



**Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR
ARTS, COMMERCE & SCIENCE COLLEGE,
NEW PANVEL (AUTONOMOUS)**

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

Program: M.Sc

**Revised Syllabus of M.Sc. Information Technology
Choice Based Credit & Grading System (60:40)
w.e.f. Academic Year 2020-2021**

M.Sc. Part I, Information Technology Syllabus

Sr. No.	Heading	Particulars
1	Title of Course	Information Technology
2	Eligibility for Admission	<p>(a) A candidate for being eligible for admission to the degree course of Bachelor of Science-Information Technology, shall have passed XII standard examination of the Maharashtra Board of Higher Secondary Education or it's equivalent with Mathematic and Statistics as one of the subject and should have secured not less than 45% marks in aggregate for open category and 40% marks in aggregate in case of Reserved category candidates.</p> <p>(b) Candidate who have passed Diploma (Three years after S.S.C. – Xth Std.) in Information Technology/ Computer Technology/ Computer Engineering/Computer Science/ Electrical, Electronics and Video Engineering and Allied Branches/Mechanical and Allied Branches/ Civil and Allied branches are eligible for direct admission to the Second Year of the B.Sc. (I.T.) degree course.</p> <p>(c) However, the Diploma should be recognized by the Board of Technical Education or any other recognized Government Body. Minimum marks required 45% aggregate for open category candidates and 40% aggregate for reserved category candidates.</p> <p>OR</p> <p>Candidates with post HSC-Diploma in Information Technology/Computer Technology/ Computer Engineering/ Computer Science/ and Allied branches will be eligible for direct admission to the Second Year of B.Sc. (I.T.). However, the Diploma should be recognized by the Board of Technical Education or any other recognized Government Body Minimum Marks required 45% aggregate for open category candidates and 40% aggregate for reserved category candidates.</p>
3	Passing marks	40%

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4	Ordinances/Regulations (if any)	
5	No. of Semesters	Two
6	Level	P.G.
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic year	2020-2021

Preamble of the Syllabus:

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

The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programmes.
- To be capable of managing complex IT projects with consideration of the human, financial and environmental factors.
- To work effectively as a part of a team to achieve a common stated goal.
- To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- To communicate effectively with a range of audiences both technical and non-technical.
- To develop an aptitude to engage in continuing professional development.

Objectives of the Course:

The new syllabus is aimed to achieve the objectives. The syllabus spanning three years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- Software Development (Programming)
- Website Development
- Mobile app development
- Embedded Systems Programming
- Embedded Systems Development
- Software Testing
- Networking
- Database Administration
- System Administration
- Cyber Law Consultant
- GIS (Geographic Information Systems)
- IT Service Desk
- Security

Course Outcome: By the end of the course, a student should develop the Ability:

- Learners are able to use and apply current technical concepts and practices in the core information technologies.
- Learners are able to apply knowledge of computing and mathematics appropriate to the discipline.
- Learners are able to analyze a problem, and identify and define the computing requirements appropriate to its solution.
- Learners are able to effectively integrate IT based solutions into the user environment.
- Learners are able to design, implement, and evaluate a computer based system, process, component, or program to meet desired needs.

Scheme of Examination

A) Internal Assessment: 40 %

40 Marks

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

Question Paper Pattern for Class Test

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination: 60 %

60 Marks

- Duration: The examination shall be of 2 hours duration.

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

➤ Passing Standard

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

**Choice Based Credit Grading and Semester System (CBCGS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2020-2021**

SEMESTER I

Course Code	Course Nomenclature	Lectures	Credits	Practical Course	Hours	Credits	Total Credits
PIT1RIC	Research in Computing	60	4	PIT1RCP	60	2	6
PIT1DSC	Data Science	60	4	PIT1DSP	60	2	6
PIT1CLC	Cloud Computing	60	4	PIT1CCP	60	2	6
PIT1SCT	Soft Computing Techniques	60	4	PIT1SCP	60	2	6
Total							24

**Choice Based Credit Grading and Semester System (CBCGS)
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SEMESTER II

Course Code	Course Nomenclature	Lectures	Credits	Practical Course	Hours	Credits	Total Credits
PIT2BDA	Big Data Analytics	60	4	PIT2BDP	60	2	6
PIT2MNW	Modern Networking	60	4	PIT2MNP	60	2	6
PIT2MSA	Microservices Architecture	60	4	PIT2MAP	60	2	6
PIT2IGP	Image Processing	60	4	PIT2IPP	60	2	6
Total							24

Semester I

Course Code PIT1RIC	Research in Computing	
Objectives To be able to conduct business research with an understanding of all the latest theories. • To develop the ability to explore research techniques used for solving any real world or innovate problem.		
Expected Learning Outcomes:		
<ol style="list-style-type: none"> 1) A learner will be able to: solve real world problems with scientific approach. 2) develop analytical skills by applying scientific methods. 3) Recognize, understand and apply the language, theory and models of the field of business analytics 4) Foster an ability to critically analyze, synthesize and solve complex unstructured business problems 5) Understand and critically apply the concepts and methods of business analytics 6) Identify, model and solve decision problems in different settings 7) Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity 8) Create viable solutions to decision making problems 		
I	Introduction: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues	12
II	Beginning Stages of Research Process: Problem definition, Qualitative research tools, Secondary data research	12
III	Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Experimental research	12
IV	Measurement Concepts, Sampling and Field work: Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size	12
V	Data Analysis and Presentation: Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	12

Course Code	Practical List
PIT1RCP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

1. Business Research Methods William G.Zikmund, B.J Babin, J.C. Carr, Cengage 8e 2016 6 Atanu Adhikari, M.Griffin
2. Business Analytics Albright Winston Cengage 5e 2015
3. Research Methods for Business Students Fifth Edition Mark Saunders 2011
4. Multivariate Data Analysis Hair Pearson 7e 2014

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Course Code PIT1DSC	Data Science	
Objectives: Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics. Practice problem analysis and decision-making. Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.		
Expected Learning Outcomes		
Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.		
<ul style="list-style-type: none"> • Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy. • Apply ethical practices in everyday business activities and make well reasoned ethical business and data management decisions. • Demonstrate knowledge of statistical data analysis techniques utilized in business decision making. • Apply principles of Data Science to the analysis of business problems. • Use data mining software to solve real-world problems. • Employ cutting edge tools and technologies to analyze Big Data. • Apply algorithms to build machine intelligence. • Demonstrate use of team work, leadership skills, decision making and organization theory 		
I	Data Science Technology Stack: 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, MQTT, The Future Layered Framework: Definition of Data Science Framework, Cross Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering Business Layer: Business Layer, Engineering a Practical Business Layer Utility Layer: Basic Utility Design, Engineering a Practical Utility Layer	12
II	Three Management Layers: 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 Retrieve Superstep : Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources.	12
III	Assess Superstep: Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep, 1	12
IV	Process Superstep : Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, Transform Superstep : Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test	12

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V	<p>Transform Superstep: Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data, Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow.</p> <p>Organize and Report Supersteps : Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference</p>	12
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Course Code	Practical List
PIT1DSP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

1. Practical Data Science Andreas François Vermeulen APress 2018
2. Principles of Data Science Sinan Ozdemir PACKT 2016
3. Data Science from Scratch Joel Grus O'Reilly 2015
4. Data Science from Scratch first Principle in python Joel Grus Shroff Publishers 2017
5. Experimental Design in Data science with Least Resources N C Das Shroff Publishers 2018

Course Code	Cloud Computing
PIT1CLC	<p>Objectives:</p> <ul style="list-style-type: none"> • To learn how to use Cloud Services. • To implement Virtualization. • To implement Task Scheduling algorithms. • Apply Map-Reduce concept to applications. • To build Private Cloud. • Broadly educate to know the impact of engineering on legal and societal issues involved. <p>Expected Learning Outcomes:</p> <ul style="list-style-type: none"> • Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures. • Design different workflows according to requirements and apply map reduce programming model. • Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms. • Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds <ul style="list-style-type: none"> • Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application • Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing
	<p>Introduction to Cloud Computing: Introduction, Historical developments,</p>

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I	<p>Building Cloud Computing Environments, Principles of Parallel and Distributed Computing: Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.</p>	12
II	<p>Cloud Computing Architecture: Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. Fundamental Cloud Security: Basics, Threat agents, Cloud security threats, additional considerations. Industrial Platforms and New Developments: Amazon Web Services, Google App Engine, Microsoft Azure.</p>	12
III	<p>Specialized Cloud Mechanisms: Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. Cloud Management Mechanisms: Remote administration system, Resource Management System, SLA Management System, Billing Management System, Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images</p>	12
IV	<p>Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. Advanced Cloud Architectures: Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture</p>	12
V	<p>Cloud Delivery Model Considerations: Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective, Cost Metrics and Pricing Models: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations, Service Quality Metrics and SLAs: Service Quality Metrics, SLA Guidelines</p>	12

Course Code	Practical List
PIT1CCP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

- 1) Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi Elsevier - 2013
- 2) Cloud Computing Concepts, Technology & Architecture Thomas Erl, Zaigham Mahmood, and Ricardo Puttini Prentice Hall - 2013
- 3) Distributed and Cloud Computing, From Parallel Processing to the Internet of Things Kai Hwang, Jack Dongarra, Geoffrey Fox MK Publishers -- 2012 VMware and Microsoft Platform in the Virtual Data center, 2006, Auerbach.

Course Code PIT1SCT	Soft Computing Techniques	
Objectives Soft computing concepts like fuzzy logic, neural networks and genetic algorithm, where Artificial Intelligence is mother branch of all. All these techniques will be more effective to solve the problem efficiently		
Expected Learning Outcomes:		
<ol style="list-style-type: none"> 1) Identify and describe soft computing techniques and their roles in building intelligent machines 2) Recognize the feasibility of applying a soft computing methodology for a particular problem 3) Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems 4) Apply genetic algorithms to combinatorial optimization problems 5) Apply neural networks for classification and regression problems 6) Effectively use existing software tools to solve real problems using a soft computing approach 7) Evaluate and compare solutions by various soft computing approaches for a given problem. 		
I	Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.	12
II	Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloch-Pitts Neuron, Linear Separability, Hebb Network. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, heteroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.	12
III	UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propagation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model.	12
IV	Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Membership Function: features of the membership functions, fuzzification, methods of membership	12

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	value assignments. Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.	
V	Fuzzy Rule base and Approximate reasoning: Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System. Genetic Algorithm: Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simple genetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of genetic algorithm. Differential Evolution Algorithm, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	12

Course Code	Practical List
PIT1SCP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

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

Semester II

Course Code PIT2BDA	Big Data Analytics	
<p>Objectives: To provide an overview of an exciting growing field of big data analytics.</p> <ul style="list-style-type: none"> • To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. • To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. • To enable students to have skills that will help them to solve complex realworld problems in for decision support. <p>Expected Learning Outcomes:</p> <ol style="list-style-type: none"> 1) Students will able to Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. 2) Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them. 3) Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing. 4) Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning. 5) Formulate and solve problems with uncertain information using Bayesian approaches. 		
I	<p>Introduction: AI, Components of AI, History of AI, Salient Points, Knowledge and Knowledge Based Systems, AI in Future, Applications.</p> <p>Logic and Computation: Classical Concepts, Computational Logic, FOL, Symbol Tableau, Resolution, Unification, Predicate Calculus in Problem Solving, Model Logic, Temporal Logic.</p> <p>Heuristic Search: Search-Based Problems, Informed Search, Water Jug Problem, TSP, Branch and Bound Method, TSP Algorithm.</p>	12
II	<p>Game Playing: AND/OR Graph, Minimax Problem, Alpha-Beta Search, Puzzle Solving, AI versus Control Robot.</p> <p>Knowledge Representation: Structure of an RBS, Merit, Demerit and Applicability of RBS, Semantic Nets, Frames, Conceptual Graphs, Conceptual Dependency, Scripts.</p> <p>Automated Reasoning: Default Logic, Problem for Default Reasoning, Closed World Assumption, Predicate Completion, Circumscription, Default Reasoning, Model Based Reasoning, Case Based Reasoning, Reasoning Models, Multimodels, Multimodal Reasoning.</p>	12
III	<p>Probabilistic Reasoning: Bayes Theorem, Bayesian Network, Dempster and Shafer Theory of Evidence, Confidence Factor, Probabilistic Logic.</p> <p>Knowledge Acquisition: Knowledge Acquisition process, Automatic Knowledge Acquisition, Machine Learning, Induction, Analogical Reasoning, Explanation-Based Learning, Inductive Learning, Knowledge Acquisition Tools.</p>	12
IV	<p>Planning: Necessity of planning, Planning Agents, Planning generating schemes, Non-hierarchical planning, Hierarchical planning, Script-based planning, Opportunistic planning, Algorithm for planning, planning representation with STRIPS an example.</p> <p>Constraint Satisfaction Problem: Constraints and Satisfiability, Basic search strategies for solving CSP, Representation of CSP problem, Examples of constraint satisfaction problem.</p>	12

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V	<p>Knowledge-Based Systems: Structure of an Expert System, Expert Systems in different Areas, Expert System Shells, Comparison of Expert Systems, Comparative View, Ingredients of Knowledge-Based Systems, Web-based Expert Systems.</p> <p>Prolog: Prolog programming features, Syntax, Syntax of Rules, LIST, Structure, Some Solutions using TURBO PROLOG.</p>	12
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Course Code	Practical List
PIT2BDP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

Artificial Intelligence, R.B.Mishra, EEE, PHI
 Artificial Intelligence & Soft Computing for Beginners, Anandita Das Bhattacharjee, SPD
 Artificial Intelligence, E.Rich and K.Knight, 2002, TMH
 Artificial Intelligence: A Modern Approach, S.Russel, P.Norvig, 2002, Pearson Education

Course Code PIT2MNW	Modern Networking
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Objectives

- To understand the state-of-the-art in network protocols, architectures and applications.
- Analyse existing network protocols and networks.
- Develop new protocols in networking
- To understand how networking research is done
- To investigate novel ideas in the area of Networking via term-long research projects. **Expected Learning**

Outcomes:

- 1) Demonstrate in-depth knowledge in the area of Computer Networking.
- 2) To demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem related to Computer Networks
- 3) Prepare a technical document for the identified Networking System Conducting experiments to analyze the identified research work in building Computer Networks

I	<p>Modern Networking Elements of Modern Networking The Networking Ecosystem ,Example Network Architectures,Global Network Architecture,A Typical Network Hierarchy Ethernet Applications of Ethernet Standards Ethernet Data Rates Wi-Fi Applications of Wi-Fi,Standards Wi-Fi Data Rates 4G/5G Cellular First Generation Second Generation, Third Generation Fourth Generation Fifth Generation, Cloud Computing Cloud Computing Concepts The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things Things on the Internet of Things, Evolution Layers of the Internet of Things, Network Convergence Unified Communications, Requirements and Technology Types of Network and Internet Traffic,Elastic Traffic,Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud Computing, and Mobile TrafficBig Data Cloud Computing,,Mobile Traffic, Requirements: QoS and QoE,,Quality of Service,Quality of Experience, Routing Characteristics, Packet Forwarding, Congestion Control ,Effects of Congestion,Congestion Control Techniques, SDN and NFV SoftwareDefined Networking,Network Functions Virtualization Modern Networking Elements</p>	12
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<p style="text-align: center;">II</p>	<p>Software-Defined Networks SDN: Background and Motivation, Evolving Network Requirements Demand Is Increasing, Supply Is Increasing Traffic Patterns Are More Complex Traditional Network Architectures are Inadequate, The SDN Approach Requirements SDN Architecture Characteristics of Software 12 20 Defined Networking, SDN- and NFV-Related Standards Standards Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and OpenFlow SDN Data Plane, Data Plane Functions Data Plane Protocols OpenFlow Logical Network Device Flow Table Structure Flow Table Pipeline, The Use of Multiple Tables Group Table OpenFlow Protocol, SDN Control Plane SDN Control Plane Architecture Control Plane Functions, Southbound Interface Northbound Interface Routing, ITU-T Model, OpenDaylight OpenDaylight Architecture OpenDaylight Helium, REST REST Constraints Example REST API, Cooperation and Coordination Among Controllers, Centralized Versus Distributed Controllers, High Availability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management IETF SDNi OpenDaylight SNDi SDN Application Plane SDN Application Plane Architecture Northbound Interface Network Services Abstraction Layer Network Applications, User Interface, Network Services Abstraction Layer Abstractions in SDN, Frenetic Traffic Engineering PolicyCop Measurement and Monitoring Security OpenDaylight DDoS Application Data Center Networking, Big Data over SDN Cloud Networking over SDN Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer</p>	<p style="text-align: center;">12</p>
<p style="text-align: center;">III</p>	<p>Virtualization, Network Functions Virtualization: Concepts and Architecture, Background and Motivation for NFV, Virtual Machines The Virtual Machine Monitor, Architectural Approaches Container Virtualization, NFV Concepts Simple Example of the Use of NFV, NFV Principles High-Level NFV Framework, NFV Benefits and Requirements NFV Benefits, NFV Requirements, NFV Reference Architecture NFV Management and Orchestration, Reference Points Implementation, NFV Functionality, NFV Infrastructure, Container Interface, Deployment of NFVI Containers, Logical Structure of NFVI Domains, Compute Domain, Hypervisor Domain, Infrastructure Network Domain, Virtualized Network Functions, VNF Interfaces, VNFC to VNFC Communication, VNF Scaling, NFV Management and Orchestration, Virtualized Infrastructure Manager, Virtual Network Function Manager, NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV Network Virtualization, Virtual LANs ,The Use of Virtual LANs, Defining VLANs, Communicating VLAN Membership, IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support, Virtual Private Networks, IPsec VPNs, MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, OpenDaylight's Virtual Tenant Network, Software-Defined Infrastructure, Software Defined Storage, SDI Architecture</p>	<p style="text-align: center;">12</p>
<p style="text-align: center;">IV</p>	<p>Defining and Supporting User Needs, Quality of Service, Background, QoS Architectural Framework, Data Plane, Control Plane, Management Plane, Integrated Services Architecture, ISA Approach ISA Components, ISA Services, Queuing Discipline, Differentiated Services, Services, DiffServ Field, DiffServ Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, Service Level Agreements, IP Performance Metrics, OpenFlow QoS Support, Queue Structures, Meters, QoE: User Quality of Experience, Why QoE?, Online Video Content Delivery, Service Failures Due to Inadequate QoE Considerations QoE-Related Standardization Projects, Definition of Quality of Experience, Definition of Quality, Definition of Experience Quality Formation Process, Definition of Quality of Experience, QoE Strategies in Practice, The QoE/QoS Layered Model Summarizing and Merging the ,QoE/QoS Layers, Factors Influencing</p>	<p style="text-align: center;">12</p>

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	QoE, Measurements of QoE, Subjective Assessment, Objective Assessment, End-User Device Analytics, Summarizing the QoE Measurement Methods, Applications of QoE Network Design Implications of QoS and QoE Classification of QoE/ QoS Mapping Models, Black-Box Media-Based QoS/QoE Mapping Models, GlassBox Parameter-Based QoS/QoE Mapping Models, Gray-Box QoS/QoE Mapping Models, Tips for QoS/QoE Mapping Model Selection, IP Oriented Parameter-Based QoS/QoE Mapping Models, Network Layer QoE/QoS Mapping Models for Video Services, Application Layer QoE/QoS Mapping Models for Video Services Actionable QoE over IP-Based Networks, The System-Oriented Actionable QoE Solution, The Service-Oriented Actionable QoE Solution, QoE Versus QoS Service Monitoring, QoS Monitoring Solutions, QoE Monitoring Solutions, QoE-Based Network and Service Management, QoE-Based Management of VoIP Calls, QoE-Based Host-Centric Vertical Handover, QoE-Based Network-Centric Vertical Handover	
V	Modern Network Architecture: Clouds and Fog, Cloud Computing, Basic Concepts, Cloud Services, Software as a Service, Platform as a Service, Infrastructure as a Service, Other Cloud Services, XaaS, Cloud Deployment Models, Public Cloud Private Cloud Community Cloud, Hybrid Cloud, Cloud Architecture, NIST Cloud Computing Reference Architecture, ITU-T Cloud Computing Reference Architecture, SDN and NFV, Service Provider Perspective Private Cloud Perspective, ITU-T Cloud Computing Functional Reference Architecture, The Internet of Things: Components The IoT Era Begins, The Scope of the Internet of Things Components of IoT-Enabled Things, Sensors, Actuators, Microcontrollers, Transceivers, RFID, The Internet of Things: Architecture and Implementation, IoT Architecture, ITU-T IoT Reference Model, IoT World Forum Reference Model, IoT Implementation, IoTivity, Cisco IoT System, ioBridge, Security Security Requirements, SDN Security Threats to SDN, Software Defined Security, NFV Security, Attack Surfaces, ETSI Security Perspective, Security Techniques, Cloud Security, Security Issues and Concerns, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computer Security Concerns, IoT Security, The Patching Vulnerability, IoT Security and Privacy Requirements Defined by ITU-T An IoT Security Framework, Conclusion	12

Course Code	Practical List
PIT2MNP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

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

M.Sc. Part I, Information Technology Syllabus

Course Code PIT2MSA	Microservice Architecture	
<p>Objectives Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC; Gain a practical understanding of .NET Core; Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio Persist data with XML Serialization and ADO.NET with SQL Server Create HTTP services using ASP.NET Core Web API; Deploy ASP.NET Core MVC applications to the Windows Azure cloud.</p> <p>Expected Learning Outcomes:</p> <ol style="list-style-type: none"> 1) Develop web applications using Model View Control. Create MVC Models and write code that implements business logic within Model methods, properties, and events. 2) Create Views in an MVC application that display and edit data and interact with Models and Controllers. 3) Boost your hire ability through innovative and independent learning. 4) Gaining a thorough understanding of the philosophy and architecture of .NET 5) Core Understanding packages, met packages and frameworks 6) Acquiring a working knowledge of the .NET programming model 7) Implementing multi-threading effectively in .NET applications 		
I	<p>Microservices: Understanding Microservices, Adopting Microservices, The Microservices Way. Microservices Value Proposition: Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. Designing Microservice Systems: The Systems Approach to Microservices, A Microservices Design Process, Establishing a Foundation: Goals and Principles, Platforms, Culture.</p>	12
II	<p>Service Design: Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies, System Design and Operations: Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting. Adopting Microservices in Practice: Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.</p>	12
III	<p>Building Microservices with ASP.NET Core: Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App. Delivering Continuously: Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub. Building Microservice with ASP.NET Core: Microservice, Team Service, API First Development, Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. Backing Services: Microservices Ecosystems, Building the location Service, Enhancing Team Service.</p>	12
IV	<p>Creating Data Service: Choosing a Data Store, Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service. Event Sourcing and CQRS: Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples. Building an ASP.NET Core Web Application: ASP.NET Core Basics, Building Cloud-Native Web Applications. Service Discovery: Cloud Native Factors, Netflix Eureka, Discovering and Advertising ASP.NET Core Services. DNS and Platform Supported Discovery.</p>	12
V	<p>Configuring Microservice Ecosystems: Using Environment Variables with Docker, Using Spring Cloud Config Server, Configuring Microservices with etcd, Securing Applications and Microservices: Security in the Cloud, Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices. Building Real-Time Apps and Services: Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider, Building the Proximity Monitor. Putting It All Together: Identifying and Fixing Anti-Patterns, Continuing the Debate over Composite Microservices, The Future.</p>	12

M.Sc. Part I, Information Technology Syllabus

Course Code	Practical List
PIT2MAP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

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

Course Code PIT2IGP	Image Processing
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Objectives: Review the fundamental concepts of a digital image processing system. Analyze images in the frequency domain using various transforms. Evaluate the techniques for image enhancement and image restoration. Categorize various compression techniques. Interpret Image compression standards. Interpret image segmentation and representation techniques.

Expected Learning Outcomes:

- 1) Understand the relevant aspects of digital image representation and their practical implications.
- 2) Have the ability to design pointwise intensity transformations to meet stated specifications.
- 3) Understand 2-D convolution, the 2-D DFT, and have the ability to design systems using these concepts.
- 4) Have a command of basic image restoration techniques.
- 5) Understand the role of alternative color spaces, and the design requirements leading to choices of color space.
- 6) Appreciate the utility of wavelet decompositions and their role in image processing systems.
- 7) Have an understanding of the underlying mechanisms of image compression, and the ability to design systems using standard algorithms to meet design specifications.

I	Introduction: Digital Image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, Intensity Transformations and Spatial Filtering: Basics, Basic Intensity Transformation Functions, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering	12
II	Filtering in the Frequency Domain: Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of the 2-D DFT and IDFT, Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using Highpass Filters, Selective Filtering, Fast Fourier Transform Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only----Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering,	12

M.Sc. Part I, Information Technology Syllabus

	Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections	
III	Wavelet and Other Image Transforms: Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images, Color Image Compression. Image Compression and Watermarking: Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking,	12
IV	Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction, Morphological Operations on Binary Images, Grayscale Morphology Image Segmentation I: Edge Detection, Thresholding, and Region Detection: Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation	12
V	Image Segmentation II: Active Contours: Snakes and Level Sets: Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. Feature Extraction: Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	12

Course Code	Practical List
PIT2IPP	10 Practical based on above syllabus, covering entire syllabus

Reference Books:

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



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR
ARTS, COMMERCE & SCIENCE COLLEGE,
NEW PANVEL (AUTONOMOUS)

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'Best College Award' by University of Mumbai

Program: M.Sc

Revised Syllabus of M.Sc. Information Technology
Choice Based Credit & Grading System (60:40)
w.e.f. Academic Year 2021-2022

M.Sc. Part II, Information Technology Syllabus

Sr. No.	Heading	Particulars
1	Title of Course	M.Sc. (Information Technology) Part II
2	Eligibility for Admission	Students who have completed MCA, M.Sc. Computer Science / Mathematics / Statistics / Physics / Electronics / Data Science, M.B.A. (I.T), M.C.M., M.Tech (20% extra seats to provided for these students) M.Sc IT from University of Mumbai (with previous syllabus under General IT) or other recognized Institutions who are willing to do specialized degree
3	Passing marks	40%
4	Ordinances/Regulations (if any)	-
5	No. of Semesters	Two years – Four Semesters
6	Level	P.G.
7	Pattern	Semester, Choice Based
8	Status	Revised
9	To be implemented from Academic year	From the Academic Year 2021 – 2022

Preamble of the Syllabus:

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

The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programmes.
- To be capable of managing complex IT projects with consideration of the human, financial and environmental factors.
- To work effectively as a part of a team to achieve a common stated goal.
- To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- To communicate effectively with a range of audiences both technical and non-technical.
- To develop an aptitude to engage in continuing professional development.

Objectives of the Course:

The new syllabus is aimed to achieve the objectives. The syllabus spanning two years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- Technical Writing and Entrepreneurship Development
- Cyber Law Consultant
- GIS (Geographic Information Systems)
- IT Service Desk
- Security Breaches and Countermeasures
- Malware Analysis
- Robotic Process Automation
- Database Administration
- System Administration
- Cyber Law Consultant
- IT Service Desk
- Security
- Blockchain
- Digital Image Forensics
- Security Operations Center
- Human Computer Interaction

Course Outcome: By the end of the course, a student should develop the Ability:

- Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.
- Ability to apply IT in the field of Security Breaches and Countermeasures, Malware Analysis, Robotic Process Automation, Blockchain, Digital Image Forensics, Security Operations Center, Human Computer Interaction
- Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Internet of Things and Embedded System, Infrastructure Services as specializations.
Ability to apply the knowledge of Intellectual Property Rights, Cyber Laws and Cyber Forensics and various standards in interest of National Security and Integrity along with IT Industry.
- Ability to write effective project reports, research publications and content development and to work in multidisciplinary environment in the context of changing technologies

Scheme of Examination

A) Internal Assessment: 40 %

40 Marks

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

Question Paper Pattern for Class Test

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination: 60 %

60 Marks

- Duration: The examination shall be of 2 hours duration.

Theory question paper pattern
<ol style="list-style-type: none">1. There shall be five questions each of 12 marks.2. All questions shall be compulsory with internal options.3. Question may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit.

➤ **Passing Standard**

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

Choice Based Credit Grading and Semester System (CBCGS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2021-2022
SEMESTER III

Course Code	Course Title	Credits
PIT3TED	Technical Writing and Entrepreneurship Development	4
PIT3SBC	Security Breaches and Countermeasures	4
PIT3MWA	Malware Analysis	4
PIT3RPA	Robotic Process Automation	4
PIT3PDP	Project Documentation and Viva	2
PIT3SBP	Security Breaches and Countermeasures Practical	2
PIT3MAP	Malware Analysis Practical	2
PIT3RAP	Robotic Process Automation Practical	2
Total Credits		24

**Choice Based Credit Grading and Semester System (CBCGS)
M. Sc. Information Technology Syllabus
To be implemented from the Academic year 2021-2022**

SEMESTER IV

Course Code	Course Title	Credits
PIT4BLC	Blockchain	4
PIT4DIF	Digital Image Forensics	4
PIT4SOC	Security Operations Center	4
PIT4HCI	Human Computer Interaction	4
PIT4BCP	Blockchain Practical	2
PIT4DFP	Digital Image Forensics Practical	2
PIT4SOP	Security Operations Center Practical	2
PIT4PIP	Project Implementation and Viva	2
Total Credits		24

Semester III

Course Code PIT3TED	Technical Writing and Entrepreneurship Development	
Objectives		
<ul style="list-style-type: none"> • This course aims to provide conceptual understanding of developing strong foundation in general writing, including research proposal and reports. • It covers the technological developing skills for writing Article, Blog, E-Book, Commercial web Page design, Business Listing Press Release, E-Listing and Product Description. • This course aims to provide conceptual understanding of innovation and entrepreneurship development. 		
Expected Learning Outcomes:		
<ol style="list-style-type: none"> 1. Learners will be able to develop technical documents that meet the requirements with standard guidelines. 		
Understanding the essentials and hands-on learning about effective Website Development.		
<ol style="list-style-type: none"> 2. Learners will be able to write Better Quality Content Which Ranks faster at Search Engines. Build effective Social Media Pages. 3. Learners will be able to evaluate the essentials parameters of effective Social Media Pages. 4. Learners will be able to understand importance of innovation and entrepreneurship. 5. Learners will be able to analyze research and development projects. 		
I	<p>Introduction to Technical Communication: What Is Technical Communication? The Challenges of Producing Technical Communication, Characteristics of a Technical Document, Measures of Excellence in Technical Documents, Skills and Qualities Shared by Successful Workplace Communicators, How Communication Skills and Qualities Affect Your Career?</p> <p>Understanding Ethical and Legal Considerations: A Brief Introduction to Ethics, Your Ethical Obligations, Your Legal Obligations, The Role of Corporate Culture in Ethical and Legal Conduct, Understanding Ethical and Legal Issues Related to Social Media, Communicating Ethically Across Cultures, Principles for Ethical Communication</p> <p>Writing Technical Documents: Planning, Drafting, Revising, Editing, Proofreading</p> <p>Writing Collaboratively: Advantages and Disadvantages of Collaboration, Managing Projects, Conducting Meetings, Using Social Media and Other Electronic Tools in Collaboration, Importance of Word Press Website, Gender and Collaboration, Culture and Collaboration.</p>	12
II	<p>Introduction to Content Writing: Types of Content (Article, Blog, E-Books, Press Release, Newsletters Etc), Exploring Content Publication Channels. Distribution of your content across various channels.</p> <p>Blog Creation: Understand the psychology behind your web traffic, Creating killing landing pages which attract users, Using Landing Page Creators, Setting up Accelerated Mobile Pages, Identifying UI UX Experience of your website or blog.</p> <p>Organizing Your Information: Understanding Three Principles for Organizing Technical Information, Understanding Conventional Organizational Patterns,</p> <p>Emphasizing Important Information: Writing Clear, Informative Titles, Writing Clear, Informative Headings, Writing Clear Informative Lists, Writing Clear Informative Paragraphs.</p>	12
III	<p>Creating Graphics: The Functions of Graphics, The Characteristics of an Effective Graphic, Understanding the Process of Creating Graphics, Using Color Effectively, Choosing the Appropriate Kind of Graphic, Creating Effective Graphics for Multicultural Readers.</p>	12

	<p>Researching Your Subject: Understanding the Differences Between Academic and Workplace Research, Understanding the Research Process, Conducting Secondary Research, Conducting Primary Research, Research and Documentation: Literature Reviews, Interviewing for Information, Documenting Sources, Copyright, Paraphrasing, Questionnaires. Report Components: Abstracts, Introductions, Tables of Contents, Executive Summaries, Feasibility Reports, Investigative Reports, Laboratory Reports, Test Reports, Trip Reports, Trouble Reports</p>	
<p>IV</p>	<p>Writing Proposals: Understanding the Process of Writing Proposals, The Logistics of Proposals, The —Deliverables of Proposals, Persuasion and Proposals, Writing a Proposal, The Structure of the Proposal. Writing Informational Reports: Understanding the Process of Writing Informational Reports, Writing Directives, Writing Field Reports, Writing Progress and Status Reports, Writing Incident Reports, Writing Meeting Minutes. Writing Recommendation Reports: Understanding the Role of Recommendation Reports, Using a Problem-Solving Model for Preparing Recommendation Reports, Writing Recommendation Reports. Reviewing, Evaluating, and Testing Documents and Websites: Understanding Reviewing, Evaluating, and Testing, Reviewing Documents and Websites, Conducting Usability Evaluations, Conducting Usability Tests, Using Internet tools to check writing Quality, Duplicate Content Detector, What is Plagiarism?, How to avoid writing Plagiarism content? Innovation management: an introduction: The importance of innovation, Models of innovation, Innovation as a management process. Market adoption and technology diffusion: Time lag between innovation and useable product, Innovation and the market Innovation and market vision ,Analysing internet search data to help adoption and forecasting sales ,Innovative new products and consumption patterns, Crowd sourcing for new product ideas, Frugal innovation and ideas from everywhere, Innovation diffusion theories.</p>	<p>12</p>
<p>V</p>	<p>Managing innovation within firms: Organisations and innovation, The dilemma of innovation management, Innovation dilemma in low technology sectors, Dynamic capabilities, Managing uncertainty, Managing innovation projects Operations and process innovation: Operations management, The nature of design and innovation in the context of operations, Process design, Process design and innovation Managing intellectual property: Intellectual property, Trade secrets, An introduction to patents, Trademarks, Brand names, Copyright Management of research and development: What is research and development?, R&D management and the industrial context, R&D investment and company success, Classifying R&D, R&D management and its link with business strategy, Strategic pressures on R&D, Which business to support and how?, Allocation of funds to R&D, Level of R&D expenditure Managing R&D projects: Successful technology management, The changing nature of R&D management, The acquisition of external technology, Effective R&D management, The link with the product innovation process, Evaluating R&D projects.</p>	<p>12</p>

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Reference Books:

1. Technical Communication Mike Markel Bedford/St. Martin's 11 2014.
2. Innovation Management and New Product Development Paul Trott Pearson 06 2017.
3. Handbook of Technical Writing Gerald J. Alred , Charles T. Brusaw , Walter E. OliuBedford/St. Martin's 09 2008.
4. Technical Writing 101: A Real-World Guide to Planning and Writing Technical ContentAlan S. Pringle and Sarah S. O'Keefe scriptorium 03 2009.
5. Innovation and Entrepreneurship Peter Drucker Harper Business 03 2009

Course Code	Project Documentation and viva
PIT3PDP	The learners are expected to develop a project beyond the undergraduate level. Normal web sites, web applications, mobile apps are not expected. Preferably, the project should be from the elective chosen by the learner at the post graduate level. In semester three. The learner is supposed to prepare the synopsis and documentation. The same project has to be implemented in Semester IV. More details about the project is given is Appendix 1.

Course Code PIT3SBC	Security Breaches and Countermeasures	
Objectives: <ul style="list-style-type: none"> • To get the insight of the security loopholes in every aspect of computing. • To understand the threats and different types of attacks that can be launched on computing systems. • To know the countermeasures that can be taken to prevent attacks on computing systems. • To test the software against the attacks Expected Learning Outcomes <ol style="list-style-type: none"> 1. Learners will be able to identify the different security breaches that can occur. The student should be able to evaluate the security of an organization and identify the loopholes. The student should be able to perform enumeration and network scanning. 2. Learners will be able to identify the vulnerability in the systems, breach the security of the system, identify the threats due to malware and sniff the network. The student should be able to do the penetration testing to check the vulnerability of the system towards malware and network sniffing. 3. Learners will be able to perform social engineering and educate people to be careful from attacks due to social engineering, understand and launch DoS and DDoS attacks, hijack and active session and evade IDS and Firewalls. This should help the students to make the organization understand the threats in their systems and build robust systems. 4. Learners will be able to identify the vulnerabilities in the Web Servers, Web Applications, perform SQL injection and get into the wireless networks. The student should be able to help the organization aware about these vulnerabilities in their systems. 5. Learners will be able to identify the vulnerabilities in the newer technologies like mobiles, IoT and cloud computing. The student should be able to use different methods of cryptography 		
I	Introduction to Security Breaching: Overview of Information Security, Threats and Attack vectors, Concepts of Hacking – Ethical and Unethical, Information Security Controls, Concepts of penetration Testing, Information Security Laws and Standards. Evaluation Security of IT Organisation: Concepts, Methodology, Tools, Countermeasures, Penetration Testing. Network Scanning: Concepts, Scanning beyond IDS and firewalls, Tools, Banner Grabbing, Scanning Techniques, Network Diagrams, penetration testing. Enumeration: Concepts, Different types of enumeration: Netbios, SNMP, LDAP, NTP, SMTP, DNS, other enumeration techniques, Countermeasures, Penetration Testing	12
II	Analysis of Vulnerability: Concepts, Assessment Solutions, Scoring Systems, Assessment Tools, Assessment Reports. Breaching System Security: Concepts, Cracking passwords, Escalating privileges, Executing Applications, Hiding files, covering tracks, penetration testing. Threats due to malware: Concepts, Malware Analysis, Trojan concepts, countermeasures, Virus and worm concepts, anti-malware software, penetration testing. Network Sniffing: Concepts, countermeasures, sniffing techniques, detection techniques, tools, penetration testing.	12
III	Social Engineering: Concepts, Impersonation on networking sites, Techniques, Identity theft, Insider threats, countermeasures, Pen testing. Denial of Service and Distributed Denial of service: Concepts, techniques, botnets, attack tools, countermeasures, protection tools, penetration testing. Hijacking an active session: Concepts, tools, application level session hijacking, countermeasures, network level session hijacking, penetration testing. Evasion of IDS, Firewalls and Honeypots: Introduction and concepts, detecting	12

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	honeypots, evading IDS, IDS and Firewall evasion countermeasures, evading firewalls, penetration testing.	
IV	<p>Compromising Web Servers: Concepts, attacks, attack methodology, attack tools, countermeasures, patch management, web server security tools, penetration testing.</p> <p>Compromising Web Applications: Concepts, threats, methods, tools, countermeasures, testing tools, penetration testing.</p> <p>Performing SQL Injection: Concepts, types, methodology, tools, techniques, countermeasures.</p> <p>Compromising Wireless Networks: Concepts, wireless encryption, threats, methodology, tools, compromising Bluetooth, countermeasures, wireless security tools, penetration testing.</p>	12
V	<p>Compromising Mobile Platforms: Attack vectors, Compromising Android OS, Compromising iOS, Mobile spyware, Mobile Device Management, Mobilesecurity, penetration testing.</p> <p>Compromising IoT: Concepts, attacks, compromising methodology, tools, countermeasures, penetration testing.</p> <p>Cloud Security: Concepts, Security, threats, attacks, tools, penetration testing.</p> <p>Cryptography: Concepts, email encryption, algorithms, disk encryption, tools, cryptanalysis, Public key infrastructure, countermeasures.</p>	12

Course Code	Security Breaches and Countermeasures Practical List
PIT3SBP	10 practicals covering the entire syllabus must be performed.

Reference Books:

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

Course Code PIT3MWA	Malware Analysis	
<p>Objectives:</p> <ul style="list-style-type: none"> • Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques. • Have an intimate understanding of executable formats, Windows internals and API, and analysis techniques. • Extract investigative leads from host and network-based indicators associated with a malicious program. • Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti-analysis techniques in future malware samples. • Achieve proficiency with industry standard tools including IDA Pro, OllyDbg, WinDBG, PE Explorer, ProcMon etc. <p>Expected Learning Outcomes:</p> <ol style="list-style-type: none"> 1. Learners will be able to understand various introductory techniques of malware analysis and creating the testing environment 2. Learners will be able to perform advanced dynamic analysis and recognize constructs in assembly code. 3. Learners will be able to perform Reverse Engineering using OLLYDBG and WINDBG and study the behaviours and functions of malware. 4. Learners will be able to understand data encoding, various techniques for anti-disassembly and anti-debugging. 5. Learners will be able to understand various anti virtual machine techniques and perform shellcode analysis of various languages along with x64 architecture. 		
I	<p>Malware Analysis: Introduction, Techniques, Types of malware, General rules for Malware Analysis. Basic Static Techniques: Antivirus Scanning, Hashing, Finding Strings, Packed and Obfuscated Malware, Portable Executable Malware, Portable executable File Format, Linked Libraries and Functions, Static Analysis, The PE file headers and sections. Malware Analysis in Virtual Machines: Structure of VM, Creating and using Malware Analysis machine, Risks of using VMware for malware analysis, Record/Replay. Basic Dynamic Analysis: Sandboxes, Running Malware, Monitoring with process monitor, Viewing processes with process explorer, Comparing registry snapshots with regshot, Faking a network, Packet sniffing with Wireshark, Using INetSim, Basic Dynamic Tools. x86 Disassembly</p>	12
II	<p>IDA PRO: Loading an executable, IDA Pro Interface, Using cross references, Analysing functions, Using graphing options, Enhancing disassembly, Extending IDA with plug-ins. Recognising C Code constructs in assembly: Global v/s local variables, Disassembling arithmetic operations, recognizing if statements, recognizing loops, function call conventions, Analysing switch statements, Disassembling arrays, Identifying structs, Analysing linked list traversal. Analysing Malicious Windows Programs: The windows API, The Windows Registry, Networking APIs, and Understanding running malware. Kernel v/s user mode, Native API. Advanced Dynamic Analysis – Debugging: Source level v/s Assembly-level debugging, kernel v/s user mode debugging, Using a debugger, Exceptions,</p>	12

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	Modifying execution with a debugger, modifying program execution.	
III	<p>Advanced Dynamic Analysis – OLLYDBG: Loading Malware, The Ollydbg Interface, Memory Map, Viewing threads and Stacks, Executing code, Breakpoints, Loading DLLs, Tracing, Exception handling, Patching, Analysing shell code, Assistance features, Plug-ins, Scriptable debugging.</p> <p>Kernel Debugging with WINDBG: Drivers and kernel code, Using WinDbg, Microsoft Symbols, kernel debugging and using it, Rootkits, Loading drivers, kernel issues with windows.</p> <p>Malware Functionality – Malware Behavior: Downloaders and launchers, Backdoors, Credential stealers, Persistence mechanisms, Privilege escalation, covering the tracks.</p> <p>Covert Malware Launching: Launchers, Process injection, Process replacement, Hook injection, detours, APC injection.</p>	12
IV	<p>Data Encoding: Goal of Analysing algorithms, Simple ciphers, Common cryptographic algorithms, Custom encoding, decoding.</p> <p>Malware – focused network signatures: Network countermeasures, Safely investigating attacker online, Content-Based Network Countermeasures, Combining Dynamic and Static Analysis Techniques, Understanding the Attacker’s Perspective.</p> <p>Anti-disassembly: Concepts, Defeating disassembly algorithms, anti-disassembly techniques, Obscuring flow control, Thwarting stack-frame analysis.</p> <p>Anti-debugging: Windows debugger detection, debugger behavior, Interfering with debugger functionality, Debugger vulnerabilities.</p>	12
V	<p>Anti-virtual machine techniques: VMWare artifacts, Vulnerable functions, Tweaking settings, Escaping the virtual machine.</p> <p>Packers and unpacking: Packer anatomy, Identifying Packed Programs, Unpacking options, Automated Unpacking, Manual Unpacking, Common packers, Analysing without unpacking, Packed DLLs,</p> <p>Shellcode Analysis: Loading shellcode for analysis, Position-independent Code, Identifying Execution Location, Manual Symbol Resolution, Shellcode encoding, NOP Sleds, Finding Shellcode.</p> <p>C++ Analysis: OOP, Virtual and Non-virtual functions, Creating and destroying objects.</p> <p>64-bit Malware: Why 64-bit malware? Differences in x64 architecture, Windows 32-bit on Windows 64-bit, 64-bit hints at malware functionality.</p>	12

Course Code	Malware Analysis Practical List
PIT3MAP	10 practicals covering the entire syllabus must be performed.

Reference Books:

1. Practical Malware Analysis – The Hands-On Guide to Dissecting Malicious Software Michael Sikorski, Andrew Honig No Scratch Press - 2013
2. Mastering Malware Analysis Alexey Kleymenov, Amr ThabetPackt Publishing - 2019
3. Windows Malware Analysis Essentials Victor MarakPackt Publishing 2015

Course Code PIT3RPA	Robotic Process Automation	
Objectives:		
<ul style="list-style-type: none"> • To make the students aware about the automation today in the industry. • To make the students aware about the tools used for automation. • To help the students automate a complete process 		
Expected Learning Outcomes:		
<ol style="list-style-type: none"> 1. Learners will be able to understand the mechanism of business process and can provide the solution in an optimize way. 2. Learners will be able to understand the features use for interacting with database plugins. 3. Learners will be able to use the plug-ins and other controls used for process automation. 4. Learners will be able to use and handle the different events, debugging and managing the errors. 5. Learners will be able to test and deploy the automated process. 		
I	Robotic Process Automation: Scope and techniques of automation, About UiPath Record and Play: UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.	12
II	Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example)	12
III	Taking Control of the Controls : Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points Tame that Application with Plugins and Extensions: Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Web integration, Excel and Word plugins, Credential management, Extensions – Java, Chrome, Firefox, and Silverlight	12
IV	Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger, Monitoring image and element triggers, An example of monitoring email, Example of monitoring a copying event and blocking it, Launching an assistant bot on a keyboard event Exception Handling, Debugging, and Logging: Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting	12
V	Managing and Maintaining the Code: Project organization, Nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use	12

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Flowcharts, State Machines, or Sequences, Using config files and examples of a configfile, Integrating a TFS server Deploying and Maintaining the Bot: Publishing using bpublish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots, License management, Publishing and managing updates	
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Course Code	Robotic Process Automation Practical List
PIT3RAP	10 practicals covering the entire syllabus must be performed.

Reference Books:

1. Learning Robotic Process Automation Alok Mani Tripathi Packt 1st 2018
2. Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation Srikanth Merianda Createspace Independent Publishing 1st 2018
3. The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization Kelly Wibbenmeyer Universe 1st 2018

Semester IV

Course Code PIT4BLC	Blockchain	
Objectives: <ul style="list-style-type: none"> • To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable. • To cover the technological underpinnings of blockchain operations as distributed data structures and decision-making systems, their functionality and different architecture types. • To provide a critical evaluation of existing —smart contract capabilities and platforms, and examine their future directions, opportunities, risks and challenges. Expected Learning Outcomes: <ol style="list-style-type: none"> 1. Learners will be able to understand the structure of a blockchain and why/when it is better than a simple distributed database. 2. Learners will be able to analyze the incentive structure in a blockchain based system and critically assess its functions, benefits and vulnerabilities 3. Learners will be able to evaluate the setting where a blockchain based structure may be applied, its potential and its limitations 4. Learners will be able to understand what constitutes a —smart contract, what are its legal implications and what it can and cannot do, now and in the near future 5. Learners will be able to Develop blockchain DApps. 		
I	Blockchain: Introduction, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases. Working of Blockchain: Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions, blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling blockchain Working of Bitcoin: Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets.	12
II	Ethereum: three parts of blockchain, Ether as currency and commodity, Building trustless systems, Smart contracts, Ethereum Virtual Machine, The Mist browser, Wallets as a Computing Metaphor, The Bank Teller Metaphor, Breaking with Banking History, How Encryption Leads to Trust, System Requirements, Using Parity with Geth, Anonymity in Cryptocurrency, Central Bank Network, Virtual Machines, EVM Applications, State Machines, Guts of the EVM, Blocks, Mining’s Place in the State Transition Function, Renting Time on the EVM, Gas, Working with Gas, Accounts, Transactions, and Messages, Transactions and Messages, Estimating Gas Fees for Operations, Opcodes in the EVM. Solidity Programming: 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,	12
III	Hyperledger: Overview, Fabric, composer, installing hyperledger fabric and composer, deploying, running the network, error troubleshooting. Smart Contracts and Tokens: EVM as Back End, Assets Backed by Anything, Cryptocurrency Is a Measure of Time, Function of Collectibles in Human Systems, Platforms for High-Value Digital Collectibles, Tokens as Category of Smart Contract, Creating a Token, Deploying the Contract, Playing with Contracts.	12

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IV	<p>Mining Ether: Why? Ether’s Source, Defining Mining, Difficulty, Self-Regulation, and the Race for Profit, How Proof of Work Helps Regulate Block Time, DAG and Nonce, Faster Blocks, Stale Blocks, Difficulties, Ancestry of Blocks and Transactions, Ethereum and Bitcoin, Forking, Mining, Geth on Windows, Executing Commands in the EVM via the Geth Console, Launching Geth with Flags, Mining on the Testnet, GPU Mining Rigs, Mining on a Pool with Multiple GPUs.</p> <p>Cryptoeconomics: Introduction, Usefulness of cryptoeconomics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios.</p>	12
V	<p>Blockchain Application Development: Decentralized Applications, Blockchain Application Development, Interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum—Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions, Public vs. Private Blockchains, Decentralized Application Architecture,</p> <p>Building an EthereumDApp: The DApp, Setting Up a Private Ethereum Network, Creating the Smart Contract, Deploying the Smart Contract, Client Application,</p> <p>DApp deployment: Seven Ways to Think About Smart Contracts, Dapp Contract Data Models, EVM back-end and front-end communication, JSONRPC, Web 3, JavaScript API, Using Meteor with the EVM, Executing Contracts in the Console, Recommendations for Prototyping, Third-Party Deployment Libraries, Creating Private Chains.</p>	12

Course Code	BlockchainPractical List
PIT4BCP	10 practicals covering the entire syllabus must be performed.

Reference Books:

1. Beginning Blockchain A Beginner’s Guide to Building Blockchain Solutions Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Apress 2018
2. Introducing Ethereum and Solidity Chris Dannen Apress 2017
3. The Blockchain Developer Elad Elrom Apress 2019
4. Mastering Ethereum Andreas M. Antonopoulos Dr. Gavin Wood O’Reilly First 2018
5. Blockchain Enabled Applications Vikram Dhillon David Metcalf Max Hooper Apress 2017

Course Code PIT4DIF	Digital Image Forensics	
Objectives		
<ul style="list-style-type: none"> • To understand describe the origin of computer forensics and the relationship between law enforcement and industry. • Describe electronic evidence and the computing investigation process. • Extracting Digital Evidence from Images and establishing them in court of Law. • Enhancing images for investigation and various techniques to enhance images. • Interpret and present Evidences in Court of Law. 		
Expected Learning Outcomes:		
<ol style="list-style-type: none"> 1. Learners will be able to understand the basics of image forensics and techniques to establish their integrity 2. Learners will be able to understand different techniques for extracting detail from images. 3. Learners will be able to understand and apply various advanced techniques in image processing and tocompare and measure various parameters associated with them 4. Learners will be able to apply various enhancement strategies for digital images 5. Learners will be able to prepare the evidence to be acceptable in the court of law. 		
I	History of Forensic Digital Enhancement, Establishing Integrity of Digital Images for Court,	12
II	Digital Still and Video Cameras, Color Modes and Channel Blending to Extract Detail.	12
III	Multiple Image Techniques, Fast Fourier Transform (FFT) – Background Pattern Removal.	12
IV	Contrast Adjustment Techniques, Advanced Processing Techniques, Comparison and Measurement	12
V	The Approach – Developing Enhancement Strategies for Images Intended for Analysis, Digital Imaging in the Courts, Interpreting and Presenting Evidence	12

Course Code	Digital Image Forensics Practical List
PIT4DFP	10 practicals covering the entire syllabus must be performed.

Reference Books:

1. Forensic Digital Image Brian Dalrymple, Jill CRC 2018 Processing: Optimization of impression Evidence Smith Press
2. Forensic Uses of Digital Imaging John C. Russ, Jens Rindel, P. Lord Taylor & Francis Group 2nd2016

Course Code PIT4SOC	Security Operations Centre
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Objectives

- The SOC (Security Operations Centre) allows an organization to enforce and test its security policies, processes, procedures and activities through one central platform that monitors and evaluates the effectiveness of the individual elements and the overall security system of the organization.
- This will also allow the learners to configure various use cases and detect various attacks across the network and report them in real time and also take appropriate actions.
- This course will cover the design, deployment and operation of the SOC.
- Once this course is completed, students will have the skills to perform your SOC responsibilities effectively.

Expected Learning Outcomes:

1. Learners will be able to understanding basics of SOC, Cryptography and managing and deploying VPNs.
2. Learners will be able to analyse Windows and Linux based logs along with logs generated by endpoints.
3. Learners will be able to understand and analyze various forms of intrusions, threats and perform forensicanalysis on them.
4. Learners will be able to understand the incident response process and handle incidents by adhering to compliance policies and standards set by the organization.
5. Learners will be able to understand the various types of attacks and vulnerabilities, categorize events and perform incident analysis.

I	<p>Introduction to Security Operations Management: Foundation Topics Introduction to Identity and Access Management Phases of the Identity and Access Lifecycle Registration and Identity Validation Privileges Provisioning Access Review Access Revocation Password Management Password Creation Password Storage and Transmission Password Reset Password Synchronization Directory Management Single Sign-On Kerberos Federated SSO Security Assertion Markup Language OAuth OpenID Connect Security Events and Logs Management Logs Collection, Analysis, and Disposal Syslog Security Information and Event Manager Assets Management Assets Inventory Assets Ownership Assets Acceptable Use and Return Policies Assets Classification Assets Labeling Assets and Information Handling Media Management Introduction to Enterprise Mobility Management Mobile Device Management Configuration and Change Management Configuration Management Change Management Vulnerability Management Vulnerability Identification Finding Information about a Vulnerability Vulnerability Scan Penetration Assessment Product Vulnerability Management Vulnerability Analysis and Prioritization Vulnerability Remediation Patch Management References and Additional Readings</p> <p>Fundamentals of Cryptography and Public Key Infrastructure (PKI): Cryptography Ciphers and Keys Ciphers Keys Block and Stream Ciphers Symmetric and Asymmetric Algorithms Symmetric Algorithms Asymmetric Algorithms Hashes Hashed Message Authentication Code Digital Signatures Digital Signatures in Action Key Management Next-Generation Encryption Protocols IPsec and SSL IPsec SSL Fundamentals of PKI Public and Private Key Pairs RSA Algorithm, the Keys, and Digital Certificates Certificate Authorities Root and Identity Certificates Root Certificate Identity Certificate X.500 and X.509v3 Certificates Authenticating and Enrolling with the CA Public Key</p>	12
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	<p>Cryptography Standards Simple Certificate Enrollment Protocol Revoking Digital Certificates Using Digital Certificates PKI Topologies Single Root CA Hierarchical CA with Subordinate CAs Cross-certifying CAs Exam Preparation Tasks Review All Key Topics Complete Tables and Lists from Memory</p> <p>Introduction to Virtual Private Networks (VPNs) What Are VPNs? Site-to-site vs. Remote-Access VPNs An Overview of IPsec IKEv1 Phase 1 IKEv1 Phase 2 IKEv2 SSL VPNs SSL VPN Design Considerations User Connectivity VPN Device Feature Set Infrastructure Planning Implementation Scope</p>	
II	<p>Windows-Based Analysis: Process and Threads Memory Allocation Windows Registration Windows Management Instrumentation Handles Services Windows Event Logs Exam Preparation Tasks</p> <p>Linux- and Mac OS X–Based Analysis: Processes Forks Permissions Symlinks Daemons UNIX-Based Syslog Apache Access Logs</p> <p>Endpoint Security Technologies: Antimalware and Antivirus Software Host-Based Firewalls and Host-Based Intrusion Prevention Application-Level Whitelisting and Blacklisting System-Based Sandboxing</p>	12
III	<p>Threat Analysis: What Is the CIA Triad: Confidentiality, Integrity, and Availability? Confidentiality Integrity Availability Threat Modeling Defining and Analyzing the Attack Vector Understanding the Attack Complexity Privileges and User Interaction The Attack Scope Exam Preparation Tasks</p> <p>Forensics: Introduction to Cybersecurity Forensics The Role of Attribution in a Cybersecurity Investigation The Use of Digital Evidence Defining Digital Forensic Evidence Understanding Best, Corroborating, and Indirect or Circumstantial Evidence Collecting Evidence from Endpoints and Servers Collecting Evidence from Mobile Devices Collecting Evidence from Network Infrastructure Devices Chain of Custody Fundamentals of Microsoft Windows Forensics Processes, Threads, and Services Memory Management Windows Registry The Windows File System Master Boot Record (MBR) The Master File Table (MFT) Data Area and Free Space FAT NTFS MFT Timestamps, MACE, and Alternate Data Streams EFI Fundamentals of Linux Forensics Linux Processes Ext4 Journaling Linux MBR and Swap File System Exam Preparation Tasks</p> <p>Fundamentals of Intrusion Analysis: Common Artifact Elements and Sources of Security Events False Positives, False Negatives, True Positives, and True Negatives Understanding Regular Expressions Protocols, Protocol Headers, and Intrusion Analysis Using Packet Captures for Intrusion Analysis Mapping Security Event Types to Source Technologies</p>	12
IV	<p>Introduction to Incident Response and the Incident Handling Process Introduction to Incident Response: What Are Events and Incidents? The Incident Response Plan The Incident Response Process The Preparation Phase The Detection and Analysis Phase Containment, Eradication, and Recovery Post- Incident Activity (Postmortem) Information Sharing and Coordination Incident Response Team Structure The Vocabulary for Event Recording and Incident Sharing (VERIS)</p> <p>Incident Response Teams: Computer Security Incident Response Teams (CSIRTs) Product Security Incident Response Teams (PSIRTs) Security Vulnerabilities and Their Severity Vulnerability Chaining Role in Fixing Prioritization Fixing Theoretical Vulnerabilities Internally Versus Externally Found Vulnerabilities National CSIRTs and Computer Emergency Response Teams (CERTs) Coordination Centers Incident Response Providers and Managed Security Service Providers (MSSPs)</p> <p>Compliance Frameworks: Payment Card Industry Data Security Standard (PCI DSS) PCI</p>	12

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	<p>DSS Data Health Insurance Portability and Accountability Act (HIPAA) HIPAA Security Rule HIPAA Safeguards Administrative Safeguards Physical Safeguards Technical Safeguards Sarbanes-Oxley (SOX) Section 302 Section 404 Section 409 SOX Auditing Internal Controls</p> <p>Network and Host Profiling: Network Profiling Throughput Measuring Throughput Used Ports Session Duration Critical Asset Address Space Host Profiling Listening Ports Logged-in Users/Service Accounts Running Processes Applications</p>	
<p>V</p>	<p>The Art of Data and Event Analysis: Normalizing Data Interpreting Common Data Values into a Universal Format Using the 5-Tuple Correlation to Respond to Security Incidents Retrospective Analysis and Identifying Malicious Files Identifying a Malicious File Mapping Threat Intelligence with DNS and Other Artifacts Deterministic Versus Probabilistic Analysis</p> <p>Intrusion Event Categories Diamond Model of Intrusion Cyber Kill Chain Model Reconnaissance Weaponization Delivery Exploitation Installation Command and Control Action and Objectives</p> <p>Types of Attacks and Vulnerabilities: Types of Attacks Reconnaissance Attacks Social Engineering Privilege Escalation Attacks Backdoors Code Execution Man-in-the-Middle Attacks Denial-of-Service Attacks Direct DDoS Botnets Participating in DDoS Attacks Reflected DDoS Attacks Attack Methods for Data Exfiltration ARP Cache Poisoning Spoofing Attacks Route Manipulation Attacks Password Attacks Wireless Attacks Types of Vulnerabilities</p> <p>Security Evasion Techniques: Key Encryption and Tunneling Concepts Resource Exhaustion Traffic Fragmentation Protocol-Level Misinterpretation Traffic Timing, Substitution, and Insertion Pivoting</p>	<p>12</p>

<p>Course Code</p>	<p>Security Operations Centre Practical List</p>
<p>PIT4SOP</p>	<p>10 practicals covering the entire syllabus must be performed.</p>

Reference Books:

1. CCNA Cyber Ops SECOPS 210-255 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1st 2017
2. CCNA Cyber Ops SECFND 210-250 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1st 2017
4. CCNA Cyber security Operations Companion Guide CISCO 1st 2018
- 5.

<p>Course Code PIT4HCI</p>	<p>Human Computer Interaction</p>
<p>Objectives:</p> <ul style="list-style-type: none"> • Understand the important aspects of implementation of human-computer interfaces. • Identify the various tools and techniques for interface analysis, design, and evaluation. • Identify the impact of usable interfaces in the acceptance and performance utilization of information 	

systems

Expected Learning Outcomes:

1. Learners will be able to have a clear understanding of HCI principles that influence a system’s interface design, before writing any code.
2. Learners will be able to understand the evaluation techniques used for any of the proposed system.
3. Learners will be able to understand the cognitive models and its design.
4. Learners will be able to able to understand how to manage the system resources and do the task analysis.
5. Learners will be able to able to design and implement a complete system.

I	<p>The Interaction: Models of interaction, Design Focus, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity</p> <p>Paradigms: Introduction, Paradigms for interaction</p> <p>Interaction design basics: What is design?, The process of design, User focus, Cultural probes, Navigation design, the big button trap, Modes, Screen design and layout, Alignment and layout matters, Checking screen colors, Iteration and prototyping</p> <p>HCI in the software process: The software life cycle, Usability engineering , Iterative design and prototyping, Prototyping in practice, Design rationale</p>	12
II	<p>Design: Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns Implementation support: Elements of windowing systems, Programming the application, Going with the grain, Using toolkits, User interface management systems</p> <p>Evaluation techniques: What is evaluation?, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method</p>	12
III	<p>Universal design: Universal design principles, Multimodal interaction, Designing websites for screen readers, Choosing the right kind of speech, Designing for diversity</p> <p>User support: Requirements of user support, Approaches to user support, Adaptive help systems, Designing user support systems</p> <p>Cognitive models: Goal and task hierarchies, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures</p>	12
IV	<p>Socio-organizational issues and stakeholder requirements: Organizational issues, Capturing requirements</p> <p>Communication and collaboration models: Face-to face communication, Conversation, Text-based communication, Group working</p> <p>Task analysis: Differences between task analysis and other techniques, Task decomposition, Knowledge based analysis, Entity–relationship-based techniques, Sources of information and data collection, Uses of task analysis</p>	12
V	<p>Dialog notations and design: What is dialog?, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design</p> <p>Models of the system: Standard formalisms, Interaction models, Continuous behavior</p> <p>Modeling rich interaction: Status–event analysis, Rich contexts, Low intention and sensor-based interaction</p>	12

Course Code	Project Implementation and Viva-Voce
PIT4PIP	The Project Implementation and Viva Voce details are given in Appendix 1.

Appendix – 1

Project Documentation and Viva-voce (Semester III) and Project Implementation and Viva-Voce (Semester IV)

Goals of the course Project Documentation and Viva-Voce

The student should:

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

To start the project:

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

Application and approval:

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

During the project:

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

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- Plan for the final presentation of the report.

Finishing the project:

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

Project Proposal/research plan

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

Project Documentation

The documentation should contain:

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

For the master's documentation, the chapters cannot be dictated, they may vary according to the type of project. However, in Semester III Project Documentation and Viva Voce must contain at least 4 chapters (Introduction, Review of Literature, Methodology / Approach, Proposed Design / UI design, etc. depending on the type of project.) The Semester III report should be spiral bound.

Examination Pattern

Theory: 100 Marks (60 +40=100)

60 Theory			40 Internal
Q.1	Solve any 2 (From 4)	12 M	1) Class Test 20M 2) Attendance 5M 3) Presentation 15M <u>Semester III (For only 1 subject)</u> SWAYAM(Advanced Course) of minimum 20 hours and certification exam should be completed in any one of the course. <u>Semester IV (For only 1 subject)</u> Research paper to be Published for any of the course.
Q.2	Solve any 2 (From 4)	12 M	
Q.3	Solve any 2 (From 4)	12 M	
Q.4	Solve any 2 (From 4)	12 M	
Q.5	Solve any 2 (From 4)	12 M	

Practical: 50 Marks

50 Marks	OR	50 Marks	
20 Program1		40 Program1	
20 Program 2			
5 Viva			5 Viva
5 Journal			5 Journal