<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16SFC151</td>
<td>Access Control and Identity Management System</td>
</tr>
<tr>
<td>2</td>
<td>16SCE12</td>
<td>Advanced Digital Design</td>
</tr>
<tr>
<td>3</td>
<td>16SCS242</td>
<td>Agile Technologies</td>
</tr>
<tr>
<td>4</td>
<td>16SCE154 / 16SCS244 / 16SFC251 / 16SIT23 / 16SSE241</td>
<td>Data Mining &amp; Data Warehousing</td>
</tr>
<tr>
<td>5</td>
<td>16SCN331</td>
<td>Analysis of Computer Networks</td>
</tr>
<tr>
<td>6</td>
<td>16LNI31 / 16SIT151</td>
<td>Client Server Programming</td>
</tr>
<tr>
<td>7</td>
<td>18SCS153 / 18SIT13</td>
<td>Data Compression</td>
</tr>
<tr>
<td>8</td>
<td>16SIT152</td>
<td>Information storage Management</td>
</tr>
<tr>
<td>9</td>
<td>16LN112/16SCN13/16SCS253</td>
<td>Information and Network Security</td>
</tr>
<tr>
<td>10</td>
<td>16LN122 / 16SCE23 / 16SCN14 / 16SCS14 / 16SSE321</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>11</td>
<td>16LN1334 / 16SCN322</td>
<td>Network Routing Algorithm</td>
</tr>
<tr>
<td>12</td>
<td>16SFC324</td>
<td>Security Assessment and Verification</td>
</tr>
<tr>
<td>13</td>
<td>16LN123 / 16SCN332</td>
<td>Protocol Engineering</td>
</tr>
<tr>
<td>14</td>
<td>16SCE242</td>
<td>Pattern Recognition</td>
</tr>
</tbody>
</table>
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16LNI23 / 16SCN332</td>
<td>Advanced Cryptography</td>
</tr>
<tr>
<td>2</td>
<td>16LNI243 / 16SCE323 / 16SCN241 / 16SCS241 / 16SIT253 / 16SSE153</td>
<td>Advances in Storage Area Network</td>
</tr>
<tr>
<td>3</td>
<td>16SCE151</td>
<td>Computer Systems Performance Analysis</td>
</tr>
<tr>
<td>4</td>
<td>16SCS12</td>
<td>Advances in Operating Systems</td>
</tr>
<tr>
<td>5</td>
<td>16SFC242</td>
<td>Biometric Security</td>
</tr>
<tr>
<td>6</td>
<td>16LNI244 / 16SCE244 / 16SIT244 / 16SCS334</td>
<td>Cyber Security and Cyber law</td>
</tr>
<tr>
<td>7</td>
<td>16SFC12</td>
<td>Ethical Hacking</td>
</tr>
<tr>
<td>8</td>
<td>16SFC31</td>
<td>File System Forensic Analysis</td>
</tr>
<tr>
<td>9</td>
<td>16SSE252</td>
<td>Information Retrieval</td>
</tr>
<tr>
<td>10</td>
<td>16LNI152 / 16SCE322 / 16SCN21</td>
<td>Multimedia Communications</td>
</tr>
<tr>
<td>11</td>
<td>16SFC13</td>
<td>Pragmatic of Information Security</td>
</tr>
<tr>
<td>12</td>
<td>16SFC21</td>
<td>Preserving and Recovering Digital Evidence</td>
</tr>
<tr>
<td>13</td>
<td>16SCE334 / 16SIT333 / 16SSE13</td>
<td>Object Oriented Software Engineering</td>
</tr>
</tbody>
</table>
### Group 3

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16SCE153</td>
<td>Advances in Computer Architecture</td>
</tr>
<tr>
<td>2</td>
<td>16SFC154 / 16SCS331</td>
<td>Application and Web Security</td>
</tr>
<tr>
<td>3</td>
<td>16SCS254</td>
<td>Advances in Digital Image Processing</td>
</tr>
<tr>
<td>4</td>
<td>16SCE31</td>
<td>ARM Processors</td>
</tr>
<tr>
<td>5</td>
<td>16LNI251 / 16SCE21 / 16SCN252 / 16SCS21 / 16SFC331 / 16SIT31 / 16SSE322</td>
<td>Managing Big Data</td>
</tr>
<tr>
<td>6</td>
<td>16LNI153 / 16SCN243</td>
<td>Ethernet Technology</td>
</tr>
<tr>
<td>7</td>
<td>16SCE253</td>
<td>Decision Support System</td>
</tr>
<tr>
<td>8</td>
<td>16SCE154 / 16SIT154 / 16SSE152</td>
<td>Distributed Operating System</td>
</tr>
<tr>
<td>9</td>
<td>16SFC323</td>
<td>Mobile Device Forensics</td>
</tr>
<tr>
<td>10</td>
<td>16LNI13</td>
<td>Network Programming</td>
</tr>
<tr>
<td>11</td>
<td>16LNI21</td>
<td>Network Protocol Design</td>
</tr>
<tr>
<td>12</td>
<td>16LNI11</td>
<td>Semantic Web and Social Networks</td>
</tr>
<tr>
<td>13</td>
<td>16SIT321 / 16SSE324</td>
<td>Supply Chain Management</td>
</tr>
</tbody>
</table>

### Group 4

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16SCS251 / 16SIT251</td>
<td>Advances in Computer Graphics</td>
</tr>
<tr>
<td>2</td>
<td>16SCE252 / 16SCS13 / 16SIT14 / 16SSE151</td>
<td>Advances in Data Base Management System</td>
</tr>
<tr>
<td>3</td>
<td>16SSE12</td>
<td>Advances in Software Testing</td>
</tr>
<tr>
<td>4</td>
<td>16LNI151 / 16SCE14 / 16SCN31 / 16SCS23 / 16SIT22 / 16SSE251</td>
<td>Cloud Computing</td>
</tr>
<tr>
<td>5</td>
<td>16SCE13 / 16SCS152</td>
<td>Embedded Computing Systems</td>
</tr>
<tr>
<td>6</td>
<td>16SFC13</td>
<td>Cyber Crime and Cyber Forensics</td>
</tr>
<tr>
<td>7</td>
<td>16SFC241</td>
<td>Cyber Laws and Ethics</td>
</tr>
<tr>
<td>8</td>
<td>16SCN323 / 16SFC243</td>
<td>Information Security Policies in Industry</td>
</tr>
<tr>
<td>9</td>
<td>16LNI154 / 16SCN253</td>
<td>Network Management</td>
</tr>
<tr>
<td>10</td>
<td>16SCE243 / 16SCS333</td>
<td>Natural Language Processing and Text Mining</td>
</tr>
<tr>
<td>11</td>
<td>16LNI323 / 16SCN244 / 16SFC332 / 16SIT241</td>
<td>Mobile Application Development</td>
</tr>
<tr>
<td>12</td>
<td>16SFC321</td>
<td>Security Architecture Design</td>
</tr>
<tr>
<td>13</td>
<td>16LNI252</td>
<td>Software Agents</td>
</tr>
<tr>
<td>14</td>
<td>16SCE333</td>
<td>Software Defined Networks</td>
</tr>
</tbody>
</table>
Visvesvaraya Technological University, Belagavi.  
PhD Coursework Courses – 2018 (Computer Science and Engineering)  
As per 2017 Regulation

### Group 5

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16SCS22/16SSE244</td>
<td>Advanced Algorithms</td>
</tr>
<tr>
<td>2</td>
<td>16LNI321 / 16SCN12 / 16SCS151</td>
<td>Advances in Computer Networks</td>
</tr>
<tr>
<td>3</td>
<td>16SCS243 / 16SIT252</td>
<td>Business Intelligence and its Applications</td>
</tr>
<tr>
<td>4</td>
<td>16SCE332 / 16SFC252</td>
<td>Database Security</td>
</tr>
<tr>
<td>5</td>
<td>16LNI253 / 16SIT242</td>
<td>Bioinformatics</td>
</tr>
<tr>
<td>6</td>
<td>16SCE254</td>
<td>Computer Vision</td>
</tr>
<tr>
<td>7</td>
<td>16SFC253 / 16SIT12 / 16SSE22 / 16SCS324</td>
<td>Enterprise Application Programming</td>
</tr>
<tr>
<td>8</td>
<td>16SCE22 / 16SCN152 / 16SCS152</td>
<td>Multi Core Architecture and Programming</td>
</tr>
<tr>
<td>9</td>
<td>16LNI322 / 16SCE321 / 16SCN324 / 16SCS31 / 16SFC254 / 16SIT322 / 16SSE334</td>
<td>Machine Learning Techniques</td>
</tr>
<tr>
<td>10</td>
<td>16LNI333 / 16SCE331 / 16SCN154 / 16SFC152</td>
<td>Cloud Security</td>
</tr>
<tr>
<td>11</td>
<td>16SFC22</td>
<td>Operating System Security</td>
</tr>
<tr>
<td>12</td>
<td>16LNI332 / 16SCN153 / 16SFC333</td>
<td>Social Network Analysis</td>
</tr>
<tr>
<td>13</td>
<td>16SIT153 / 16SSE14</td>
<td>Service Oriented Architecture</td>
</tr>
<tr>
<td>14</td>
<td>16SFC23</td>
<td>Secured Programming</td>
</tr>
</tbody>
</table>

### Group 6

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16LNI331 / 16SCE241 / 16SCN151 / 16SCS323</td>
<td>Wireless Networks &amp; Mobile Computing</td>
</tr>
<tr>
<td>2</td>
<td>16SCN424</td>
<td>Web Mining</td>
</tr>
<tr>
<td>3</td>
<td>16SCN333 / 16SIT324</td>
<td>Web Engineering</td>
</tr>
<tr>
<td>4</td>
<td>16LNI324 / 16SCE251 / 16SCN251</td>
<td>Wireless Sensor Networks</td>
</tr>
<tr>
<td>5</td>
<td>16SCN242</td>
<td>Switching &amp; Statistical Multiplexing In Telecommunications</td>
</tr>
<tr>
<td>6</td>
<td>16LNI242 / 16SIT21 / 16SSE154</td>
<td>Web Services</td>
</tr>
<tr>
<td>7</td>
<td>16LNI241 / 16SCN23</td>
<td>Wireless Ad hoc Networks</td>
</tr>
<tr>
<td>8</td>
<td>16SFC322</td>
<td>Steganography and Digital Watermarking</td>
</tr>
<tr>
<td>9</td>
<td>16SSE21 / 16SCS332</td>
<td>Software Project Planning &amp; Management</td>
</tr>
<tr>
<td>10</td>
<td>16SFC334 / 16SIT243 / 16SSE242</td>
<td>Software Metrics &amp; Quality Assurance</td>
</tr>
<tr>
<td>11</td>
<td>16SFC244 / 16SSE253</td>
<td>Trust Management in E-commerce</td>
</tr>
<tr>
<td>12</td>
<td>16SCS23</td>
<td>Software Design Patterns</td>
</tr>
<tr>
<td>13</td>
<td>16SCS252 / 16SIT323 / 16SSE254</td>
<td>Trends in Artificial Intelligence and Soft Computing</td>
</tr>
<tr>
<td>14</td>
<td>16SSE41</td>
<td>Soft Computing</td>
</tr>
</tbody>
</table>
**Visvesvaraya Technological University, Belagavi.**  
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**  
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>01</th>
<th>16SFC151</th>
<th>Group-1</th>
<th>ACCESS CONTROL AND IDENTITY MANAGEMENT SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam Hours:</strong></td>
<td>03</td>
<td><strong>Exam Marks:</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
Elements of trust paradigms in computing, Third party approach to identity trust, Kerberos, Explicit third party authentication paradigm, PKI approach to trust establishment, Attribute certificates, Generalized web of trust models, Examples.

**Module -3**
Mandatory access control, comparing information flow in BLP and BIBA models, Combining the BLP and BIBA models, Chinese wall problem.

**Module -4**
Discretionary access control and Access matrix model, definitions, Safety problem, The take grant protection model, Schematic protection model, SPM rules and operations, Attenuating, Applications

**Module -5**
Role based access control, Hierarchical Access Control, Mapping of a mandatory policy to RABC, Mapping discretionary control to RBAC, RBAC flow analysis, Separation of Duty in RBAC, RBAC consistency properties, The privileges perspective of separation of duties, Functional specification for RBAC.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
## Module -1
Introduction: Design methodology – An introduction; IC technology options

## Module -2
Logic Design with Verilog: Structural models of combinational logic; Logic simulation, Design verification, and Test methodology; Propagation delay; Truth-Table models of Combinational and sequential logic with Verilog.

## Module -3
Logic Design with Behavioral Models: Behavioral modeling; A brief look at data types for behavioral modeling; Boolean-Equation – Based behavioral models of combinational logic; Propagation delay and continuous assignments; Latches and Level – Sensitivity circuits in Verilog; Cyclic behavioral models of Flip-Flops and Latches; Cyclic behavior and edge detection; A comparison of styles for behavioral modeling; Behavioral models of multiplexers, encoders, and decoders; Dataflow models of a Linear-Feedback Shift Register; Modeling digital machines with repetitive algorithms; Machines with multi-cycle operations; Design documentation with functions and tasks; Algorithmic state machine charts for behavioral modeling; ASMD charts; Behavioral models of counters, shift registers and register files; Switch debounce, meta-stability and synchronizers for asynchronous signals; Design example

## Module -4
Synthesis of Combinational and Sequential Logic: Introduction to synthesis; Synthesis of combinational logic; Synthesis of sequential logic with latches; Synthesis of three-state devices and bus interfaces; Synthesis of sequential logic with flip-flops; Synthesis of explicit state machines; Registered logic; State encoding; Synthesis of implicit state machines, registers and counters; Resets; Synthesis of gated clocks and clock enables; Anticipating the results of synthesis; Synthesis of loops; Design traps to avoid; Divide and conquer: Partitioning a design.

## Module -5
Programmable Logic and Storage Devices: Programmable logic devices; storage devices; PLA; PAL; Programmability of PLDs; CPLDs; FPGAs; Verlog-Based design flows for FPGAs; Synthesis with FPGAs.

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:
## AGILE TECHNOLOGIES

<table>
<thead>
<tr>
<th>Module</th>
<th>16SCS242 Group-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>Why Agile?: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile?: Agile Methods, Don’t Make Your Own Method, The Road to Mastery, Find a Mentor</td>
</tr>
<tr>
<td>Module 2</td>
<td>Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us?, Go!, Assess Your Agility</td>
</tr>
<tr>
<td>Module 5</td>
<td>Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence: Software Doesn’t Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery</td>
</tr>
</tbody>
</table>

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:

### Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>04</th>
<th>16SCS244</th>
<th>Group-1</th>
<th>DATA MINING &amp; DATA WAREHOUSING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exam Hours:03</td>
</tr>
<tr>
<td>Module -1</td>
<td>Introduction and Data Preprocessing</td>
<td>Why data mining. What is data mining. What kinds of data can be mined. What kinds of patterns can be mined. Which Technologies Are used. Which kinds of Applications are targeted. Major issues in data mining. Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization.</td>
<td></td>
</tr>
<tr>
<td>Module -2</td>
<td>Data warehousing and online analytical processing</td>
<td>Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation, Data generalization by attribute-oriented induction.</td>
<td></td>
</tr>
<tr>
<td>Module -3</td>
<td>Classification</td>
<td>Basic Concepts: Basic Concepts, Decision tree induction, Bays Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy.</td>
<td></td>
</tr>
<tr>
<td>Module -4</td>
<td>Cluster Analysis</td>
<td>Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering.</td>
<td></td>
</tr>
<tr>
<td>Module -5</td>
<td>Data mining trends and research frontiers</td>
<td>Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society.</td>
<td></td>
</tr>
</tbody>
</table>

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining Concepts and Techniques, ELSEVIER(MK) 3rd edition 2012.

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td>Introduction</td>
<td>Two examples of analysis: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; the importance of quantitative modeling in the Engineering of Telecommunication Networks.</td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td>Multiplexing</td>
<td>Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td>Stream Sessions</td>
<td>Deterministic Network Analysis: Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling (continued).</td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td>Stream Sessions</td>
<td>Stochastic Analysis: Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little’s theorem, Brumelle’s theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range-Dependent traffic.</td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td>Adaptive Bandwidth Sharing for Elastic Traffic</td>
<td>Elastic transfers in a Network; Network parameters and performance objectives; sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet’s Adaptive Window Protocol; Bandwidth sharing in a Network.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Text Books:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Exam Hours: 03</th>
<th>Exam Marks: 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td>16LN131</td>
</tr>
<tr>
<td>Group-1</td>
<td>CLIENT SERVER PROGRAMMING</td>
</tr>
</tbody>
</table>
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)

As per 2017 Regulation

Client for the ECHO Service.


Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

<table>
<thead>
<tr>
<th>07</th>
<th>16SCS153</th>
<th>Group-1</th>
<th>DATA COMPRESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td>Module -1: Introduction</td>
<td>Compression techniques, modeling and coding mathematical preliminaries for lossless compression: A brief introduction to information theory, models, coding, algorithmic information theory, minimum description length principle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Module -2: Huffman Coding</td>
<td>The Huffman coding algorithm, non binary Huffman codes, adaptive Huffman coding, golomb codes, rice codes, Tunstall codes, application of Huffman coding.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Module -3: Lossless Image Compression</td>
<td>Introduction, CALIC, JPEG-LS, multi resolution approaches, facsimile encoding, MRC-T.44, Mathematical Preliminaries For Lossy Coding: Introduction, distortion criteria, information theory revisited, rate distortion theory, models</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Module -4: Wavelet Based Compression</td>
<td>Introduction, wavelets, multi resolution analysis and scaling function, implementation using filters, image compression, embedded zero tree coder, set partitioning in hierarchical trees, JPEG zero. Audio Coding: Introduction, MPEG coding, MPEG advanced audio coding, Dolby AC3(DOLBY DIGITAL) other standards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Question paper pattern:</td>
<td>The question paper will have ten questions. Each full question consists of 20 marks.</td>
</tr>
</tbody>
</table>
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>08</th>
<th>16SIT152</th>
<th>Group-1</th>
<th>INFORMATION STORAGE MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

*Introduction to Information Storage:* Information Storage, Evolution of Storage Architecture, Data center Infrastructure, Virtualization and cloud computing. **Data Center Environment:** Application, Database Management System(DBMS), Host(compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage. Storage Design Based On Application, Disk Native Command Queuing, Introduction to Flash Drives, Concept in Practice: VMware ESXi. **Data Protection:** RAID: RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares.

**Module -2**


**Module -3**


**Module -4**


**Module -5**


**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
1. EMC2 : Information Storage and Management, Willey India 2013.

**Reference Books:**
4. Additional resource material on www.emc.com/resource-library/resource-library.esp
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>09</th>
<th>16LN112/16SCN13/16SCS253</th>
<th>Group-1</th>
<th>INFORMATION AND NETWORK SECURITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Classical Encryption Techniques** Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. **Block Ciphers and the data encryption standard:** Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.

**Module -2**

**Public-Key Cryptography and RSA:** Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems:** Diffie-hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA.

**Module -3**

**Key Management and Distribution:** Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, public key infrastructure. **User Authentication:** Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation, Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication, federated identity management, identity management, identity federation, personal identity verification.

**Module -4**


**Module -5**


**Question paper pattern:**
- The question paper will have ten questions.
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Text Books:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
</table>
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Exam Hours: 03</th>
<th>Exam Marks: 100</th>
</tr>
</thead>
</table>

**INTERNET OF THINGS**

**Module -1** What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks- IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples- Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.


**Module -4** Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

**Module -5** Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

*As per 2017 Regulation*

<table>
<thead>
<tr>
<th>11</th>
<th>16SCN322</th>
<th>Group-1</th>
<th>NETWORK ROUTING ALGORITHMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**


**Routing Algorithms: Shortest Path and Widest Path:** Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra’s Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra’s Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm


**Module -2**


**OSPF and Integrated IS-IS:** From a Protocol Family to an Instance of a Protocol, OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS, Similarities and Differences Between IS-IS and OSPF

**Internet Routing Architectures:** Internet Routing Evolution, Addressing and Routing: Illustrations, Current Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability

**Module -3**

**Router Architectures:** Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures. **IP Address Lookup Algorithms:** Impact of Addressing on Lookup, Longest Prefix Matching, Naïve Algorithms, Binary Tries, Multibit Tries, Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches. **IP Packet Filtering and Classification:** Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions.

**Module -4**

**ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS:** Wireless networking basic aspects, Basic routing concepts, AD hoc routing, Mesh routing, Vehicular routing, Sensor routing

**Module -5**


**Question paper pattern:**

- The question paper will have ten questions.
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.  
PhD Coursework Courses – 2018 (Computer Science and Engineering)  
As per 2017 Regulation

<table>
<thead>
<tr>
<th>12</th>
<th>16SFC324</th>
<th>Group-1</th>
<th>SECURITY ASSESSMENT AND VERIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**  
Evolution of information security: information assets, security standards, organizational impacts, security certifications, elements of information security program, need for security assessment, security assessment process.

**Module -2**  

**Module -3**  
Business process evaluation, Technology evaluation, Risk analysis, Risk mitigation.

**Module -4**  

**Module -5**  
Information security standards, Information security Legislation, Formal security verification, Security verification with SSL.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)

As per 2017 Regulation

<table>
<thead>
<tr>
<th>13</th>
<th>16SCN332</th>
<th>Group-1</th>
<th>PROTOCOL ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
<th>Group-1</th>
<th>PATTERN RECOGNITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -2</td>
<td>Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -3</td>
<td>Nearest Neighbor based classifiers &amp; Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayessian belief network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -5</td>
<td>Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy’s, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>OSI security architecture: Classical encryption techniques, Cipher principles, Data encryption standard, Block cipher design principles and modes of operation, Evaluation criteria for AES, AES cipher, Triple DES, Placement of encryption function, Traffic confidentiality.</td>
</tr>
<tr>
<td>Module -2</td>
<td>Key management: Diffie Hellman key exchange, Elliptic curve architecture and cryptography, Introduction to number theory, Confidentiality using symmetric encryption, Public key cryptography and RSA.</td>
</tr>
<tr>
<td>Module -4</td>
<td>Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. non local interactions, entanglements, EPR paradox, Bell’s theorem, Bell basis, teleportation of a single qubit theory and experiments.</td>
</tr>
<tr>
<td>Module -5</td>
<td>Future trends: Review of recent experimental achievements, study on technological feasibility of a quantum computer candidate physical systems and limitations imposed by noise.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>02</th>
<th>16SCS241</th>
<th>Group-2</th>
<th>ADVANCES IN STORAGE AREA NETWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Introduction**: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.

**Module -2**

**I/O Techniques**: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

**Module -3**

**Storage Virtualization**: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

**Module -4**

**SAN Architecture and Hardware devices**: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch’s Operating system; Device Drivers; Supporting the switch’s components; Configuration options for SANs.

**Module -5**


**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2013.

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>03</th>
<th>16SCS151</th>
<th>Group-2</th>
<th>COMPUTER SYSTEMS PERFORMANCE ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**
Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

**Module -4**
Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote- Terminal Emulation; Components of an RTE; Limitations of RTEs. Experimental Design and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.

**Module -5**
Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little’s Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little’s Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>04</th>
<th>16SCS12</th>
<th>Group-2</th>
<th>ADVANCES IN OPERATING SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
**Threads, SMP, and Microkernel, Virtual Memory:** Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX Memory Management, Windows Vista Memory Management, Summary

**Module -3**
**Multiprocessor and Real-Time Scheduling:** Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSl) Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biometrics: Introduction, benefits of biometrics over traditional authentication systems, benefits of biometrics in identification systems, selecting a biometric for a system, Applications, Key biometric terms and processes, biometric matching methods, Accuracy inbiometric systems.</td>
</tr>
<tr>
<td>4</td>
<td>Multi biometrics: Multi biometrics and multi factor biometrics, two-factor authentication with passwords, tickets and tokens, executive decision, implementation plan.</td>
</tr>
<tr>
<td>5</td>
<td>Case studies on Physiological, Behavioral and multifactor biometrics in identification systems.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>06</th>
<th>16SCS334</th>
<th>Group-2</th>
<th>CYBER SECURITY AND CYBER LAW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1

Module -2

Module -3

Module -4

Module -5

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
| Module |  
|--------|---|
| **Module -1** | Casing the Establishment: What is footprinting, Internet Footprinting, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Case study: Network Security Monitoring. |
| **Module -2** | Securing permission: Securing file and folder permission, Using the encrypting file system, Securing registry permissions. Securing service: Managing service permission, Default services in windows 2000 and windows XP. Unix: The quest for Root, Remote Access vs Local access, Remote access, Local access, After hacking root. |
| **Module -3** | Dial-up, PBX, Voicemail and VPN hacking, Preparing to dial up, War-Dialing, Brute-Force Scripting PBX hacking, Voice mail hacking, VPN hacking. Network Devices: Discovery Autonomous System Lookup, Public Newsgroups, Service Detection, Network Vulnerability, Detecting Layer 2 Media. |
| **Module -5** | Remote Control Insecurities, Discovering Remote Control Software, Connection, Weakness.VNC, Microsoft Terminal Server and Citrix ICA, Advanced Techniques Session Hijacking, Back Doors, Trojans, Cryptography, Subverting the systems Environment, Social Engineering, Web Hacking, Web server hacking web application hacking, Hacking the internet Use, Malicious Mobile code, SSL fraud, E-mail Hacking, IRC hacking, Global countermeasures to Internet User Hacking. |

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
2. Rafay Baloch, “A Beginners Guide to Ethical Hacking”.
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -5</td>
<td>UFS1 and UFS2 Concepts and Analysis: Introduction, File System Category, Content Category, Metadata Category, File Name Category, The Big Picture. UFS1 and UFS2 Data Structures: UFS1 Superblock, UFS2 Superblock, Cylinder Group Summary, UFS1 Group Descriptor, UFS2 Group Descriptor, Block and Fragment Bitmaps, UFS1 Inodes, UFS2 Inodes, UFS2 Extended Attributes, Directory Entries</td>
</tr>
</tbody>
</table>

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
**Visvesvaraya Technological University, Belagavi.**
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>09</th>
<th>16SSE252</th>
<th>Group-2</th>
<th>INFORMATION RETRIEVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**
**Introduction:** Motivation, Basic concepts, Past, present, and future, The retrieval process. **Modeling:** Introduction, A taxonomy of information retrieval models, **Retrieval:** Adhoc and filtering. A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing.

**Module -2**
**Retrieval Evaluation:** Introduction, Retrieval performance evaluation, Reference collections. **Query Languages:** Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. **Query Operations:** Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.

**Module -3**

**Module -4**
**User Interfaces and Visualization:** Introduction, Human-Computer interaction, The information access process, Starting pints, Query specification, Context, Using relevance judgments, Interface support for the search process. **Searching the Web:** Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Finding the needle in the haystack, Searching using hyperlinks.

**Module -5**
**Indexing and Searching:** Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression. **Parallel and Distributed IR:** Introduction, Parallel IR, Distributed IR.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>10</th>
<th>16SCN21</th>
<th>Group-2</th>
<th>MULTIMEDIA COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**
Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles, Text, images, audio and video.

**Module -2**
Text and image compression, compression principles, text compression - Runlength, Huffman, LZW,
Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG

**Module -3**
Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.

**Module -4**
Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs,
MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.

**Module -5**
Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
**Visvesvaraya Technological University, Belagavi.**  
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**  
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>11</th>
<th>16SFC13</th>
<th>Group-2</th>
<th>PRAGMATIC OF INFORMATION SECURITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**  
Perimeter Security: Firewalls, Intrusion Detection, Intrusion Prevention systems, Honeypots  
Case Study: Readings, Intrusion and intrusion detection by John McHugh.

**Module -2**  
User Authentication: Password, Password-based, token based, Biometric, Remote User authentication. Access  
Control: Principles, Access Rights, Discretionary Access Control, Unix File Access Control, Role Based  

**Module -3**  
Cryptographic Tools: Confidentiality with symmetric encryption, Message Authentication & Hash Functions,  
Digital Signatures, Random Numbers. Symmetric Encryption and Message Confidentiality: DES, AES,  
Stream Ciphers, Cipher Block Modes of Operation, Key Distribution.

**Module -4**  
Case Study: Readings, Programming Satan's Computer Ross Anderson and Roger Needham.

**Module -5**  
Malicious Software: Types of Malware, Viruses & Counter Measures, Worms, Bots, Rootkits Software  
Security: Buffer Overflows, Stack overflows, Defense, Other overflow attacks Case Study.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
1. Readings: Smashing The Stack For Fun And Profit, Aleph One http://www.phrack.com/ issues.html?issue=49&id=14#article
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>12</th>
<th>16SFC21</th>
<th>Group-2</th>
<th>PERSERVING AND RECOVERING DIGITAL EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1
Digital evidence and computer crime: history and terminals of computer crime investigation, technology and law, the investigate process, investigate reconstruction, modus operandi, motive and technology, digital evidence in the court room.

Module -2
Computer basics for digital investigators: applying forensic science to computers, forensic examination of windows systems, forensic examination of Unix systems, forensic examination of Macintosh systems, and forensic examination of handheld devices.

Module -3
Networks basics for digital investigators: applying forensic science to networks, digital evidence on physical and datalink layers, digital evidence on network and transport layers, digital evidence on the internet.

Module -4
Investigating computer intrusions, investigating cyber stalking, digital evidence as alibi.

Module -5
Handling the digital crime scene, digital evidence examination guidelines.

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books

Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>13</th>
<th>Group-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>16SCE334 / 16SIT333 / 16SSE13</td>
<td>OBJECT ORIENTED SOFTWARE ENGINEERING</td>
</tr>
</tbody>
</table>

Exam Hours:03  Exam Marks:100

Module -1

Module -2

Module -3

Module -4

Module -5

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td>Data-Level Parallelism in vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instructions Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-level Parallelism, Crosscutting Issues, Putting it All Together: Mobile versus Server GPUs and Tesla versus Core i7, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Study and Exercises by Jason D. Bakos.</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td>Thread-Level Parallelism: Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting it All Together: Multicore Processors and Their Performance, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Studies and Exercises by Amr Zaky and David A. Wood.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
### Visvesvaraya Technological University, Belagavi.

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>02</th>
<th>16SCS331</th>
<th>Group-3</th>
<th>APPLICATION AND WEB SECURITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours: 03</td>
<td>Exam Marks: 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**
Multistep Validation and Canonicalization: Handling Attackers, Handling Errors, Maintaining Audit Logs, Alerting Administrators, Reacting to Attacks.

**Module -2**
Web Application Technologies: The HTTP Protocol, HTTP Requests, HTTP Responses, HTTP Methods, URLs, REST, HTTP Headers, Cookies, Status Codes, HTTPS, HTTP Proxies, HTTP Authentication, Web Functionality, Server-Side Functionality, Client-Side Functionality, State and Sessions, Encoding Schemes, Unicode Encoding, HTML Encoding, Base64 Encoding, Hex Encoding, Remoting and Serialization Frameworks.

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Summary</th>
</tr>
</thead>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
## Visvesvaraya Technological University, Belagavi.

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

As per 2017 Regulation

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
</table>

| **Module -2** | ARM Assembly Language Programming: Data processing instructions. Data transfer instructions. Control flow instructions. Writing simple assembly language programs. ARM Organization and Implementation: 3-stage pipeline ARM organization. 5-stage pipeline ARM organization. ARM instruction execution. ARM implementation. The ARM coprocessor interface. |


### Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:


### Reference Books:

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>05</th>
<th>16SCS21</th>
<th>Group-3</th>
<th>MANAGING BIG DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1

Module -2

Module -3

Module -4

Module -5

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>06</th>
<th>16SCN243</th>
<th>Group-3</th>
<th>ETHERNET TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours: 03</td>
<td>Exam Marks: 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
**Ethernet Media Systems:** Ethernet Media Fundamentals Twisted-Pair Media System (10Base-T) Fiber Optic Media System (10Base-F) Fast Ethernet Twisted-Pair Media System (100Base-TX)

**Module -3**
Fast Ethernet Fiber Optic Media System (100Base-FX) Gigabit Ethernet Twisted-Pair Media System (1000Base-T) Gigabit Ethernet Fiber Optic Media System (1000Base-X)

**Module -4**
Multi-Segment Configuration Guidelines **Building Your Ethernet System:** structured Cabling Twisted-Pair Cables and Connectors Fiber Optic Cables and Connectors

**Module -5**
Ethernet Repeater Hubs Ethernet Switching Hubs **Performance and troubleshooting:** Ethernet Performance Troubleshooting.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
### Module -1
Introduction to decision support systems: DSS Defined, History of decision support systems, Ingredients of a DSS, Data and model management, DSS Knowledge base, User interfaces, User interfaces, The DSS user, Categories and classes of DSSs, Chapter Summary. Decisions and decision makers Decision makers: who are they, Decision styles, Decision effectiveness, How can a DSS help?, A Typology of decisions, Decision theory and Simon’s model of problem solving, Bounded decision making, The process of choice, Cognitive processes, Biases and heuristics in decision making, Chapter summary.

### Module -2
Decisions in the organization: Understanding the organization, Organizational culture. Modeling decision processes: Defining the problem and its structures, Decision models, Types of probability, Techniques for forecasting probabilities, Calibration and sensitivity, Chapter summary.

### Module -3
Group decision support and groupware technologies: Group Decision making, the problem with groups, MDM support technologies, Managing MDM activities, the virtual workspace, chapter summary. Executive information systems: What exactly is an EIS, Some EIS history, Why area top executives so different?, EIS components, Making the EIS work, The future of executive decision making and the EIS, chapter summary.

### Module -4
Designing and building decision support systems: Strategies for DSS analysis and design, The DSS developer, DSS user interface issues, chapter summary. Implementing and integrating decision support systems: DSS implementation, System evaluation, The importance of integration, chapter summary.

### Module -5
Creative decision making and problem solving What is creativity?, Creativity defined, The occurrence of creativity, Creative problem solving techniques, Creativity and the role of technology, chapter summary.

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:

### Reference Books:
1. NILL.
<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -2</td>
<td><strong>Remote Procedure Calls:</strong> Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC.</td>
</tr>
<tr>
<td>Module -3</td>
<td><strong>Distributed Shared Memory:</strong> Introduction, General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. <strong>Synchronization:</strong> Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
**Visvesvaraya Technological University, Belagavi.**  
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**  
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>09</th>
<th>16SFC323</th>
<th>Group-3</th>
<th>MOBILE DEVICE FORENSICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Module -1** | Android and mobile forensics: Introduction, Android platform, Linux, Open source software and forensics, Android Open Source Project, Internationalization, Android Market, Android forensics |
| **Module -2** | Android hardware platforms: Overview of core components, Overview of different device types, Read-only memory and boot loaders, Manufacturers, Specific devices |
| **Module -3** | Android software development kit and android debug bridge: Android platforms, Software development kit (SDK), Android security model, Forensics and the SDK. |
| **Module -4** | Android file systems and data structures: Data in the shell, Type of memory, File systems, Mounted file systems and directory structures. Android forensic techniques: Procedures for handling an Android device, Imaging Android USB mass storage devices, Logical techniques, Physical techniques |
| **Module -5** | Android device data and app security: Data theft targets and attack vectors, Security considerations, Individual security strategies, Corporate security strategies, App development security strategies. Android application and forensic analysis: Analysis techniques, FAT forensic analysis, YAFFS2 forensic analysis, Android app analysis |

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>10</th>
<th>16LNI13</th>
<th>Group-3</th>
<th>NETWORK PROGRAMMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td>Module -1</td>
<td></td>
</tr>
<tr>
<td>Introduction to network application, client/server communication, OSI Model, BSD Networking history, Test Networks and Hosts, Unix Standards, 64-bit architectures, Transport Layer: TCP, UDP and SCTP.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sockets Introduction – socket address structures, value-result arguments, byte ordering and manipulation functions, address conversion functions, Elementary TCP Sockets – socket, connect, bind, listen, accept, fork and concurrent server design, getcsockname and getpeername functions and TCP Client/Server Example-client/server programming through TCP sockets, Normal startup, termination, POSIX signal handling, Signal handling in server, Crashing, rebooting of server host, shutdown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O Multiplexing and Socket Options, Elementary SCTP Sockets- Interface Models, sctp_xx functions, shutdown function, Notifications, SCTP Client/Server Examples – One-to-Many, Head–of-Line Blocking, Controlling number of streams and Termination, IPv4 and IPv6 Interoperability–different interoperability scenarios.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daemon Processes, syslogd, daemonizing functions and the inetd super server, Advanced I/O functions- ready, write, sendmsg and recvmsg, Ancillary data, Advanced polling, Unix domain protocols- socket address structure, functions and communication scenarios, Nonblocking I/O – connect and accept examples.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module -5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ioctl operations- socket, file, interface configuration information, ARP cache and routing table operations, Routing sockets- data link socket address structure, reading and writing, sysctl operations, interface name and index functions, Key Management functions – reading, writing, SADB, SA, Dynamically Maintaining SA’s, Out-of-Band data, Threads- basic thread functions, TCP echo server using threads, Mutexes and Conditional variables.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
### Visvesvaraya Technological University, Belagavi.

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>11</th>
<th>16LNI21</th>
<th>Group-3</th>
<th>NETWORK PROTOCOL DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam Hours:</strong></td>
<td><strong>Exam Marks:</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

### Module -1

How to specify network protocols? Semantics of traditional protocol specifications, syntax of traditional protocol. Network processes constants, inputs, and variables. Specifications in new protocol, A vending machine protocol, a request/reply protocol, a Manchester encoding protocol. Current internet

### Module -2


### Module -3


### Module -4

Local and global topology information, maintaining local topology information, hierarchical topology information topology information in the internet, Abstraction of perfect channel in the internet, Hierarchical routing, random routing.

### Module -5


### Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:


### Reference Books:

### Module - 1

### Module - 2

### Module - 3

### Module - 4

### Module - 5
Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books

### Reference Books:
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>13</th>
<th>16SIT321</th>
<th>Group-3</th>
<th>SUPPLY CHAIN MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**


**Module -2**


**Module -3**

**Designing and Planning Transportation Networks**: Role of transportation - modes and their performance - transportation infrastructure and policies - design options and their trade-offs - Tailored transportation.

**Module -4**

**Sourcing and Pricing**: Sourcing – In-house or Outsource – 3rd and 4th PLs – supplier scoring and assessment, selection – design collaboration – procurement process – sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts.

**Module -5**

**Information Technology in the supply chain**: IT Framework – customer relationship management – internal supply chain management – supplier relationship management – transaction management – future of IT.

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


**Reference Books:**

Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>01</th>
<th>16SCS251</th>
<th>Group-4</th>
<th>ADVANCES IN COMPUTER GRAPHICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1
Three-Dimensional Object Representations: Polyhedra, OpenGL Polyhedron Functions, Curved Surfaces, Quadratic Surfaces, Super quadrics, OpenGL Quadric-Surface and Cubic-Surface Functions, Blobby Objects, Spline Representations, Cubic-Spline Interpolation Methods, Bezier Spline Curves, Bzier Surfaces B-Spline Curves, B-Spline Surfaces, Beta- Splines, Retinal Splines, Conversion Between Spline Representations, Displaying Spline Curves and Surfaces, OpenGL Approximation-Spline Functions, Sweep Representations, Constructive Solid –Geometry Method, Octrees, BSP Trees, Fractal-Geometry Methods, Shape Grammars and Others Procedural Methods, Particle Systems, Physically Based Modeling, Visualization Of Data Sets.

Module -2

Module -3

Module -4

Module -5
Hierarchical modeling and Graphics file formats: Basic modeling concepts, Modeling packages, General hierarchical modeling methods, Hierarchical modeling using openGL display list, Image-File configurations, Color-reduction methods, File-compression techniques, Composition of the major file formats.

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
**Visvesvaraya Technological University, Belagavi.**  
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**  
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td><strong>Review of Relational Data Model and Relational Database Constraints:</strong> Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Overview of Object-Oriented Concepts – Objects, Basic properties. Advantages, examples, Abstract data types, Encapsulation, class hierarchies, polymorphism, examples.</td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td><strong>Object and Object-Relational Databases:</strong> Overview of OOP; Complex objects; Identity, structure etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; syntax and demo examples, The nested relational model. Overview of C++ language binding;</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td><strong>Parallel and Distributed Databases:</strong> Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.</td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td><strong>DataWarehousing, Decision Support and Data Mining:</strong> Introduction to decision support; OLAP, multidimensional model; Window queries in SQL; Finding answers quickly; Implementation techniques for OLAP; Data Warehousing; Views and Decision support, View materialization, Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; ROC and CMC Curves; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks.</td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td><strong>Enhanced Data Models for Some Advanced Applications:</strong> Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -2</strong> Decision Table-Based Testing</td>
<td>Decision tables, Test cases for the triangle problem, Test cases for the NextDate function, Test cases for the commission problem, Guidelines and observations. <strong>Data Flow Testing</strong>: Definition-Use testing, Slice-based testing, Guidelines and observations. <strong>Levels of Testing</strong>: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing. <strong>Integration Testing</strong>: A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integrations, Case study.</td>
</tr>
<tr>
<td><strong>Module -3</strong> System Testing</td>
<td>Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines, ASF (Atomic System Functions) testing example. <strong>Interaction Testing</strong>: Context of interaction, A taxonomy of interactions, Interaction, composition, and determinism, Client/Server Testing. <strong>Issues in Object-Oriented Testing</strong>: Units for object-oriented testing. Implications of composition and encapsulation, inheritance, and polymorphism, Levels of object-oriented testing. <strong>GUI Testing</strong>: Dataflow testing for object-oriented software, Examples. <strong>Class Testing</strong>: Methods as units, Classes as units.</td>
</tr>
<tr>
<td><strong>Module -4</strong> Object-Oriented Integration Testing</td>
<td>UML support for integration testing, MM-paths for object-oriented software, A framework for object-oriented dataflow integration testing. <strong>GUI Testing</strong>: The currency conversion program. <strong>GUI Testing</strong>: Integration Testing and System testing for the currency conversion program. <strong>Object-Oriented System Testing</strong>: Currency converter UML description, UML-based system testing, Statechart-based system testing.</td>
</tr>
<tr>
<td><strong>Module -5</strong> Exploratory Testing</td>
<td>The context-driven school, Exploring exploratory testing. Exploring a familiar example, Exploratory and context-driven testing observations. <strong>Model-Based Testing</strong>: Testing based on models, Appropriate models, Use case-based testing, Commercial tool support for model-based testing. <strong>Test-Driven Development</strong>: Test-then-code cycles, Automated test execution, Java and JUnit example, Remaining questions, Pros, cons, and open questions of TDD, Retrospective on MDD versus TDD.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Module</th>
<th>CLOUD COMPUTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03 Exam Marks:100</td>
<td></td>
</tr>
<tr>
<td><strong>Module -1</strong>&lt;br&gt;<strong>Introduction, Cloud Infrastructure:</strong> Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing, Exercises and problems.</td>
<td></td>
</tr>
<tr>
<td><strong>Module -2</strong>&lt;br&gt;<strong>Cloud Computing: Application Paradigms:</strong> Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.</td>
<td></td>
</tr>
<tr>
<td><strong>Module -3</strong>&lt;br&gt;<strong>Cloud Resource Virtualization:</strong> Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems.</td>
<td></td>
</tr>
<tr>
<td><strong>Module -4</strong>&lt;br&gt;<strong>Cloud Resource Management and Scheduling:</strong> Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.</td>
<td></td>
</tr>
<tr>
<td><strong>Module -5</strong>&lt;br&gt;<strong>Cloud Security, Cloud Application Development:</strong> Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis, Exercises and problems.</td>
<td></td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>05</th>
<th>16SCE13/16SCS152</th>
<th>Group-4</th>
<th>EMBEDDED COMPUTING SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**
Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.

**Module -2**
Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systems-network protocols, Wireless and mobile system protocols.

**Module -3**
Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.

**Module -4**
Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Interprocess communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.

**Module -5**
Real-time operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

06 16SFC13 Group-4 CYBER CRIME AND CYBER FORENSICS

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
</table>

**Module -1**

**Module -2**

**Module -3**

**Module -4**

**Module -5**
Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC, Electronic Communication Privacy ACT, Legal Policies.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>07</th>
<th>16SFC241</th>
<th>Group-4</th>
<th>CYBER LAWS AND ETHICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**
Intellectual Property Law for Cyber Space: Concept of Virtual assets, nature of Intellectual property, Trademarks and domain names, copyright law, law of patents.

**Module -4**
Intellectual Property Law for Cyber Space: Concept of Virtual assets, nature of Intellectual property, Trademarks and domain names, copyright law, law of patents.

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)

As per 2017 Regulation

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td>08 16SCN323</td>
<td>Group-4</td>
</tr>
</tbody>
</table>

**INFORMATION SECURITY POLICIES IN INDUSTRY**

**Module -1**
Introduction to Information Security Policies: About Policies, why Policies are Important, When policies should be developed, How Policy should be developed, Policy needs, Identify what and from whom it is being protected, Data security consideration, Backups, Archival storage and disposal of data, Intellectual Property rights and Policies, Incident Response and Forensics, Management Responsibilities, Role of Information Security Department, Security Management and Law Enforcement, Security awareness training and support.

**Module -2**

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation


Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td>Module -1</td>
<td>Module -2</td>
<td>Module -3</td>
<td>Module -4</td>
<td>Module -5</td>
<td>Question paper pattern:</td>
<td>Text Books:</td>
<td>Reference Books:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• There will be 2 full questions (with a maximum of four sub questions) from each module.</td>
<td>3. Gerald J. Kowalski and Mark.T. Maybury, “Information Storage and Retrieval systems”, Kluwer academic Publishers, 2000.</td>
<td>4. Steven Bird, Ewan Klein, Edward Loper, “Natural Language Processing with Python,” Publisher: O'Reilly Media, June 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Each full question will have sub questions covering all the topics under a module.</td>
<td>5. Christopher D.Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.</td>
<td>5. Christopher D.Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.</td>
</tr>
</tbody>
</table>
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>11</th>
<th>16SCN244</th>
<th>Group-4</th>
<th>MOBILE APPLICATION DEVELOPMENT</th>
</tr>
</thead>
</table>

**Exam Hours:** 03  | **Exam Marks:** 100

**Module -1**
Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.

**Module -2**

**Module -3**

**Module -4**

**Module -5**
Displaying web pages and maps, communicating with SMS and emails. Creating and using content providers: Creating and consuming services, publishing android applications

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
1. Mobile Computing: (technologies and Applications-N. N. Jani Schand
2. B.M.Hirwani- Android programming Pearson publications-2013

**Reference Books:**
1. NIL
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>12</th>
<th>16SFC321</th>
<th>Group-4</th>
<th>SECURITY ARCHITECTURE DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

**Reference Books:**
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

As per 2017 Regulation

<table>
<thead>
<tr>
<th>13</th>
<th>16LNI252</th>
<th>Group-4</th>
<th>SOFTWARE AGENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -3</strong></td>
<td>Agents that Reduce Work and Information Overload Introduction, Approaches to Building Agents, Training a Personal Digital Assistant, Some Example of Existing Agents, Electronic Mail Agents, Meeting Scheduling Agent, News Filtering Agent, Entertainment Selection Agent, Discussion, Acknowledgements Software Agents for Cooperative Learning: Computer-Supported Cooperative Learning, Examples of Software Agents for Cooperative Learning, Examples of Software Agents for Cooperative Learning, Developing an Example, Discussion and Perspectives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td>Agent for Information Gathering: Agent Organization, The Knowledge of an Agent, The Domain Model of an Agent, Modeling other Agent, communication language and protocol, query processing, an information goal, information source selection, generating a query access plan, interleaving planning and execution , semantic query optimization, learning, caching retrieved data, related work, discussion, acknowledgement. Mobile Agents: Enabling Mobile Agents, Programming Mobile Agents, Using Mobile Agents.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


**Reference Books:**

Module - 1 Introduction. Centralized and Distributed Control and Data Planes.

Module - 2 OpenFlow.

SDN Controllers.

Module - 3 Network Programmability.

Module - 4 Network Function Virtualization.

Module - 5 Building an SDN Framework.

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
3. When SDN Meets Hadoop big data analysis, things get dynamic – Conrad Menezes – TechTarget.
### Visvesvaraya Technological University, Belagavi.

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>01</th>
<th>16SCS22</th>
<th>Group-5</th>
<th>ADVANCED ALGORITHMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam Hours:</strong></td>
<td>03</td>
<td><strong>Exam Marks:</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

#### Module -1


#### Module -2

**Graph Algorithms:** Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson’s Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

#### Module -3

**Number -Theoretic Algorithms:** Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization

#### Module -4

**String-Matching Algorithms:** Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.

#### Module -5

**Probabilistic and Randomized Algorithms:** Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

#### Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

#### Text Books:


#### Reference Books:

ADVANCES IN COMPUTER NETWORKS

Module -1
T1: Chapter 1.1, 1.2, 1.5.1, 1.5.2, 2.1, 2.5
T2: Chapter 4

Module -2
Internetworking I: Switching and Bridging, Datagram’s, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.
T1: Chapter 3.1, 3.2

Module -3
Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP
T1: Chapter 3.3, 4.1.1,4.1.3 T2:Chapter 13.1 to 13.18 , Ch 18.

Module -4
End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End to- End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery
T1: Chapter 5.1, 5.2.1 to 5.2.8, 6.2, 6.3

Module -5
Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web (HTTP), Network Management (SNMP) T1: Chapter 6.4 T2: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>03</th>
<th>16SCS243</th>
<th>Group-5</th>
<th>BUSINESS INTELLIGENCE AND ITS APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process

**Module -3**
Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery

**Module -4**

**Module -5**
Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics f enterprise reporting, BI road ahead.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
# DATABASE SECURITY

**Exam Hours:** 03  
**Exam Marks:** 100

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
</tr>
</thead>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
1. Database security by Alfred Basta, Melissa Zgola , CENGAGE learning.
VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

PHD COURSEWORK COURSES – 2018 (COMPUTER SCIENCE AND ENGINEERING)

AS PER 2017 REGULATION

BIOINFORMATICS

EXAM HOURS: 03
EXAM MARKS: 100

GROUP-5

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td>INTRODUCTION: Need for Bioinformatics technologies – Overview of Bioinformatics technologies – Structural bioinformatics – Data format and processing – secondary resources- Applications – Role of Structural bioinformatics - Biological Data Integration System.</td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td>DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS: Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture- Applications in bioinformatics.</td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td>MICROARRAY ANALYSIS: Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding, spot extraction, normalization, filtering – cluster analysis – gene network analysis</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
1. NILL
**Visvesvaraya Technological University, Belagavi.**  
**PhD Coursework Courses – 2018 (Computer Science and Engineering)**  
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Group</th>
<th>Exam Hours</th>
<th>Exam Marks</th>
<th>Module</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 16SCE254</td>
<td>Group-5</td>
<td>03</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)

As per 2017 Regulation

<table>
<thead>
<tr>
<th>Group-5</th>
<th>ENTERPRISE APPLICATION PROGRAMMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>16SCS324</td>
</tr>
</tbody>
</table>

**Exam Hours:** 03  **Exam Marks:** 100

### Module 1

**Web application and java EE 6:** Exploring the HTTP Protocol, Introducing web applications, describing web containers, exploring web architecture models, exploring the MVC architecture. **Working with servlets 3.0** Exploring the features of java servlet, Exploring new features in servlet 3.0, Exploring the servlet API, explaining the servlet life cycle, creating a sample servlet, creating a servlet by using annotation, working with servlet config and servlet context objects, working with the HTTP servlet request and HTTP servlet response interfaces, Exploring request delegation and request scope, implementing servlet collaboration.

### Module 2

**Handling sessions in servlet 3.0:** Describing a session, introducing session tracking, Exploring the session tracking mechanisms, using the java servlet API for session tracking, creating login application using session tracking. **Implementing event handling** Introducing events, Introducing event handling, working with the servlet events, developing the online shop web application. **Working with java server pages:** Introducing JSP technology, Exploring new features of JSP2.1, listing advantages of JSP over java servlet, Exploring the architecture of a JSP page, Describing the life cycle of a JSP page, working with JSP basic tags and implicit objects, working with the action tags in JSP, exploring the JSP unified EL, using functions with EL.

### Module 3

**Implementing JSP tag extensions:** Exploring the elements of tag extensions, Working with classic tag handlers, Exploring the tag extensions, Working with simple tag handlers. **Implementing java server pages standard tag library 1.2:** Introducing JSTL, Exploring the tag libraries JSTL, working with the core tag library. **Implementing filters:** Exploring the need of filters, exploring the working of filters, exploring filters API, configuring a filter, creating a web application using filters, using initializing parameter in filters.

### Module 4

**Persistence Management and Design Patterns:** Implementing java persistence using hibernate Introducing hibernate, exploring the architecture of hibernate, downloading hibernate, exploring HQL, understanding hibernate O/R mapping, working with hibernate, Implementing O/R mapping with hibernate. **Java EE design patterns:** Describing the java EE application architecture, Introducing a design patterns, discussing the role of design patterns, exploring types of patterns.

### Module 5

**Web Frameworks:** Working with struts 2 Introducing struts 2, understanding actions in struts 2. **Working with java server faces 2.0:** Introducing JSF, Explaining the features of JSF, Exploring the JSF architecture, describing JSF elements, Exploring the JSF request processing life cycle. **Working with spring 3.0:** Introducing features of the spring framework, exploring the spring framework architecture, exploring dependency injection & inversion of control, exploring AOP with spring, managing transactions. **Securing java EE 6 applications:** Introducing security in java EE 6, exploring security mechanisms, implementing security on an application server.

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:
1. Kogent learning solution: JAVA SERVER PROGRAMMING JAVA EE6(J2EE 1.6), Dreamtech press 2014
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>08</th>
<th>16SCS152</th>
<th>Group-5</th>
<th>MULTI CORE ARCHITECTURE AND PROGRAMMING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>08</td>
<td></td>
<td>Exam Hours:03</td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**
Threading APIs : Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

**Module -4**

**Module -5**
Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:** Nil
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>09</th>
<th>16SCS31</th>
<th>Group-5</th>
<th>MACHINE LEARNING TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
## Visvesvaraya Technological University, Belagavi.
### PhD Coursework Courses – 2018 (Computer Science and Engineering)
#### As per 2017 Regulation

<table>
<thead>
<tr>
<th>10</th>
<th>16SCN154</th>
<th>Group-5</th>
<th>CLOUD SECURITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Module -1

### Module -2
Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.

### Module -3

### Module -4
Data Center Operations: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, **8 Hours**

### Module -5

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:

### Reference Books:
Module -1

Module -2

Module -3
Security in ordinary operating system: UNIX security, windows security Verifiable security goals: Information flow, information flow secrecy, models, information flow integrity model, the challenges of trusted, process, covert channels.

Module -4
Security Kernels: The Security Kernels, secure communications, processor Scomp, Gemini secure OS, Securing commercial OS, Retrofitting security into a commercial OS, History Retrofitting commercial OS, Commercial era, microkernel era, UNIX era- IX, domain and type enforcement.

Module -5
Case study: Solaris Extensions Trusted extensions, access control, Solaris compatibility, trusted extensions, mediations process rights management, role based access control, trusted extensions, networking trusted extensions, multilevel services, trusted extensions administration.
Case study: Building secure OS for Linux: Linux security modules, security enhanced Linux.

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
1. Michael Palmer, Guide to Operating system Security Thomson
2. Andrew S Tanenbaum, Modern Operating systems, 3rd Edition
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>12</th>
<th>16SCN153</th>
<th>Group-5</th>
<th>SOCIAL NETWORK ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
**Network structure, Node centralities and ranking on network:** Nodes and edges, network diameter and average path length. Node centrality metrics: degree, closeness and betweenness centrality. Eigenvector centrality and PageRank. Algorithm HITS.

**Module -3**

**Module -4**
**Information and influence propagation on networks and Network visualization:** Social Diffusion. Basic cascade model. Influence maximization. Most influential nodes in network. Network visualization and graph layouts. Graph sampling. Low-dimensional projections.

**Module -5**
**Social media mining and SNA in real world: FB/VK and Twitter analysis:** Natural language processing and sentiment mining. Properties of large social networks: friends, connections, likes, re-tweets.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

**Reference Books:**
NIL
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)

As per 2017 Regulation

<table>
<thead>
<tr>
<th>13</th>
<th>16SSC14</th>
<th>Group-5</th>
<th>SERVICE ORIENTED ARCHITECTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1

Module -2

Module -3

Module -4

Module -5

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validating all input &amp; Designing secure programs: Command line and environment variables, File descriptors, names and contents, Web based application inputs, Locale selection and character encoding, Filtering represent able URIs, preventing cross site malicious input content, Forbidding HTTP Input to perform non-queries. Good security design principles: Securing the interface, separation of data and control. Minimize privileges: Granted, time, modules, resources etc, Using chroot, careful use of setuid/setgid, Safe default value and load initializations. Avoid race conditions, Trustworthy channels and trusted path, Avoiding semantics and algorithmic complexity attacks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declarations and Initializations and Expressions: Declare objects with appropriate storage durations, Identifier declaration with conflict linkage classifications, Using correct syntax for declaring flexible array member, Avoiding information leakage in structure padding, Incompatible declarations of same function or object. Dependence on evaluation order for side effects: Reading uninitialized memory and dereferencing null pointers, Modifying objects with temporary lifetime, Accessing variable through (pointer) incompatible type, Modifying constant objects and comparing padding data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integers and Floating Points: Wrapping of unsigned integers, Integer conversions and misrepresented data, Integer overflow and divide by zero errors, Shifting of negative numbers, Using correct integer precisions, Pointer conversion to integer and vice versa. Floating point values for counters: Domain and range errors in math functions, Floating point conversions and preserving precision.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrays , Strings and Memory Management: Out of bounds subscripts and valid length arrays, Comparing array pointers, Pointer arithmetic for non-array object, scaled integer, Modifying string literals, Space allocation for strings (Null terminator), Casting large integers as unsigned chars, Narrow and wide character strings and functions. Accessing freed memory: Freeing dynamically allocated memory, Computing memory allocation for an object, Copying structures containing flexible array members, Modifying object alignment by using realloc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module -5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O, Signals and Error Handling: User input and format strings, Opening an pre-opened file, Performing device operations appropriate for files, Dealing with EOF, WEOF, Copying FILE object, Careful use of fgets, fgetws, getc, putc, putwc. Use of fsetops and fgeto ps, Accessing closed files. Using asynchronous safe functions and signal handlers: Shared objects and signal handlers, Using signal() within interruptible signal handlers, Returning computation exception signal handler. Using errno: check and set, Depending upon indeterminate values of errno, Handling standard library errors.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Course Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -2</td>
<td>Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6</td>
</tr>
<tr>
<td>Module -4</td>
<td>Building, Mobile Internet Applications: Thin client: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXML.</td>
</tr>
<tr>
<td>Module -5</td>
<td>J2ME: Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs: Communication in MIDP, Security Considerations in MIDP.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.  
PhD Coursework Courses – 2018 (Computer Science and Engineering)  
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module -1</strong></td>
<td><strong>INTRODUCTION:</strong> Crawling and Indexing, Topic Directories, Clustering and Classification, Hyperlink Analysis, Resource Discovery and Vertical Portals, Structured vs. Unstructured Data Mining. <strong>INFRASTRUCTURE and WEB SEARCH</strong> – Crawling the web – HTML and HTTP Basics – Crawling Basics – Engineering Large Scale Crawlers- Putting together a Crawler- Boolean Queries and the Inverted Index – Relevance Ranking – Similarity Search.</td>
</tr>
<tr>
<td><strong>Module -3</strong></td>
<td><strong>LEARNING I:</strong> Similarity and Clustering – Formulations and approaches- Bottom up and Top down Partitioning Paradigms – Clustering and Visualization via Embedding’s – Probabilistic Approaches to clustering – Collaborative Filtering, <strong>SUPERVISED LEARNING:</strong> The Supervised Learning Scenario, Overview of Classification Strategies, Evaluating Text Classifiers, Nearest Neighbor Learners, Feature Selection.</td>
</tr>
<tr>
<td><strong>Module -4</strong></td>
<td><strong>LEARNING II : SUPERVISED LEARNING</strong> – Bayesian Learners, Exploiting Hierarchy among Topics, Maximum Entropy Learners, Discriminative Classification, Hypertext Classification, <strong>SEMI SUPERVISED LEARNING--</strong> Expectation Maximization, Labeling Hypertext Graphs and Co-training.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
## Visvesvaraya Technological University, Belagavi.
### PhD Coursework Courses – 2018 (Computer Science and Engineering)
**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
</table>

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:

### Reference Books:
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>Module</th>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td>Introduction, Overview and Applications of Wireless Sensor Networks</td>
<td></td>
</tr>
</tbody>
</table>

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:
1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MULTIPLEXING IN TELECOMMUNICATION</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
Switching: Crossbar Switching, Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Crosspoint Technology, Crossbar Exchange Organization

**Module -3**
Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Twostage, Three-stage and n-stage Networks. Digital Transmission and Multiplexing: Sampling, Quantization and Binary Coding, Quantization Noise, Companding, Differential Coding, Vocoders, Pulse Transmission, Line Coding, Time Division Multiplexing

**Module -4**
Time Division Switching: Basic Division Space and Time Switching, Time Multiplexed Space and Time Switching, Combination Switching, Three-stage and n-stage Combination Switching

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
Visvesvaraya Technological University, Belagavi.

PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>06</th>
<th>16LNI242</th>
<th>Group-6</th>
<th>WEB SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Module -1
**Middleware:** Understanding the middleware, RPC and Related Middleware, TP Monitors, Object Brokers, Message-Oriented Middleware.

Module -2
**Web Services:** Web Services Technologies, Web Services Architecture.

Module -3
**Basic Web Services Technology:** WSDL Web Services Description Language, UDDI Universal Description Discovery and Integration, Web Services at work interactions between the Specifications, Related Standards.

Module -4
**Service Coordination Protocols:** Infrastructure for Coordination Protocols, WSCoordination, WS-Transaction, Rosetta Net and Other Standards Related to Coordination Protocols.

Module -5
**Service Composition:** Basic of Service Composition, A New Chance of Success for Composition, Services Composition Models, Dependencies between Coordination and Composition, BPEL: Business Process Execution Language for Web Services, Outlook, Applicability of the Web Services, Web services as a Problem and a Solution: AN Example.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>07</th>
<th>16SCN23</th>
<th>Group-6</th>
<th>WIRELESS ADHOC NETWORKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours: 03</td>
<td>Exam Marks: 100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**

**Module -3**

**Module -4**

**Module -5**

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>08</th>
<th>16SFC322</th>
<th>Group-6</th>
<th>STEGANOGRAPHY AND DIGITAL WATERMARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module -1**

**Module -2**
Survey of steganographic techniques: Substitution system and bit plane tools, Transform domain techniques, Spread spectrum and information hiding, Statistical Steganography, Distortion and code generation techniques, Automated generation of English text.

**Module -3**
Steganalysis: Detecting hidden information, Extracting hidden information, Disabling hidden information, Watermarking techniques, History, Basic Principles, applications, Requirements of algorithmic design issues, Evaluation and benchmarking of watermarking system.

**Module -4**
Survey of current watermarking techniques: Cryptographic and psycho visual aspects, Choice of a workspace, binary image, audio, video. Formatting the watermark beds: Digital watermarking schemes, Spread Spectrum, DCT (Discrete Cosine Transform), Domain and Quantization schemes, Watermarking with side information, Robustness to temporal and geometric distortions.

**Module -5**
Data Right Management: DRM Products and Laws, Fingerprints, Examples, Protocols and Codes, Boneh-Shaw finger printing Scheme, Steganography and watermarking applications, Military, Digital copyright protection and protection of intellectual property.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
SOFTWARE PROJECT PLANNING & MANAGEMENT

Module -1
Metrics: Introduction, The Metrics Roadmap, A Typical Metrics Strategy, What Should you Measure?, Set Targets and track Them, Understanding and Trying to minimize variability, Act on data, People and Organizational issues in Metrics Programs, Common Pitfalls to watch out for in Metrics Programs, Matrices implementation checklists and tools, Software configuration management: Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation.

Module -2

Module -3
Software Requirements gathering: Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering, outputs and quality records from the requirements phase, skill sets required during requirements phase, differences for a shrink-wrapped software, challenges during the requirements management phase, Metrics for requirements phase. Estimation: What is Estimation? when and why is Estimation done?, the three phases of Estimation, Estimation methodology, formal models for size Estimation, Translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation , Metrics for the Estimation processes. Design and Development Phases: Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint, design for reusability, technology choices/ constraints, design to standards, design for portability, user interface issues, design for testability, design for diagnose ability, design for maintainability, design for install ability, inter-operability design, challenges during design and development phases, skill sets for design and development, metrics for design and development phases.

Module -4
Project management in the testing phase: Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management structures for testing in global teams, metrics for testing phase. Project management in the Maintenance Phase: Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, skill sets for people in the maintenance phase, estimating size, effort, and people resources for the maintenance phase, advantages of using geographically distributed teams for the maintenance phase, metrics for the maintenance phase.

Module -5
Globalization issues in project management: Evolution of globalization, challenges in building global teams, Models for the execution of global projects, some effective management techniques for managing global teams. Impact of the internet on project management: Introduction, the effect of internet on project management, managing projects for the internet, Effect on the project management activities. People focused
process models: Growing emphasis on people centric models, people capability maturity model(P-CMM), other people focused models in the literature, how does an organization choose the models to use?

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
## Visvesvaraya Technological University, Belagavi.

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

As per 2017 Regulation

<table>
<thead>
<tr>
<th>10</th>
<th>16SFC334</th>
<th>Group-6</th>
<th>SOFTWARE METRICS &amp; QUALITY ASSURANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Hours:03</td>
<td>Exam Marks:100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Module -1

### Module -2
**Applying The Seven Basic Quality Tools In Software Development** : Ishikawa’s Seven Basic Tools, Checklist, Pareo Diagram, Histogram, Run Charts, Scatter Diagram, Control Chart, Cause And Effect Diagram. **The Rayleigh Model:** Reliability Models, The Rayleigh Model Basic Assumptions, Implementation, Reliability And Predictive Validity.

### Module -3
**Complexity Metrics And Models:** Lines Of Code, Halstead’s Software Science, Cyclomatic Complexity Syntactic Metrics, An Example Of Module Design Metrics In Practice. **Metric And Lessons Learned For Object Oriented Projects:** Object Oriented Concepts And Constructs, Design And Complexity Metrics, Productivity Metrics, Quality And Quality Management Metrics, Lessons Learned For object oriented Projects.

### Module -4
**Availability Metrics:** Definition And Measurement Of System Availability, Reliability Availability And Defect Rate, Collecting Customer Outage Data For Quality Improvement, In Process Metrics For Outage And Availability. **Conducting Software Project Assessment** :Audit Ad Assessment, Software Process Maturity Assessment And Software Project Assessment, Software Process Assessment A Proponed Software Project Assessment Method.

### Module -5

### Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

### Text Books:
<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -3</td>
<td>Inter-organizational trust in E-Commerce: Need, Trading partner trust, Perceived benefits and risks of E-Commerce, Technology trust mechanism in E-Commerce, Perspectives of organizational, economic and political theories of inter-organizational trust, Conceptual model of inter-organizational trust in E-Commerce participation.</td>
</tr>
<tr>
<td>Module -4</td>
<td>Introduction to trusted computing platform: Overview, Usage Scenarios, Key components of trusted platform, Trust mechanisms in a trusted platform.</td>
</tr>
<tr>
<td>Module -5</td>
<td>Trusted platforms for organizations and individuals: Trust models and the E-Commerce domain.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
Visvesvaraya Technological University, Belagavi.
PhD Coursework Courses – 2018 (Computer Science and Engineering)
As per 2017 Regulation

<table>
<thead>
<tr>
<th>16SSC23</th>
<th>Group-6</th>
<th>SOFTWARE DESIGN PATTERNS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Exam Hours:03 Exam Marks:100</td>
</tr>
</tbody>
</table>

**Module -1**
Introduction: what is a design pattern? describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. What is object-oriented development? , key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm

**Module -2**
Analysis a System: overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation, discussions and further reading.

**Module -3**
Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.

**Module -4**
Interactive systems and the MVC architecture: Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature, pattern based solutions.

**Module -5**
Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays.

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

**Reference Books:**
1. Frank Bachmann, RegineMeunier, Hans Rohnert “Pattern Oriented Software Architecture” – Volume 1, 1996.
**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Computer Science and Engineering)**

**As per 2017 Regulation**

<table>
<thead>
<tr>
<th>Exam Hours:03</th>
<th>Exam Marks:100</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>16SCS252</td>
</tr>
<tr>
<td><strong>Group-6</strong></td>
<td><strong>TRENDS IN ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING</strong></td>
</tr>
</tbody>
</table>

**Module -1** Role of AI in Engineering, AI in daily life, Intelligence and AI, Different Task Domains of AI, History and Early Works of AI, History of AI, Programming Methods, Limitations of AI, Agent, Performance Evaluation, Task environment of an Agent, Agents Classification, Agent Architecture

Logic Programming, Logic Representation, Propositional Logic, Predicate Logic and Predicate Calculus, Horn Clauses, Well formed Formula, Computable functions and predicate, Quantifiers, Universe of discourse, Applications of Predicate Logic, Unification, Resolution, Conjunctive Normal Form, conversion to normal form or clausal form.

**Module -2** Fundamental Problem of Logic: Logic Inadequacy: Fundamental Problem of Logic-Monotonicity with “Flying Penguin” example, General disadvantage of monotonicity property in logic, logic in search space problem, logic in decidability and Incompleteness, Logic in Uncertainty Modelling.

Knowledge representation: Knowledge, Need to represent knowledge, Knowledge representation with mapping scheme, properties of a good knowledge base system, Knowledge representation issues, AND-OR graphs, Types of knowledge, Knowledge representation schemes, semantic nets, Frames, conceptual graphs, conceptual dependence theory, script, weak and strong slot filler.

Reasoning: Types of Reasoning, Methods of reasoning, Application of Reasoning, Forward and Backward Reasoning.

**Module -3** Search Techniques: Search, Representation techniques, Categories of Search, Disadvantage of state space search, Issues in design of search programs, General Search examples, Classification of search diagram representation, Hill climbing method and Hill climbing search, Simulates Annealing, Best-First Search, Branch and Bound Search, A* search

Game Playing: Two player games, Minmax Search, Complexity of Minmax algorithm, Alpha-Beta Pruning


**Module -4** Fuzzy Sets and Uncertainties: Fuzzy set and fuzzy logic, set and fuzzy operators, Extended fuzzy operations, Fuzzy relations, Properties of fuzzy relations, Fuzzy system and design, Linguistic hedges, Syntax for IF and Then rules, Types of fuzzy rule based system, Fuzzy linguistic controller, Fuzzy Inference, Graphical techniques of Inference, How, Fuzzy logic is used, Fuzzification, De-fuzzification. Unique features of Fuzzy Logic, Application of Fuzzy Logic, Fuzzy logic uncertainty and probability, Advantages and Limitations of Fuzzy logic and Fuzzy Systems.


**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**
<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module -1</td>
<td><strong>Introduction to Soft computing</strong>: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Fundamental concept of ANN, Evolution, basic Model of ANN, Terminologies used in ANN, MP model, Hebb model.</td>
</tr>
<tr>
<td>Module -2</td>
<td><strong>Perceptron Network</strong>: Adaptive linear neuron, Multiple adaptive linear neurons, Back propagation Network (Theory, Architecture, Algorithm for training, learning factors, testing and applications of all the above NN models).</td>
</tr>
<tr>
<td>Module -3</td>
<td><strong>Introduction to classical sets and fuzzy sets</strong>: Classical relations and fuzzy relations, Membership functions.</td>
</tr>
<tr>
<td>Module -4</td>
<td><strong>Defuzzification</strong>: Fuzzy decision making, and applications.</td>
</tr>
<tr>
<td>Module -5</td>
<td><strong>Genetic algorithms</strong>: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.</td>
</tr>
</tbody>
</table>

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

**Reference Books:**