and Integrate theory and practice.	1,2,3,4,5,6	PSO1, PSO2, PSO3,

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

			PSO4
CO2	Assess interests and abilities in their field of study. Learn to appreciate work and its function in the economy.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4
CO3	Develop work habits and attitudes necessary for job success. Develop communication, interpersonal and other critical skills in the job interview process. Build a record of work experience.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4
CO4	Acquire employment contacts leading directly to a full-time job following graduation from college.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4
CO5	Identify, write down, and carry out performance objectives related to their job assignment.	1,2,3,4,5,6	PSO1, PSO2, PSO3, PSO4

**On-Job Training: Internship / Apprenticeship / Field Project Rules**

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 area of Information Technology, Networking, Software Development, Software Testing, Cloud Computing, Business Analytics, Data Science and Artificial Intelligence etc. 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.

The project report should be documented with a scientific approach to the solution of the problem

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

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.

Project report must contain relevant documents from the list given below –

1. Title Page
2. Original Copy of The Approved Performa of The Project Proposal
3. Certificate of Authenticated Work (From College And From Company In Case of Live Projects)
4. Role And Responsibility Form (If Applicable)
5. Attendance Certificate
6. Abstract
7. Acknowledgement
8. Table of Contents
9. Report
10. Bibliography and References

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Scheme of Examination**

**Semester I**

Sr. No.	Course Code	Course Name	Maximum Marks			Credits
			Internal	External	Total	
1.	RJSPIT101	Fundamentals of Cloud Computing	40	60	100	3
2.	RJSPIT101P	Fundamentals of Cloud Computing Practical	-	50	50	2
3.	RJSPIT102	Microservice Architecture	40	60	100	3
4.	RJSPIT102P	Microservice Architecture Practical	-	50	50	2
5.	RJSPIT103	Introduction to Data Science	40	60	100	2
6.	RJSPIT103P	Introduction to Data Science Practical	-	50	50	2
7.	RJSPITE101	Security Breaches and Countermeasures	40	60	100	2
8.	RJSPITE101P	Security Breaches and Countermeasures Practical	-	50	50	2
9.	RJSPITE102	Artificial Intelligence	40	60	100	2
10.	RJSPITE102P	Artificial Intelligence Practical	-	50	50	2
11.	RJSPITOE101	Research Methodology	40	60	100	4
<b>Total</b>					<b>700</b>	<b>22</b>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Semester II**

Sr. No.	Course Code	Course Name	Maximum Marks			Credits
			Internal	External	Total	
1.	RJSPIT201	Server Virtualization	40	60	100	3
2.	RJSPIT201P	Server Virtualization Practical	-	50	50	2
3.	RJSPIT202	Big Data with Hadoop and Spark	40	60	100	3
4.	RJSPIT202P	Big Data with Hadoop and Spark Practical	-	50	50	2
5.	RJSPIT203	Theory and Applications of Blockchain	40	60	100	2
6.	RJSPIT203P	Theory and Applications of Blockchain Practical	-	50	50	2
7.	RJSPITE201	Modern Networking	40	60	100	2
8.	RJSPITE201P	Modern Networking Practical	-	50	50	2
9.	RJSPITE202	Image Processing	40	60	100	2
10.	RJSPITE202P	Image Processing Practical	-	50	50	2
11.	RJSPITOJT201	On-Job Training	40	60	100	4
<b>Total</b>					<b>700</b>	<b>22</b>



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Evaluation and Assessment**

**1. Total Marks per Theory Course - 100 (Internal: 40 Marks and External:60 Marks).**

a. The internal assessment - 40 marks, shall be awarded as follows:

I. 25 marks (Any one of the following):

i. Written Test / Case study / Presentation /

or

ii. SWAYAM NPTEL (Advanced Course) of minimum 20 hours and certification examination completed

or

iii. Valid International Certifications (Prometric, Pearson, Certiport, Coursera, Udemy, edx and the like).

or

iv. One certification mark shall be awarded one course only. For four courses, the students will have to complete four certifications.

II. 15 Marks - Mini Project or Assignment.

III. For Research Methodology (RJSPIT0EC101P) the Internal marks will be given out of 40 for presentation or review of classic and recent research paper or research based case study.

**2. Semester End Examination - 60 marks (Question paper covering all units unless otherwise specified).**

**Semester I Courses:** RJSPIT101, RJSPIT102, RJSPIT103, RJSPITE101 / RJSPITE102 and RJSPIT0EC101.

**Semester II Courses:** RJSPIT201, RJSPIT202, RJSPIT203 and RJSPITE201 / RJSPITE202.

Question	Knowledge	Understanding	Application & Analyze	Total Marks Per Unit
Unit I	06	02	04	12
Unit II	06	02	04	12
Unit III	06	02	04	12
Unit IV	06	02	04	12
Short Notes from the topic covering all the Units	04	04	04	12
Total Per Objective	28	12	20	60

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

<b>Weightage(%)</b>	46	20	34	100
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**3. Assessment of Practical - 50 Marks.**

**Semester I Courses:** RJSPIT101P, RJSPIT102P, RJSPIT103P and RJSPITE101P / RJSPITE102P.

**Semester II Courses:** RJSPIT201P, RJSPIT202P, RJSPIT203P and RJSPITE201P / RJSPITE202P.

**Sample Question Paper Pattern:**

<b>Questions</b>		<b>Marks</b>
a)	Practical Question 1.	15
b)	Practical Question 2.	15
c)	e-Journal and Continuous evaluation.	15
d)	Viva.	05

OR

<b>Questions</b>		<b>Marks</b>
a)	Practical Question 1.	30
b)	e-Journal and Continuous evaluation.	15
c)	Viva.	05

**4. Assessment of OJT.**

**a. On-Job Training: Internship / Apprenticeship Assessment - 100 Marks.**

**Report Format:**

<b>Name of Department:</b> _____	
<b>Course Code:</b> _____	<b>Course Name:</b> _____ <b>Date</b> _____
<b>Roll No.:</b> _____	<b>UID No.:</b> _____ <b>Marks:</b> _____/60
<b>Name of Student:</b> _____	
<b>Title of Project:</b> _____	
<b>Report Contents:</b> <i>As Specified in the Course.</i>	

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Assessment Grid:**

OJT Parameters	Marks	Performance / Distribution of Marks			
		Excellent 81-100%	Good 61-80%	Satisfactory 41-60%	Average 20-40%
Work done at OJT includes attendance	50	41-50/50	31-40/50	21-30/50	10-20/50
Report writing and conclusions	30	25-30/30	19-24/30	13-18/30	6-12/30
Presentation and Communication	20	17-20/20	13-16/20	7-12/20	4-6/20

- b. On-Job Training: Field Project Assessment or the project assessment wherever mentioned.**

**Report Format:**

Name of Department: _____	
Course Code: _____	Course Name: _____ Date _____
Roll No.: _____	UID No.: _____ Marks: _____/60
Name of Student: _____	
Title of Project: _____	
Report Contents: <i>As Specified in the Course.</i>	

**Assessment Grid:**

Project Work or Report Parameters	Marks	Performance / Distribution of Marks			
		Excellent 81-100%	Good 61-80%	Satisfactory 41-60%	Average 20-40%
Project Work done	50	41-50/50	31-40/50	21-30/50	10-20/50
Report Writing and Conclusions	30	25-30/30	19-24/30	13-18/30	6-12/30
Presentation and Communication	20	17-20/20	13-16/20	7-12/20	4-6/20

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

## **Teaching Learning Process**

The teaching learning process in the learning outcomes-based curriculum framework in the subject of Information Technology is designed to help students to learn the subject in greater detail, analyze and apply as and when required. The course offers the requisite skills for professions and jobs in Information Technology. All courses have practical and hands-on sessions, an integral part which promotes the learner to acquire the requisite skills for employment by experiential learning. Teaching also involves guest lectures by experts drawn from research institutes of repute, industries, and entrepreneurs.

An interesting combination of teaching learning processes is adopted in which the teacher and learners are actively involved.

**Some of the silent teaching learning processes are**

- ☐ Class lectures
- ☐ Hands-on sessions
- ☐ Presentations and Videos
- ☐ Case Study
- ☐ Group Discussion, workshops
- ☐ Peer teaching and learning
- ☐ Flipped classroom, project-based learning, quiz, seminars, exhibitions, posters
- ☐ Practical's experimental design planning, analysis, interpretation, application of knowledge gained
- ☐ On-Job Training/ Field Project
- ☐ Technology enabled self-learning
- ☐ Learning Management System - Google Classroom
- ☐ Online Tools

The effective teaching strategies would address the requirements of learners to learn at their own pace. Self-learning is encouraged at postgraduate level, emphasis is on acquiring higher order skills. The entire program is also designed to foster the technical skills as per the industry requirement. The teaching learning processes adopted would aim at participatory pedagogy.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

**Mapping of the courses to Employability/ Entrepreneurship/ Skill Development**

Course Name	Course Code	Topic focusing on Employability/ Entrepreneurship/ skill development	Employability / Entrepreneurs hip / Skill development	Specific Activity
<b>Semester I</b>				
Fundamentals of Cloud Computing	RJSPIT101 & RJSPIT101P	<b>Skill Development Unit I</b> Introduction, Evolution and Enabling Technologies, Benefits and Challenges, Cloud Computing Model <b>Unit II</b> Resource Virtualization, Operating System Level Virtualization, Resource Pooling, Sharing and Provisioning <b>Unit III</b> Scaling in the Cloud, Capacity Planning, Load Balancing <b>Unit IV</b> Security Reference Model, Security Issues, Portability and Interoperability Issues, Popular Cloud Services	1. Technical skills in utilising the open-source tools to configure various cloud services 2. Employability skills in providing overview of various Cloud service platforms and services.	Experiential learning enhances the skills of problem identification and providing feasible solutions in the cloud.

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Microservices Architecture Fundamentals	RJSPIT102 & RJSPIT102P	<b>Skill Development</b> <b>Unit I</b> Microservices, Microservices Value Proposition, Designing Microservice Systems, Establishing a Foundation <b>Unit II</b> Service Design, System Design and Operations, Adopting Microservices in Practice <b>Unit III</b> ASP.NET Core Primer, Delivering Continuously, Building Microservice with ASP.NET Core <b>Unit IV</b> Backing Services, Creating Data Service, Event Sourcing and CQRS, Building an ASP.NET Core Web Application	1. Technical skills in understanding and developing the ASP.NET core ,Web API and MVC application using visual studio IDE and Docker. 2. Enterprise skills are achieved in designing and implementing web API using ASP.NET core framework and using Docker container to push and pull images.	Experiential learning enhances the skills of problem identification and providing feasible solutions in Web services and Applications.
Introduction to Data Science	RJSPIT103 & RJSPIT103P	<b>Skill Development:</b> <b>Unit I</b> Data Science Technology Stack, Layered Framework, Business Layer <b>Unit II</b> Utility Layer, Three Management Layers, Retrieve Superstep, <b>Unit III</b> Assess Superstep, Process Superstep <b>Unit IV</b> Transform Superstep	1. Technical skill in data preparation and model building using machine learning algorithms. 2. Analytical skills in evaluating the models/ ML algorithms.	Experiential learning enhances the skills of problem identification and providing feasible solutions to the Data related problems.
Security Breaches and Countermeasures	RJSPITE101 & RJSPITE101P	<b>Skill Development</b> <b>Unit I</b> Essential Knowledge about Security, Reconnaissance, Information	1. Technical skills in different cyber security methods in detecting and	Experiential learning enhances the skills of problem identification and

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

		<p>Gathering for the Ethical Hacker, Scanning and Enumeration</p> <p><b>Unit II</b></p> <p>Sniffing and Evasion, Attacking a System,</p> <p><b>Unit III</b></p> <p>Web-Based Hacking: Servers and Applications, Wireless Network Hacking</p> <p><b>Unit IV</b></p> <p>Trojans and Other Attacks, Social Engineering and Physical Security</p>	<p>preventing attacks.</p> <p>2. Employability skills in setting up software and network security parameters.</p>	<p>providing feasible solutions using security tools.</p>
Artificial Intelligence	RJSPITE102 & RJSPITE102P	<p><b>Skill Development, Employability</b></p> <p><b>Unit I</b></p> <p>Introduction to Artificial Intelligence, Intelligent Agents</p> <p><b>Unit II</b></p> <p>Uninformed Search Strategies, Informed (Heuristic) Search Techniques</p> <p><b>Unit III</b></p> <p>Constraint Satisfaction problem, Adversarial Search,</p> <p><b>Unit IV</b></p> <p>Knowledge Representation, Reasoning, and Planning, Uncertain Knowledge and Probabilistic reasoning</p>	<p>1. Technical skills in developing and implementing various search techniques and reinforcement learning.</p> <p>2. Technical skills in Artificial Intelligence language - Prolog</p>	<p>Experiential learning enhances the skills of problem identification and providing feasible solutions using AI algorithms and techniques.</p>
Research Methodology	RJSPITOE101	<p><b>Skill Development</b></p> <p><b>Unit I</b></p> <p>Introduction to Research, Business Research, Research Methods and Data Collection</p> <p><b>Unit II</b></p> <p>Formulation of</p>	<p>1. Technical skills in developing and implementing various research</p>	<p>Experiential learning enhances the skills of problem identification and provides a feasible solution</p>

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

		research problem, Variables, Data collection and sampling, Selection of project domain <b>Unit III</b> Research Paper Writing, Presentation of selected project proposal	methods and techniques. 2. Technical skills in collecting data, organising data, and reporting results.	to the research problem.
<b>Semester II</b>				
Server Virtualization & Server Virtualization Practical	RJSPIT201 & RJSPIT201P	<b>Skill Development, Employability</b> <b>Unit I</b> Understanding Virtualization, Understanding Hypervisors, Understanding Virtual Machines, Planning and Installing VMware ESXi <b>Unit II</b> Installing and Configuring vCenter server, vSphere Update Manager and the vCenter Support Tools, Creating and Configuring vSphere Networks <b>Unit III</b> Creating and Configuring Storage Devices, Ensuring High Availability and Business Continuity, Using VM, Templates and vApps, Securing VMware vSphere <b>Unit IV</b> Managing Resource Allocation, Balancing Resource Utilization, Monitoring VMware vSphere Performance,	1. Technical skills in understanding and configuring VMware vSphere client and server. 2. Employability skill used in server virtualization	Experiential learning enhances the skills of problem identification and providing feasible solutions using virtualization.



**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

		Automating VMware vSphere		
Big Data with Hadoop and Spark & Big Data with Hadoop and Spark Practical	RJSPIT202 & RJSPIT202P	<b>Skill Development, Employability</b> <b>Unit I</b> Overview of Big Data, An Operating System for Big Data, A Framework for Python and Hadoop Streaming <b>Unit II</b> In-Memory Computing with Spark, Distributed Analysis and Patterns <b>Unit III</b> Data Mining and Warehousing, Data Ingestion, Analytics with Higher-Level APIs <b>Unit IV</b> In-Database Analytics, Machine Learning.	1. Technical skills in processing and analysing data using big data frameworks. 2. Employability skills in big data analysis using various BDA tools.	Experiential learning enhances the skills of problem identification and providing feasible solutions using Big Data Systems and Tools.
Theory and Applications of Blockchain & Theory and Applications of Blockchain Practical	RJSPIT203 & RJSPIT203P	<b>Skill development, Employability</b> <b>Unit I:</b> Blockchain, Decentralization, Working of Bitcoin <b>Unit II:</b> How Ethereum Works, Solidity Programming <b>Unit III:</b> Smart Contracts and Tokens, Blockchain Application Development <b>Unit IV:</b> DApp deployment, Use Cases	1. Technical skills in understanding various technical factors involved in block chain technology 2. Employability skill is achieved in designing the smart contract and block chain platform for various problem statement	Experiential learning enhances the skills of problem identification and providing feasible solutions using Blockchain.
Foundation of	RJSPITE201 & RJSPITE201P	Skill Development <b>Unit I:</b> Elements of	1. Technical skills in functional	Experiential learning

**M.Sc. Information Technology Part I Syllabus As Per NEP 2020**

Modern Networking & Foundation of Modern Networking Practical		Modern Networking, Requirements and Technology <b>Unit II:</b> Defining and Supporting User Needs, Quality of Service, QoE, <b>Unit III:</b> The Evolution of Network Architecture, Software Defined Networking (SDN) <b>Unit IV:</b> SDN Controller, SDN Protocols	network configuration using WiFi 4G/5G for different applications. 2. Employability skills in setting up software defined networks and VLAN.	enhances the skills of problem identification and providing feasible solutions using the Modern Networking techniques.
Image Processing & Image Processing Practical	RJSPITE202 & RJSPITE202P	<b>Skill Development, Employability</b> <b>Unit I:</b> Introduction Digital Image Processing, Convolution and Correlation <b>Unit II:</b> Image Enhancement in Spatial Domain Image Restoration and Denoising <b>Unit III:</b> Image Segmentation, Image Compression <b>Unit IV:</b> Binary Image Processing, Color Image Processing	1. Technical skills in utilizing the open-source tools for Image Processing and Image transformations techniques. 2. Technical skills for pursuing a research career in object recognition, pattern matching.	Experiential learning enhances the skills of problem identification and providing feasible solutions using Image processing tools and techniques.
On-Job Training	RJSPITOJT201	Internship / Apprenticeship / Field Project	1. Technical skill in the domain of IT. 2. Employability skill to apply in the field of IT.	Experiential learning enhances the skills of problem identification and providing feasible solutions.