



Master of Science (Information and Communication Technology)

Name of Program	Master of Science (Information and Communication Technology)
Abbreviation	M.Sc. (I.C.T.)
Duration	2 Years
Eligibility Criteria	Graduate in the discipline of computer application / computer science / computer engineering / Information Science / Information Technology
Objective of Program	To prepare human resource for cutting edge technologies in the field of ICT.
Program Outcome	<p>PO1 : Fundamental Knowledge Enrichment Program trains students with the core computer science and Information Technology (IT) knowledge domains. It also makes students capable of using core concepts in the conceptualization of domain specific application development.</p> <p>PO2 : Critical Thinking Development The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem.</p> <p>PO3 : Advanced Emerging Technology Awareness The program trains students with the latest technologies that is being used in the industry. The continuous syllabi review adds value to the program for the outgoing students and make them ready to face challenging demands of the industry.</p> <p>PO4 : Advanced Tools Usage The program teaches the students to apply the advanced tools to solve real world problems.</p> <p>PO5 : Nurturing Project Planning and Management Capabilities The program trains students for designing and conceptualizing the software architecture, planning and managing the product development process of complex and live software projects. It also makes students understand the decision making for selection of an appropriate project management capabilities.</p> <p>PO6 : Real World Problem / Project Development Real world project provides the candidates exposure to work in the challenging and demanding environment of the industry. The project development training makes students employable and industry ready.</p> <p>PO7 : Team Work and Leadership Development Trains students to work in a team and also to take leadership of the of the project management team.</p>
Program Specific Outcomes	<p>PSO1 : Students will learn various aspects of Digital Communication Technologies.</p> <p>PSO2 : Students will be able to utilize knowledge of communication technologies in I.C.T. based applications.</p>

R. N. Desai

		<p>PSO3 : Students will be able to solve complex programming problems.</p> <p>PSO4 : Students will be able to learn emerging technologies and apply them for the development of Web applications, Mobile applications, IOT applications, etc....</p> <p>PSO5: Students will develop necessary Entrepreneur and Technical skills to start their own business in I.C.T domain.</p>																																																																						
Mapping between POs and PSOs		<table border="1"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> <th colspan="2"></th> </tr> </thead> <tbody> <tr> <th>PO1</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO2</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO3</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO4</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO5</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO6</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>PO7</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>								PSO1	PSO2	PSO3	PSO4	PSO5			PO1								PO2								PO3								PO4								PO5								PO6								PO7							
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Medium of Instruction		English																																																																						
Program Structure		Semester 1																																																																						
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ICT 304	Open Source Web Development	4	0	4	3 Hrs	70	30	100																																																																
ICT 305	Practical 5	-	3	3	2 Hrs	70	30	100																																																																
ICT 306	Practical 6	-	3	3	2 Hrs	70	30	100																																																																
ICT 307	Part Time Project 3	-	3	3	-	70	30	100																																																																
Total		16	9	25		490	210	700																																																																
Program Structure		Semester 2																																																																						
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12/2/2021

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Abbreviation		M.Sc. (I.C.T.)						
Duration		2 years						
Eligibility		Graduate in the discipline of computer application / computer science / computer engineering / Information Science / Information Technology						
Objective of Program		To prepare human resource for cutting edge technologies in the field of ICT.						
Program Outcome		After the completion of the course, students will be able to develop and manage various types of projects in the field of ICT.						
Effective From		June 2020						
Program Structure		M.Sc. (I.C.T.) – Semester 1 (M.Sc. (I.C.T.) 2 years PG Course)						
Course Code	Title	Teaching per week (Hrs.)		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
ICT 301	Introduction to Python and Data Science	4	0	4	3 Hrs	70	30	100
ICT 302	Data Communication and Internet of Things	4	0	4	3 Hrs	70	30	100
ICT 303	Cloud Computing	4	0	4	3 Hrs	70	30	100
ICT 304	Open Source Web Development	4	0	4	3 Hrs	70	30	100
ICT 305	Practical 5	-	3	3	2 Hrs	70	30	100
ICT 306	Practical 6	-	3	3	2 Hrs	70	30	100
ICT 307	Part Time Project 3	-	3	3	-	70	30	100
Total		16	9	25	-	490	210	700
Program Structure		M.Sc. (I.C.T.) – Semester 2 (M.Sc. (I.C.T.) 2 years PG Course)						
Course Code	Title	Teaching per week (Hrs.)		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
ICT 401	Project	-	-	25	-	490	210	700
Total				25	-	490	210	700
Program Passing Rules		As per University rules						

M.Sc. (I.C.T.) 3rd Semester

Course: 301: Introduction to Python and Data Science

Course Code	301																												
Course Title	Introduction to Python and Data Science																												
Credit	4																												
Teaching per Week	4 Hrs																												
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)																												
Effective From	June 2019																												
Purpose of Course	The purpose of this course is to provide introductory knowledge of Python programming and data science.																												
Course Objective	The objective of the course is to impart practical knowledge of Python programming and data science concepts.																												
Course Outcomes	<p>CO1 : Students will be able to understand python language in detail using different python libraries.</p> <p>CO2 : Students will be able to perform data wrangling and statistical operations using python.</p> <p>CO3 : Students will be able to learn to mine data using python libraries.</p>																												
Mapping between COs with PSOs	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> </tr> </thead> <tbody> <tr> <th>CO1</th> <td></td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO2</th> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO3</th> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table>						PSO1	PSO2	PSO3	PSO4	PSO5	CO1						CO2						CO3					
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Pre-requisite	Basic concepts of Programming, Mathematics and Statistics.																												
Course Outcome	Students will be able to apply data science concepts using Python programming language.																												

P. V. D. S. S.

Course: ICT 301: Introduction to Python and Data Science

Course Code	ICT 301
Course Title	Introduction to Python and Data Science
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	The purpose of this course is to provide introductory knowledge of Python programming and data science.
Course Objective	The objective of the course is to impart practical knowledge of Python programming and data science concepts.
Pre-requisite	Basic concepts of Programming, Mathematics and Statistics.
Course Out come	Students will be able to apply data science concepts using Python programming language.
Course Content	<p>Unit : 1 : Introduction to Data science</p> <p>1.1 Brief history 1.2 Data Science Life cycle 1.3 Application of data science 1.3.1 Natural Language Processing 1.3.2 Computer Vision 1.3.3 Big Data 1.4 Issues in data science</p> <p>Unit : 2 : Core statistics for data science</p> <p>2.1 Vectors 2.2 Matrices 2.3 Descriptive Statistics 2.3.1 Mean 2.3.2 Median 2.3.3 Mode 2.3.4 Standard Deviation 2.3.5 Variance and Covariance 2.4 Measures of Central Tendency and Variance 2.5 Normal, Binomial and Poisson Distributions 2.6 Correlations 2.7 Normal and Continues Probability 2.8 Stochastic Gradient Decent 2.9 Confidence Interval 2.10 Root Mean Square Error(RMSE)</p> <p>Unit : 3 : Basics of Python</p> <p>3.1 Working with script files in Python 3.2 Data structures and Data types in Python 3.3 Working with Programming Constructs in Python 3.4 Strings 3.5 Exception 3.6 Lists 3.7 Tuples 3.8 Dictionaries Sets 3.9 Sorting 3.10 Object Oriented Programming</p> <p>Unit : 4 : Working with Python Libraries for Data Science</p> <p>4.1 NumPy 4.1.1 Arrays and its operations 4.1.2 Indexing and Slicing 4.1.3 Array Shape manipulation and sorting 4.2 Pandas 4.2.1 Working with Data frames 4.2.2 Indexing of data frames 4.2.3 Grouping and Merging of data frames</p>

	<p>4.3 Introduction to Scipy and iPython</p> <p>4.5 Data Visualization with Matplotlib</p> <p>4.5.1. Bar Chart</p> <p>4.5.2. Line Chart</p> <p>4.5.3. Scatter Plot</p> <hr/> <p>Unit : 5 : Working with Models</p> <p>5.1 Descriptive and Predictive Modeling</p> <p>5.2 Supervised Vs Unsupervised Learning</p> <p>5.3 Types of data : training, test, validation</p> <p>5.4 Dataset Preparation</p> <p>5.5 Model Preparation</p> <p>5.6 Dimension Reduction : Principal Component Analysis (PCA)</p> <p>5.7 Classification</p> <p>5.8 Regression</p> <p>5.9 Cross-Validation</p>
Reference Book	<ol style="list-style-type: none"> 1. Python Data Science Handbook: Essential Tools for Working with Data, Jake VanderPlas, 1 January 2016, O'Reilly Media, ISBN : 978-1491912058 2. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools , Davy Cielen et.al. , 1 January 2016, dreamtech, ISBN: 978-1633430037 3. Data Science From Scratch: First Principles with Python, Second Edition, Joel Grus, 5 May 2019, O'Reilly Media, ISBN: 9781492041139 4. Python for Data Science For Dummies, 2ed,, Luca Massaron John Paul Mueller, Paperback – 2019, Wiley; January 2019, ISBN: 9781119547648 5. Data Science with Python, Rohan Chopra, Aaron England, Et al, July 19, 2019, Packt , ISBN: 9781838552862 6. Python Data Science Essentials - Third Edition, Alberto Boschetti, Luca Massaron, September 27, 2018, Packt , ISBN: 9781789537864 7. Statistics for Data Science, James D. Miller, November 17, 2017 ,Packt, ISBN: 9781788290678
Teaching Methodology	Lectures, Discussion, Independent Study, Seminars and Assignment
Evaluation Method	<p>30% Internal assessment</p> <p>70% External assessment</p>



M.Sc. (I.C.T.) 3rd Semester

Course: 302: Data Communication and Internet of Things

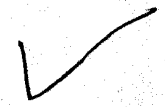
Course Code	302																								
Course Title	Data Communication and Internet of Things																								
Credit	4																								
Teaching per Week	4 Hrs																								
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)																								
Effective From	June 2020																								
Purpose of Course	The purpose of this course is to provide understanding of data communication and IoT.																								
Course Objective	The objective of this course is to provide knowledge of data communication, understanding of IoT application, IoT development process, IoT reference architecture, security issues of IoT and embedded system role in IoT.																								
Course Outcomes	<p>CO1 : Students will be able to analyze and understand the vision of IoT.</p> <p>CO2 : Students will be able to learn about embedded devices for IOT, data organizing and data processing in IOT.</p> <p>CO3 : Students will be able to learn about business models in IOT and security requirements.</p>																								
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Pre-requisite	Computer Network																								
Course Outcome	Students will get knowledge of Data communication and IoT concepts.																								

P. V. Dasa

Course : ICT 302 : Data Communication and Internet of Things

Course Code	ICT 302
Course Title	Data Communication and Internet of Things
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	The purpose of this course is to provide understanding of data communication and IoT.
Course Objective	The objective of this course is to provide knowledge of data communication, understanding of IoT application, IoT development process, IoT reference architecture, security issues of IoT and embedded system role in IoT.
Pre-requisite	Computer Network
Course Out come	Students will get knowledge of Data communication and IoT concepts
Course Content	<p>Unit : 1:Introduction of IoT</p> <p>1.1 Introduction of IoT. 1.2 Introduction of IoT architecture. 1.3 IOT conceptual framework. 1.4 Technology behind IoT. 1.5 Sources of IoT.</p> <p>Unit : 2: Prototyping the Embedded Devices for IoT and M2M Data Communication</p> <p>2.1 Introduction of sensor technology. 2.2 Embedded Computing Basics 2.3 Embedded Platforms for Prototyping 2.4 Wired and wireless communication technologies for M2M communication. 2.5 Things always connected to the internet.</p> <p>Unit : 3:Fundamental of Data Acquisition, Data Organizing and Data Processing in IoT</p> <p>3.1 Data Acquiring and Storage 3.2 Organizing Data and Data Analytics 3.3 Transactions, Business Processes, Integration and Enterprise System. 3.4 Knowledge acquiring, managing and Storing Processes.</p> <p>Unit : 4: IoT Privacy, Security and Vulnerabilities Solutions</p> <p>4.1 Introduction 4.2 Vulnerabilities, security requirements and Threat Analysis 4.3 IoT security Tomography and Layered Attacker Models 4.4 Identity Management and Establishment, access Control and Secure Message Communication 4.5 Introduction of Security Models, Profiles and Protocols for IoT.</p> <p>Unit : 5: Business Models and Process using IoT</p> <p>5.1 Business models and innovations 5.2 Value creation through IoT 5.3 Business Model scenario for IoT 5.4 IoT case studies.</p>
Reference Book	<ol style="list-style-type: none"> 1. Internet of Things architecture and Design Principles, Raj Kamal, McGrawhill Education private limited, 2017 2. Learning Internet of Things, Peter Waher, / Packt Publishing Limited, 2015 3. Internet of Things: Technologies and Applications for a New Age of Intelligence, Vlasios Tsiatsis, Stamatis Karnouskos and Jan Holler, Academic Press, 2018 4. Raspberry Pi Cookbook, Simon Monk,, O'Reilly Publishing Limited, 2014

	<p>5. The Internet of Things, Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley,2018</p> <p>6. Designing the Internet of Things, Adrian McEwen & Hakim Cassimally, Wiley,2018</p> <p>7. The Internet of Things, Hakima Chaouchi, Wiley,2017</p>
Teaching Methodology	Lectures, Discussion, Independent Study, Seminars and Assignment
Evaluation Method	<p>30% Internal assessment</p> <p>70% External assessment</p>



M.Sc. (I.C.T.) 3rd Semester

Course: 303: Cloud Computing

Course Code	303																								
Course Title	Cloud Computing																								
Credit	4																								
Teaching per Week	4 Hrs																								
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)																								
Effective From	June 2020																								
Purpose of Course	This course helps students to understand concepts of Cloud Computing and Micro Service Architecture implementations.																								
Course Objective	To impart knowledge of Cloud Computing concepts and cloud services for application development, deployment and management on cloud.																								
Course Outcomes	<p>CO1 : Students will be able to learn about cloud infrastructure and architectures.</p> <p>CO2 : Students will be able to learn concepts of cloud computing and basic services of AWS, Azure and GCP</p> <p>CO3 : Students will be able to learn about microservices architecture and devOps toolchain.</p>																								
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CO1																									
CO2																									
CO3																									
Pre-requisite	Basic concepts of Programming, Operating System and Networking																								
Course Outcome	Students will get knowledge of Cloud Computing concepts along with development, deployment and management of application(s) using Micro Service Architecture.																								

R. V. Desai

Course : ICT 303 : Cloud Computing

Course Code	ICT 303
Course Title	Cloud Computing
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	This course helps students to understand concepts of Cloud Computing and Micro Service Architecture implementations.
Course Objective	To impart knowledge of Cloud Computing concepts and cloud services for application development, deployment and management on cloud.
Pre-requisite	Basic concepts of Programming, Operating System and Networking
Course Out come	Students will get knowledge of Cloud Computing concepts along with development, deployment and management of application(s) using Micro Service Architecture.
Course Content	<p>Unit : 1: Introduction to Cloud Computing</p> <p>1.1 Characteristics of Cloud Computing</p> <p>1.2 Cloud Service Models - Infrastructure as a Service, Platform as a Service, Software as a Service and Anything as a Service</p> <p>1.3 Cloud Deployment Models - Private Cloud, Community Cloud, Public Cloud and Hybrid Cloud</p> <p>1.4 Difference Between Traditional Computing and Cloud Computing</p> <p>1.5 Virtualization</p> <p>1.5.1 Need of Virtualization</p> <p>1.5.2 Types of Virtualization</p> <p>1.5.3 Virtualization in Cloud Computing</p> <p>1.6 Containerization</p> <p>1.6.1 Concept of Containerization</p> <p>1.6.2 Need of Containerization</p> <p>1.6.3 Containerization and Virtualization</p> <p>Unit : 2: Cloud Infrastructure and Architectures</p> <p>2.1 Cloud Computing Stack</p> <p>2.1.1 Composability</p> <p>2.1.2 Infrastructure</p> <p>2.1.3 Platforms</p> <p>2.1.4 Virtual Applications</p> <p>2.1.5 Communication Protocols</p> <p>2.1.6 Applications</p> <p>2.2 Cloud Data Center Architecture</p> <p>2.3 Conceptual View of Networking in Cloud Computing</p> <p>2.4 Cloud Data Storage (Overview of SAN, DFS, etc.)</p> <p>2.5 Computing Cluster in Cloud</p> <p>2.6 Service Level Agreement and Cloud Pricing Model</p> <p>2.7 Cloud Security Concepts</p> <p>2.8 QoS Measurement in Cloud</p> <p>2.9 Inter Cloud Communication</p> <p>Unit : 3: Service Offerings by Cloud Providers</p> <p>3.1 Introduction to Amazon Cloud Services</p> <p>3.1.1 EC2 – Elastic Cloud Compute</p> <p>3.1.2 Elastic Container Service</p> <p>3.1.3 Elastic Kubernetes Service</p> <p>3.1.4 Lambda – Serverless Computing</p> <p>3.1.5 VPC – Virtual Private Cloud</p> <p>3.1.6 S3 – Simple Storage Service</p> <p>3.1.7 EBS – Elastic Block Storage</p> <p>3.1.8 RDS – Relational Database Service</p> <p>3.1.9 DynamoDB</p> <p>3.1.10 Cloud9</p>

3.2 Introduction to Microsoft Azure

- 3.2.1 Service Fabric
- 3.2.2 AKS – Azure Kubernetes Service
- 3.2.3 Container Instances
- 3.2.4 Azure SQL
- 3.2.5 Azure DevOps
- 3.2.6 Security Center
- 3.2.7 Azure IoT Hub
- 3.2.8 Traffic Manager
- 3.2.9 Cognitive Services

3.3 Introduction to Google Cloud Services

- 3.3.1 Google App Engine
- 3.3.2 Google Compute Engine
- 3.3.3 Google Kubernetes Engine
- 3.3.4 Cloud Functions
- 3.3.5 Cloud SQL
- 3.3.6 Cloud BigTable
- 3.3.7 Cloud Code
- 3.3.8 Virtual Private Cloud
- 3.3.9 Knative
- 3.3.10 Persistent Disk

Unit : 4: Micro Services Architecture (MSA)

4.1 An Overview of Current Architectural Patterns

- 4.1.1 Monolithic architecture
- 4.1.2 Enterprise Architecture
- 4.1.3 Service Oriented Architecture
- 4.1.4 Micro Services Architecture

4.2 Microservice Architecture

- 4.2.1 Decomposition
- 4.2.2 Decompose by Business Capability
- 4.2.3 Decompose by Subdomain
- 4.2.4 Self-Contained Service
- 4.2.5 Service per Team

4.3 Data Management

- 4.3.1 Database per Service
- 4.3.2 Saga Design Pattern for Database Transactions in MSA
- 4.3.3 API Composition
- 4.3.4 Command Query Responsibility Segregation (CQRS)
- 4.3.5 Domain Event
- 4.3.6 Event Sourcing

4.4 Transactional Messaging

- 4.4.1 Transactional Outbox
- 4.4.2 Transaction Log Tailing

4.5 Health Check API

4.6 Log Deployments and Changes

Unit : 5: Realizing Micro Services with DevOps

5.1 Ecology for MSA

5.2 Micro Servers

5.3 Rest API

5.4 Packaging Micro Services Applications

5.5 Containerization with Docker

5.6 Docker Client Commands

5.7 Cluster Management with Hazelcast

5.8 Data Caching for Micro Services

5.9 Container Orchestration and Load Balancing

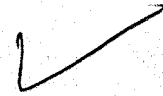
5.10 Security Propagation across Micro Services

5.11 Micro Profile based Application for MSA

5.12 Service Discovery API

5.13 Deploying MSA based Applications on cloud.

Reference Book	<ol style="list-style-type: none"> 1. Cloud Computing and Virtualization by Dac-Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, WILEY, 2018 2. Cloud Computing : A Practical Approach by Anthony Velte, Toby Velte, Robert Elsenpeter, Mc Graw Hill, 2017 3. Cloud Computing – Black Book by Kailash Jayaswal, Jagannath kallakurchi, Donald Houde, Deven Shah, Dreamtech Press, 2014 4. Architecting The Cloud by Michael Kavis, WILEY, 2014 5. Learning AWS by Aurobindo Sarkar, Amit Shah, Packt Publication, 2015 6. Google Cloud Platform Cookbook by LegorieRajan, Packt Publication, 2018 7. Building Your Next Big Thing with Google Cloud Platform by S.P.T. Krishnan, Jose L. Ugia Gonzalez, Apress, 2015 8. Microsoft Azure Fundamentals by Jim Cheshire, Pearson, 2019 9. Microservice Architecture: Aligning Principles, Practices, and Culture by Mike Amundsen, Ronnie Mitra, SPD publications, 2016 10. Building Microservices Paperbackby Sam Newman, SPD Press, 2017 11. Microservices for Java EE Architects: Addendum for The Java EE Architect's Handbook by Derek C. Ashmore, 2017 12. Kubernetes Microservices with Docker by Deepak Vohra,Apress Publication, 2018 13. Docker Quick Start Guide: Learn Docker like a boss, and finally own your applications by Earl Waud, PACKT publications, 2018 14. Apache ZooKeeper Essentials by Saurav Haloi, PACKT publications, 2015 15. Hazelcast A Complete Guide - 2019 Edition by Gerardus Blokdyk publication: 5STARCOoks, 2019 16. Microservices Patterns: With examples in Java by Chris Richardson, Publisher: Manning Publications, 2018 17. Microservices and Containers 1st Edition by Parminder Singh, Kocher Publisher - Addison-Wesley Professional, 2018 18. Hands-On Microservices with Kubernetes: Build, deploy, and manage scalable microservices on Kubernetes, by Gigi Sayfan, Packt Publications
Teaching Methodology	Lectures, Discussion, Independent Study, Seminars and Assignment
Evaluation Method	30% Internal assessment 70% External assessment



M.Sc. (I.C.T.) 3rd Semester

Course: 304: Open Source Web Development

Course Code	304																												
Course Title	Open Source Web Development																												
Credit	4																												
Teaching per Week	4 Hrs																												
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)																												
Effective From	June 2020																												
Purpose of Course	The purpose of the course is to provide knowledge of web application development using open source web technologies.																												
Course Objective	The objective of the course is to impart knowledge of web application development using PHP and Nodejs.																												
Course Outcomes	<p>CO1 : Students will be able to learn web development using PHP.</p> <p>CO2 : Students will be able to learn web development in NodeJS and express.</p> <p>CO3 : Students will be able to develop backend applications using PHP & NodeJS and implement version control using Git.</p>																												
Mapping between COs with PSOs	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td></td> <td style="background-color: #cccccc;"></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>CO2</td> <td></td> <td style="background-color: #cccccc;"></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>CO3</td> <td></td> <td style="background-color: #cccccc;"></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table>						PSO1	PSO2	PSO3	PSO4	PSO5	CO1						CO2						CO3					
	PSO1	PSO2	PSO3	PSO4	PSO5																								
CO1																													
CO2																													
CO3																													
Pre-requisite	Basic concepts of Web development and Object-Oriented programming																												
Course Outcome	Students will be able to develop web application using PHP and NodeJS.																												

P. V. Desai

Course : ICT 304 : Open Source Web Development

Course Code	ICT 304
Course Title	Open Source Web Development
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	June 2020
Purpose of Course	The purpose of the course is to provide knowledge of web application development using open source web technologies.
Course Objective	The objective of the course is to impart knowledge of web application development using PHP and Nodejs.
Pre-requisite	Basic concepts of Web development and Object-Oriented programming
Course Out come	Students will be able to develop web application using PHP and NodeJS.
Course Content	<p>Unit : 1 : Open Source Web Technology and PHP Language Basics</p> <ol style="list-style-type: none"> 1.1 Client server architecture, Web servers , Apache , Nginx 1.2 Understanding of frontend and backend technologies 1.3 PHP Language Characteristics, Features and Extensions 1.4 Dependencies, Use of Composer 1.5 Language Constructs, Variables, Declarations and Types, Constants 1.6 Use of Operators and Control Structures 1.7 Arrays, Functions and References 1.8 PHP Configuration Directives of php.ini file 1.9 Super Global Arrays 1.10 Handling Session, Cookies, Form Data, File Uploads, Server Data, Server Environment 1.11 OOP Features of PHP, Use Of Constructors, Destructors, Inheritance Serialization 1.12 Built-In Libraries: String, Array, Mathematics, Graphics Library, File System, Date and Time, Files and Directory, XML, PDF, HTTP, Network, PHP Options and Information, ZIP File 1.13 Security, Encryption, Securing Request Data, Filtering, Using CAPTCHA <p>Unit : 2 : Database Integration in PHP</p> <ol style="list-style-type: none"> 2.1 Configuring and Starting MySQL Server, Database, Tables 2.2 Working with PhpMyAdmin 2.3 MySqlConnection libraries, MySQLi, PDO, Error Handling, SQL Injection Attack and Prevention 2.4 NoSQL Databases, Types of NoSQL Databases, SQL vs NoSQL 2.5 Any one NoSQL Database Integration with PHP 2.6 Develop REST API, GraphQL 2.7 Test REST API: Use Postman tool, browser tools and CURL 2.8 Call Third Party API from PHP <p>Unit : 3 : Introduction to PHP Frameworks</p> <ol style="list-style-type: none"> 3.1 PHP Frameworks and Libraries 3.2 Introduction to Any one MVC framework in PHP 3.3 Use of AJAX with jQuery and JSON <p>Unit : 4 : Node.js</p> <ol style="list-style-type: none"> 4.1 Architecture of Node.js Ecosystem 4.2 Familiarity with JavaScript 4.3 Events, Callbacks, Asynchronous execution, I/O 4.4 Prototypal inheritance 4.5 Modules, npm, package.json 4.6 Basic utility packages 4.7 Express framework: Routing, Middleware, Templates, Form data, URL, Cookies, Session, Authentication 4.8 Working with Database Engine like Mongo and Mongoose 4.9 RESTful API

	Unit : 5 : Developer Tools 5.1 Browser Tools 5.2 Version control using Git and others
Reference Book	<ol style="list-style-type: none"> 1. Programming PHP - Rasmus Lerdorf, Kevin Tatroe - O'Reilly 2. PHP 7 Programming Cookbook - Doug Bierer- O'Reilly - PACKT 3. Mastering PHP 7 by BrankoAjzele - O'Reilly 4. NoSQL For Dummies 1st Edition by Adam Fowler Publisher: For Dummies 5. Beginning PHP: Master the latest features of PHP 7 and fully embrace modern PHP development – 31 Jul 2018 - David Carr - PACKT 6. Learning PHP 7 High Performance - 6 Jan 2016 by Altaf Hussain - PACKT 7. Mastering Laravel - Pecoraro Christopher John - PACKT 8. Node.js for PHP developers - Daniel Howard - First edition - O'Reilly 9. Mastering Node.js - Second Edition: Build robust and scalable real-time server-side web application -- Sandro Pasquali - PACKT
Teaching Methodology	Lectures, Discussion, Independent Study, Seminars and Assignment
Evaluation Method	30% Internal assessment 70% External assessment



M.Sc. (I.C.T.) 3rd Semester

Course: 305: Practical 5

Course Code	ICT 305																								
Course Title	Practical 5																								
Credit	3																								
Teaching per Week	3 Hrs																								
Minimum weeks per Semester	15 (Including Practical Work, examination, preparation, holidays etc.)																								
Effective From	June 2020																								
Purpose of Course	The purpose of this course is to provide introductory practical knowledge of Python programming, data science and application development using Micro Services Architecture.																								
Course Objective	The objective of the course is to impart practical knowledge of Python programming, data science concepts and application development using Micro Services Architecture.																								
Course Outcomes	<p>CO1 : Students will be able to develop the application using the python programming.</p> <p>CO2 : Students will be able to develop data analysis models using the data science concepts.</p> <p>CO3 : Students will be able to develop the application using Micro Service Architecture.</p>																								
Mapping between COs with PSOs	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> </tr> </thead> <tbody> <tr> <th>CO1</th> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO2</th> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO3</th> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table>		PSO1	PSO2	PSO3	PSO4	PSO5	CO1						CO2						CO3					
	PSO1	PSO2	PSO3	PSO4	PSO5																				
CO1																									
CO2																									
CO3																									
Pre-requisite	Basic concepts of Programming, Mathematics and Statistics.																								
Course Outcome	Students will be able to apply data science concepts using Python programming language and will be able to develop applications using Micro Services Architecture.																								

P. V. Desai

Course:ICT 305: Practical5

Course Code	ICT 305
Course Title	Practical 5
Credit	3
Teaching Per Week	3Hrs
Minimum Weeks Per Semester	15 (Including Practical Work, Examination, Preparation, Holidays etc.)
Review/Revision	June 2020
Purpose of Course	The purpose of this course is to provide introductory practical knowledge of Python programming, data science and application development using Micro Services Architecture.
Course Objective	The objective of the course is to impart practical knowledge of Python programming, data science concepts and application development using Micro Services Architecture.
Prerequisite	Basic concepts of Programming, Mathematics and Statistics.
Course Outcome	Students will be able to apply data science concepts using Python programming language and will be able to develop applications using Micro Services Architecture.
Course Content	Practical based on Paper No. ICT 301 – Introduction to Python and Data Science and ICT 303 – Cloud Computing (Unit 4 : Micro Services Architecture)
Reference Books	NIL
Teaching Methodology	Lab Work
Evaluation Method	30% Internal Assessment 70% External Assessment

M.Sc. (I.C.T.) 3rd Semester

Course: 306: Practical 6

Course Code	ICT 306																								
Course Title	Practical 6																								
Credit	3																								
Teaching per Week	3 Hrs																								
Minimum weeks per Semester	15 (Including Practical Work, examination, preparation, holidays etc.)																								
Effective From	June 2020																								
Purpose of Course	The purpose of the course is to provide practical knowledge of web application development using open source web technologies.																								
Course Objective	The objective of the course is to impart practical knowledge of web application development using PHP and NodeJS.																								
Course Outcomes	<p>CO1 : Students will be able to develop web applications in PHP.</p> <p>CO2 : Students will be able to develop web applications in NodeJS and express.</p> <p>CO3 : Students will be able to develop backend applications using PHP & NodeJS and version control using git practically.</p>																								
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	PSO1	PSO2	PSO3	PSO4	PSO5																				
CO1																									
CO2																									
CO3																									
Pre-requisite	Basic concepts of Object-Oriented programming																								
Course Outcome	Students will be able to develop web application using PHP and NodeJS.																								

R. M. Desai

Course: ICT 306: Practical6

Course Code	ICT 306
Course Title	Practical6
Credit	3
Teaching Per Week	3 Hrs
Minimum Weeks Per Semester	15 (Including Practical Work, Examination, Preparation, Holidays etc.)
Review/Revision	June 2020
Purpose of Course	The purpose of the course is to provide practical knowledge of web application development using open source web technologies.
Course Objective	The objective of the course is to impart practical knowledge of web application development using PHP and NodeJS.
Prerequisite	Basic concepts of Object-Oriented programming
Course Outcome	Students will be able to develop web application using PHP and NodeJS.
Course Content	Practical based on Paper No. ICT 304-Open Source Web Development
Reference Books	NIL
Teaching Methodology	Lab Work
Evaluation Method	30% Internal Assessment 70% External Assessment

M.Sc. (I.C.T.) 3rd Semester

Course: 307: Part Time Project 3

Course Code	ICT 307																								
Course Title	Part Time Project 3																								
Credit	3																								
Teaching per Week	3 Hrs																								
Minimum weeks per Semester	15 (Including Practical Work, examination, preparation, holidays etc.)																								
Effective From	June 2020																								
Purpose of Course	The purpose of this course is to develop skills to solve real world problems using Mobile / MEAN stack / IoT / PHP / Data Science / Cloud technologies.																								
Course Objective	The objective of this course is to acquaint students for the development of software application based on Mobile / MEAN stack / IoT / PHP / Data Science / Cloud.																								
Course Outcomes	<p>CO1 : Students will be able to develop project in Mobile / Full stack / IOT / PHP / Data science / Cloud technology.</p> <p>CO2 : Students will be able to apply Software Engineering concepts to solve real world problems.</p> <p>CO3 : Students will be able to apply database related concepts to design database for the project.</p>																								
Mapping between COs with PSOs	<table border="1"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> </tr> </thead> <tbody> <tr> <th>CO1</th> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO2</th> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <th>CO3</th> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table>		PSO1	PSO2	PSO3	PSO4	PSO5	CO1						CO2						CO3					
	PSO1	PSO2	PSO3	PSO4	PSO5																				
CO1																									
CO2																									
CO3																									
Pre-requisite	Fundamental of software application development																								
Course Outcome	After completion of this course, students will be able to develop and demonstrate software applications based on Mobile / MEAN stack / IoT / PHP / Data Science / Cloud technologies.																								

P. V. Desai

Course : ICT 307 : Part Time Project 3

Course Code	ICT 307
Course Title	Part Time Project3
Credit	3
Teaching Per Week	3 Hrs
Duration	-
Minimum Weeks Per Semester	15 (Including Practical Work, Examination, Preparation, Holidays etc.)
Review/Revision	June 2020
Purpose of Course	The purpose of this course is to develop skills to solve real world problems using Mobile / MEAN stack / IoT / PHP / Data Science / Cloud technologies.
Course Objective	The objective of this course is to acquaint students for the development of software application based on Mobile / MEAN stack / IoT / PHP / Data Science / Cloud.
Prerequisite	Fundamental of software application development
Course Outcome	After completion of this course, students will be able to develop and demonstrate software applications based on Mobile / MEAN stack / IoT / PHP / Data Science / Cloudtechnologies.
Course Content	<p>The students are required to develop project using Mobile / MEAN stack / IoT / PHP/ Data Science / Cloud technologies.</p> <p>The students must prepare documentation of the project completed as per the Software Engineering Guidelines.</p> <p>At the end of the semester, the students have to submit their project report in bounded form to the institution.</p> <p>The Project Presentation and Viva – Voce will be conducted as per the University exam schedule.</p> <p>The students have to submit the following reports atthe institution:</p> <ol style="list-style-type: none"> 1. Project Joining Report 2. Project Title Report 3. Progress Report 4. Project Completion Certificate 5. Institution Certificate 6. Non-disclosure of Source Code Certificate (In case the student is unable to demonstrate project source code) <p>Note : If student's performance is not satisfactory then as per the direction of the internal project guide / external examiner student may have to do coding in the lab according to the project work submitted during internal submission / external examination.</p>
Reference Books	NIL
Teaching Methodology	Project guidance, Review
Evaluation Method	30% Internal Assessment 70% External Assessment