CIRCULAR:-

A reference is invited to the syllabi relating to the Master of Engineering (Information Technology) Information Security Subject degree course vide this office Circular No.UG/41 of 2013-14, dated 30th May, 2013 and the Principals of affiliated Colleges in Engineering are hereby informed that the recommendation made by Ad-hoc Board of Studies in Electrical Engineering at its meeting held on 8th July, 2016 has been accepted by the Academic Council at its meeting held on 14th July, 2016 vide item No. 4.29 and that in accordance therewith, the revised syllabus as per Choice Based Credit System for Master of Engineering (Information Technology) Information Security Subjects (Sem. I & II), which is available on the University’s web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2016-17.

MUMBAI – 400 032

November, 2016

(Dr.M.A.Khan)
REGISTRAR

To,

The Principals of affiliated Colleges in Engineering.

A.C/ 4.29/14/07/2016.

***************

No. UG/41-A of 2016 MUMBAI-400 032 November, 2016

Copy forwarded with compliments for information to:-

1. The Dean, Faculty of Technology,
2. The Chairman, Ad-hoc Board of the Studies in Electrical Engineering
3. The Director, Board of College and University Development,
4. The Controller of Examinations,
5. The Co-Ordinator, University Computerization Centre.

(Dr.M.A.Khan)
REGISTRAR

... PTO
UNIVERSITY OF MUMBAI

Syllabus for the
M. E. (Information Technology)
Information Security subjects
Revised 2016

Choice Based Credit and Grading System

(As per Choice Based Credit and Grading System with effect from the academic year 2016–2017)
From Co-ordinator’s Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO’s) give freedom to affiliated Institutes to add few (PEO’s) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner’s learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner’s performance. Credit grading based system was implemented for First Year of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2017-2018, for Third Year Final Year Engineering in the academic years 2018-2019, 2019-2020, respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai
Preamble

It is an honor and a privilege to present the revised syllabus of Master of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.

Information Technology is comparatively a young branch among other engineering disciplines in University of Mumbai. It is evident from the placement statistics of various colleges affiliated to University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.

It has been observed that graduate engineers having work experience in IT industry would prefer to pursue their post graduate studies in IT in spite of having done their graduation degree in any branch.

Keeping these aspects in mind, University of Mumbai has designed postgraduate courses as per current requirements of IT industry.

The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.

I sincerely hope that the revised syllabus will help all post graduate engineers to face the future challenges in the field of information and technology

Program Outcome for Postgraduate Program in Information Technology

1. Apply Core Information Technology knowledge to develop stable and secure IT system
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

Chairman (Ad-hoc Board Information Technology)

University of Mumbai)
Program Structure for
ME (Information Technology - in Information Security subjects)
Mumbai University

(With Effect from 2016-2017)

Semester I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Contact Hours)</th>
<th>Credits Assigned</th>
</tr>
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<tbody>
<tr>
<td>ME-ISC101</td>
<td>Advanced Web Technologies</td>
<td>04</td>
<td>--</td>
</tr>
<tr>
<td>ME-ISC102</td>
<td>IT Infrastructure Design</td>
<td>04</td>
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</tr>
<tr>
<td>ME-ISC103</td>
<td>Cryptography and PKI</td>
<td>04</td>
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<td>ME-ISL101</td>
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<tr>
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<tr>
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<td></td>
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<tr>
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<td>Cryptography and PKI</td>
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<td>ME-ISL102</td>
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</table>
# Department Level Optional Course (DLOC)

Every student is required to take one Department Level Optional Course for Semester I and Semester II. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

# Institute Level Optional Course (ILOC)

Every student is required to take one Institute Level Optional Course for Semester I and Semester II, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Department Level Optional Course (DLOC)</th>
<th>Subject Code</th>
<th>Institute Level Optional Course (ILOC)</th>
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<td>ME-ISDLOC-I1041</td>
<td>Ad-hoc Networks</td>
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<td>ME-ISDLOC-I1042</td>
<td>IoT</td>
<td>ME-ISILOC-I1052</td>
<td>Reliability Engineering</td>
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<td>ME-ISDLOC-I1043</td>
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<tr>
<td>ME-ISDLOC-I1044</td>
<td>Unix OS &amp; OS Security</td>
<td>ME-ISILOC-I1054</td>
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<td></td>
<td>ME-ISILOC-I1055</td>
<td>Operation Research</td>
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<td>ME-ISILOC-I1056</td>
<td>Cyber Security and Laws</td>
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<td>ME-ISILOC-I1057</td>
<td>Disaster Management and Mitigation Measures</td>
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<td>ME-ISILOC-I1058</td>
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**End Semester Examination:** In all six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.
## Semester II

<table>
<thead>
<tr>
<th>Subject Code</th>
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<tbody>
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<td>Network Security</td>
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<tr>
<td>ME-ISC202</td>
<td>Application and Web Security</td>
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<tr>
<td>ME-ISC203</td>
<td>Security &amp; Risk Management</td>
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<td>ME-ISILOC-II205</td>
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<td>ME-ISL201</td>
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<th>Subject Code</th>
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<tbody>
<tr>
<td></td>
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<td>Theory</td>
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<td>ME-ISC202</td>
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</table>
Every student is required to take one Department Level Optional Course for Semester I and Semester II. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

### Institute Level Optional Course (ILOC)

Every student is required to take one Institute Level Optional Course for Semester I and Semester II, which is not closely allied to their disciplines. Different sets of courses will run in both the semesters.

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Department (DLOC)</th>
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<td>Law of Data Security and Investigations</td>
<td>ISILOC-</td>
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<td>II2051</td>
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<td>ME-</td>
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<td>IT Security Strategic Planning, Policy and Leadership</td>
<td>ISILOC-</td>
<td>Finance Management</td>
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<td>ISDLOC-</td>
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<td>II2052</td>
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<td>II2042</td>
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<td>Hacker Technique, Exploits and Incident handling</td>
<td>ISILOC-</td>
<td>Entrepreneurship Development and Management</td>
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<td>ISDLOC-</td>
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<td>ME-</td>
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</table>

**End Semester Examination:** In all six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.
### Semester III

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<thead>
<tr>
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<th>Examination Scheme</th>
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<tr>
<td></td>
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<td>Theory</td>
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<td></td>
<td></td>
<td>Internal Assessment</td>
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<td>ME-ISS301</td>
<td>Seminar</td>
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</tr>
<tr>
<td>ME-ISD301</td>
<td>Dissertation I</td>
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### Semester IV

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* The Term Work and Oral of Project II of Semester IV should be assessed jointly by the pair of Internal and External Examiners

**Note:** The Contact Hours for the calculation of load of teacher are as follows
- Seminar: 01 Hour / week / student
- A project I and II: 02 Hour / week / student

**End Semester Examination:** In all, six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Module</th>
<th>Detailed Content</th>
<th>Hours</th>
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</thead>
</table>
| I      | Web Technology Basics & HTML 5.0 | **Introduction to web technologies**: Web system architecture-1, 2, 3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators  
**Web Site Design Issues**: Planning a Web Site –Objective and Goals, Audience, Organizing contents.  
**Publishing of Web Site. Function of Web Server**  
**Basic HTML**: Formatting and fonts, Anchors, images, lists, tables, frames and forms. XML basics.  
**HTML 5**: Fundamental Syntax and Semantics, Progressive Markup and Techniques, Forms, Native Audio and Video, Micro data and Custom data, Accessibility, Geo-location, Canvas. | 09 |
| II     | Responsive web design with HTML5 and CSS3 | **Introduction to CSS**: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS  
**CSS3 and Responsive Web Design.**  
**CSS3**: Selectors, Typography and color Modes  
**Stunning Aesthetics with CSS3**, **CSS3 Transitions**, **Transformations and Animations**, **Conquer Forms HTML5 and CSS3** | 02 |
REST-ful web services, Resource Oriented Architecture, Comparison of REST, SOA, SOAP. | 07 |
| IV     | Rich Internet Application (RIA) | **Introduction to Ajax**: Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds  
**Working with JavaScript Object Notation (JSON)**: Create Data in JSON Format, JSON parser, Implement JSON on the Server Side, Implementing Security and Accessibility in AJAX Applications: Secure AJAX Applications, Accessible Rich Internet Applications,  
**Developing RIA using AJAX techniques**: CSS, HTML, DOM, XMLHttpRequest, JavaScript, PHP, AJAX as REST Client  
**Open Source Frameworks and CMS for RIA**: Django, Drupal, Joomla introduction and comparison. | 08 |
| V      | Web Analytics 2.0 | Introduction to Web Analytics 2.0 1: State of the Analytics Union, State of the Industry, Rethinking Web Analytics: Meet Web Analytics 2.0, Optimal Strategy for Choosing | 08 |
### Web 3.0 and Semantic Web

**Web 3.0 and Semantic Web**: Challenges, Components, Semantic Web Stack: RDF, RDF Schema (RDFS), Simple Knowledge Organization System (SKOS), SPARQL as RDF query language, N-Triples as a format for storing and transmitting data, Turtle (Terse RDF Triple Language), Web Ontology Language (OWL) a family of knowledge representation languages, Rule Interchange Format (RIF), a framework of web rule language dialects supporting rule interchange on the Web.

### Text Books:

1. HTML 5 Black Book: Kogent Learning solutions
2. Tim O’Reilly, What is Web 2.0? : Design Patterns and Business Models for the Next Generation of Software, O’REILLY

### References:


### List of Experiments: based on Laboratory Practical’s/ Case studies

1. Design a website with features like login for users and several gadgets, it should at least have a twitter box, a video, a calendar with events, event announcements and information with a registration form.
2. A mini project based on REST API and web analytics 2.0
3. Apache Jena based RDF and SPARQL based Tutorials

### Assessment:

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**End Semester Examination:**

Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.
<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic of Networking Topology</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>OSI Layer Basics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basics of Internetworking Devices</td>
<td></td>
</tr>
</tbody>
</table>
Center Design Example.

IV. Enterprise Wireless LAN Architecture: Components of Centralize Architecture: understanding 802.11X standards, LWAPP WLAN Controller. WLAN technologies (Narrow Band, Spread Spectrum, FHSS, DSS) and topologies, Wireless Network Components: Access Point and NICs, Router etc; WLAN enterprise design, WLAN performance, WLAN monitoring and troubleshooting, WLAN security. Intra and inter controller roaming.


References:

2. CCDA Cisco official Guide
7. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India
8. Storage Networks explained by Ulf Troppen, wiley publication
9. Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs by Richard Barker, Paul Massiglia, Wiley India

List of Experiments: based on Laboratory Practical’s/ Case studies

1. Design on Enterprise LAN.
2. Design on Enterprise Wireless LAN.
3. Case study on SAN and RAID.

Assessment:
Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of the end semester examination.
Course Objective:
- Provide knowledge of Cryptography.
- Provide Knowledge of Symmetric and Asymmetric Algorithms.
- Give insight on Message Authentication and Hash Functions.
- Understand the concepts of Digital Signatures and Public Key Infrastructure.

Course Outcome: Students should be able to
- Discuss knowledge & concepts of Cryptography.
- Implement Symmetric and Asymmetric Algorithms.
- Develop Message Authentication and Hash Functions.
- Identify the concepts of Digital Signatures and Public Key Infrastructure.

Prerequisite: Computer Networks.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Symmetric Key Algorithms</td>
<td>Symmetric Key Algorithms: DES,3DES, AES, IDEA, RC4, RC5, Confidentiality using symmetric encryption.</td>
<td>10</td>
</tr>
<tr>
<td>IV</td>
<td>Message Authentication and Hash Functions</td>
<td>Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, MAC, Hash Functions, Security of Hash Functions and MACs, SHA, HMAC</td>
<td>10</td>
</tr>
<tr>
<td>VI</td>
<td>Elliptic Curves</td>
<td><strong>Elliptic Curves:</strong> The Addition Law, Elliptic curve Mod p, Factoring with Elliptic Curves, Elliptic Curve Cryptosystems</td>
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<td></td>
</tr>
</tbody>
</table>

**Text Books/References:**
1. Information Security Principal and Practice: Mark stamp, Wiley
2. Cryptography and security, wiley, Shyamala, harini
4. Introduction to Cryptography with coding Theory, Pearson,WadenTrappe

**List of Experiments:** based on Laboratory Practical’s/ Case studies
1. Implement RSA algorithm.
2. Implement Diffie-Helman Key Exchange algorithm.
3. Implement AES algorithm.

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<tbody>
<tr>
<td>II</td>
<td>Medium access protocols</td>
<td>MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.11p, 802.15. HIPER LAN.</td>
<td>8</td>
</tr>
</tbody>
</table>
Mobile/vehicular Ad-hoc Networks


Textbook

References

Practical
1. Implement Ad-hoc network using BlueHoc Simulator.
2. Implement MANET using DARS Simulator.

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<th>Hours</th>
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<tbody>
<tr>
<td>II</td>
<td>Open – Source Prototyping Platforms for IoT</td>
<td>Basic Arduino Programming Extended Arduino Libraries, Arduino – Based Internet Communication, Raspberry PI, Sensors and Actuators and Interfacing.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td>IoT Protocol &amp; Technology</td>
<td>RFID + NFC, Wireless Networks + WSN, RTLS + GPS, Agents + Multi – Agent Systems, Composition Models for the Web of Things and resources on the Web, Discovery, Search, IoT Mashups and Others. IoT Protocols - M2M, BacNet, ModBus, Bluetooth, Wifi, ZigBee.</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td>Data Analytics for IoT</td>
<td>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, Tools for IoT:- Chef, Chef Case Studies, Puppet, Puppet Case Study - Multi-tier Deployment, NETCONF-YANG Case Studies, IoT Code Generator.</td>
<td>10</td>
</tr>
</tbody>
</table>

**Text Books:**

1. The Internet of Things (MIT Press) by Samuel Greengard.
The Internet of Things (Connecting objects to the web) by Hakima Chaouchi (Wiley Publications).

Internet of Things (A Hands-on-Approach) by Arshdeep Bhaga and Vijay Madisetti.

Reference Books:
2. IoT –From Research and Innovation to Market development (River Publication) by Ovidiu Vermesan and Peter Friess.
3. Building Internet of Things with Arduino by Charalampos Doukas.

List of Experiments:

1) Implement A Heterogeneous, Hierarchical Wireless Sensor Network using Cooja/ MSPSim Simulator also add routing protocol, broadcasting message in WSN.
2) Create a smart city and IoT WSN using CupCARBON U-ONE 2.8.5 simulator and senscript.
3) Building machine to machine (M2M) applications such as remote monitoring/Vehicle Tracking, fleet management or smart grid using M2MLabs open source application framework.

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<tbody>
<tr>
<td>I</td>
<td>Virtualization: What is Virtualization, Virtualization theory, VMDK File Structure, Advantages and Disadvantages of machine being a file, CPU Virtualization, Memory Virtualization, Interrupt Management VMFS file system, Storage Virtualization, Network Virtualization, Virtual machine and Security issues</td>
<td>13</td>
</tr>
<tr>
<td>II</td>
<td>VMware Virtualization Technologies</td>
<td>VMware Virtualization Technologies: ESX internals, Microsoft Windows Virtualization Technologies: Hyper-V, Xen and KVM Hypervisor, QEMU, SUN’s VirtualBox</td>
</tr>
<tr>
<td>III</td>
<td>Cloud computing</td>
<td>Introduction to cloud computing, cloud architecture and service models, the economics and benefits of cloud computing, horizontal/vertical scaling, thin client, multimedia content distribution, multiprocessor and virtualization, distributed storage, security and federation/presence/identity/privacy in cloud computing, disaster recovery</td>
</tr>
<tr>
<td>V</td>
<td>Cloud Platform Architectures</td>
<td>Cloud Platform Architectures, o Amazon AWS, o Microsoft Azure, o Google App Engine, o Google MapReduce / Yahoo Hadoop, o Eucalyptus, Nimbus, OpenStack</td>
</tr>
</tbody>
</table>
Text Books/Reference Book:

2. Enterprise Cloud Computing by Gautam Shroff, Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman, Pearson
5. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD, O'REILLY)
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India
9. Virtualization for Dummies :, Wiley India.

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<tbody>
<tr>
<td>I</td>
<td>Unix OS</td>
<td><em>What is OS?</em> Kernel, thread, process, scheduling algorithms etc.* &lt;br&gt;<strong>Unix System Overview:</strong> &lt;br&gt;Unix Architecture, Logging in, Files and Directories, Input and Output, Programs and Processes, Error Handling, User Identification, Signals, Time Values, System Calls and Library Functions</td>
<td>06</td>
</tr>
<tr>
<td>II</td>
<td>System Data Files</td>
<td><em>System Data Files and Information:</em> &lt;br&gt;Password file, Shadow passwords, Group file, Supplementary Group IDs, Implementation Differences, Login Accounting, System Identification, Time and Date routines</td>
<td>04</td>
</tr>
<tr>
<td>III</td>
<td>Thread Control</td>
<td><em>Thread Control:</em> &lt;br&gt;Thread Limits, Thread attributes, synchronization attributes, Reentrancy, Thread-specific data, Cancel options, signals, threads and I/O, threads and fork &lt;br&gt;<em>Daemon Processes:</em> &lt;br&gt;Daemon characteristics, coding rules, Error logging, Single-instance daemons, Daemon conventions</td>
<td>08</td>
</tr>
<tr>
<td>IV</td>
<td>Advanced I/O</td>
<td><em>Advanced I/O:</em> &lt;br&gt;Nonblocking I/O, Record Locking, Streams, I/O Multiplexing, Asynchronous I/O, Related functions, Memory mapped I/O</td>
<td>10</td>
</tr>
<tr>
<td>V</td>
<td>Interprocess</td>
<td><em>Interprocess Communication:</em> &lt;br&gt;Pipes, FIFO, Semaphores, Message Queues, Shared Memory &lt;br&gt;<em>Network IPC: Sockets</em> &lt;br&gt;Socket Descriptors, Addressing, Connection Establishment, Data Transfer, Socket Options, Out-of-band data, Nonblocking and Asynchronous I/O &lt;br&gt;<em>Advanced IPC:</em> streams-based pipes, Unix Domain Sockets, Passing File Descriptors</td>
<td>10</td>
</tr>
</tbody>
</table>

**Prerequisite:** Operating System
VI OS Security

Terminal I/O:
- Special Input characters, Getting and setting terminal attributes, Terminal option flags, sty command, Baud rate functions, Line Control functions, Terminal Identification, canonical, noncanonical mode, Terminal window size, termcap, terminfo, curses


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

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.

Text Books/References:

2. Maurice Bach, “The Design of the UNIX Operating System
7. Guide to Operating system security, Thomson
8. Andrew S Tanenbaum, Modern Operating systems

List of Experiments: based on Laboratory Practical’s/ Case studies

1. Experiment 1 (Basic commands)
   a) Installation of Unix/Linux operating system.
   b) Study of logging/logout details.
   c) Study of Unix/Linux general purpose utility command list obtained from (man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown) commands.
   e) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system.
f) Study of Unix/Linux file system (tree structure).

g) Study of .bashrc, /etc/bashrc and Environment variables

2. I. Write a shell script program to display the process attributes.

II. Write a shell script to change the priority of processes.

III. Write a shell script to change the ownership of processes

IV. Write a program to send back a process from foreground.

V. Write a program to retrieve a process from background.

VI. Write a program to create a Zombie process.

VII. Write a program to create a child process and allow the parent to display “parent” and the child to display “child” on the screen.

3. I. Write a shell script program to check variable attributes of file and processes.

II. Write a shell script program to check and list attributes of processes.

III. Shell Script program to implement read, write, and execute permissions.

IV. Shell Script program for changing process priority.

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<tbody>
<tr>
<td>ME-ISILOC-</td>
<td>Product Life Cycle Management</td>
<td>03</td>
</tr>
<tr>
<td>I1051</td>
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</tbody>
</table>

**Objectives:**
1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

**Outcomes:** Learner will be able to…
1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

<table>
<thead>
<tr>
<th>Module</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction to Product Lifecycle Management (PLM):</strong> Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance &amp; Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>PLM Strategies:</strong> Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td><strong>Product Data Management (PDM):</strong> Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td><strong>Virtual Product Development Tools:</strong> For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case</td>
<td>05</td>
</tr>
</tbody>
</table>
### References:


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**End Semester Theory Examination:**
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1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
Course Code | Course Name | Credits
---|---|---
ME-ISILOC-11052 | Reliability Engineering | 03

**Objectives:**
1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

**Outcomes:** Learner will be able to…
1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

<table>
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<tbody>
<tr>
<td>01</td>
<td><strong>Probability theory:</strong> Probability: Standard definitions and concepts; Conditional Probability, Baye’s Theorem. <strong>Probability Distributions:</strong> Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. <strong>Measures of Dispersion:</strong> Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.</td>
<td>08</td>
</tr>
<tr>
<td>02</td>
<td><strong>Reliability Concepts:</strong> Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. <strong>Failure Data Analysis:</strong> Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. <strong>Reliability Hazard Models:</strong> Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>System Reliability:</strong> System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td><strong>Reliability Improvement:</strong> Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.</td>
<td>08</td>
</tr>
<tr>
<td>05</td>
<td><strong>Maintainability and Availability:</strong> System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.</td>
<td>05</td>
</tr>
<tr>
<td>06</td>
<td><strong>Failure Mode, Effects and Criticality Analysis:</strong> Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis</td>
<td>05</td>
</tr>
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**REFERENCES:**


**Assessment:**

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4. Only Four question need to be solved.
Objective:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today’s business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

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<tr>
<td>01</td>
<td>Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.</td>
<td>4</td>
</tr>
<tr>
<td>02</td>
<td>Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results</td>
<td>7</td>
</tr>
<tr>
<td>03</td>
<td>Ethical issues and Privacy: Information Security, Threat to IS, and Security Controls</td>
<td>7</td>
</tr>
<tr>
<td>05</td>
<td>Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.</td>
<td>6</td>
</tr>
</tbody>
</table>

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
Assessment:

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<tr>
<td>ME-ISILOC-I1054</td>
<td>Design of Experiments</td>
<td>03</td>
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</table>

**Objectives:**
1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

**Outcomes:** Learner will be able to...
1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

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</thead>
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<tr>
<td>01</td>
<td><strong>Introduction</strong></td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>1.1 Strategy of Experimentation</td>
<td></td>
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<td>1.2 Typical Applications of Experimental Design</td>
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<td></td>
<td>1.3 Guidelines for Designing Experiments</td>
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<td>1.4 Response Surface Methodology</td>
<td></td>
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<tr>
<td>02</td>
<td><strong>Fitting Regression Models</strong></td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>2.1 Linear Regression Models</td>
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<td>2.2 Estimation of the Parameters in Linear Regression Models</td>
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<td>2.3 Hypothesis Testing in Multiple Regression</td>
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<td>2.4 Confidence Intervals in Multiple Regression</td>
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<td>2.5 Prediction of new response observation</td>
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<td>2.6 Regression model diagnostics</td>
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<td>2.7 Testing for lack of fit</td>
<td></td>
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<tr>
<td>03</td>
<td><strong>Two-Level Factorial Designs</strong></td>
<td>07</td>
</tr>
<tr>
<td></td>
<td>3.1 The $2^2$ Design</td>
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<td></td>
<td>3.2 The $2^3$ Design</td>
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<td>3.3 The General $2^k$ Design</td>
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<td>3.4 A Single Replicate of the $2^k$ Design</td>
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<td>3.5 The Addition of Center Points to the $2^k$ Design</td>
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<td>3.6 Blocking in the $2^k$ Factorial Design</td>
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<td>3.7 Split-Plot Designs</td>
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<tr>
<td>04</td>
<td><strong>Two-Level Fractional Factorial Designs</strong></td>
<td>07</td>
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<tr>
<td></td>
<td>4.1 The One-Half Fraction of the $2^k$ Design</td>
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<td>4.2 The One-Quarter Fraction of the $2^k$ Design</td>
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<td></td>
<td>4.3 The General $2^{k-p}$ Fractional Factorial Design</td>
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<td>4.4 Resolution III Designs</td>
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<td>4.5 Resolution IV and V Designs</td>
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<tr>
<td></td>
<td>4.6 Fractional Factorial Split-Plot Designs</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td><strong>Response Surface Methods and Designs</strong></td>
<td>07</td>
</tr>
<tr>
<td></td>
<td>5.1 Introduction to Response Surface Methodology</td>
<td></td>
</tr>
</tbody>
</table>
5.2 The Method of Steepest Ascent  
5.3 Analysis of a Second-Order Response Surface  
5.4 Experimental Designs for Fitting Response Surfaces  

<table>
<thead>
<tr>
<th>06</th>
<th>Taguchi Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Crossed Array Designs and Signal-to-Noise Ratios</td>
<td></td>
</tr>
<tr>
<td>6.2 Analysis Methods</td>
<td></td>
</tr>
<tr>
<td>6.3 Robust design examples</td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Assessment:

Internal:  
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:  
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question  
2. All question carry equal marks  
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)  
4. Only Four question need to be solved.
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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-ISILOC-I1055</td>
<td>Operations Research</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

**Outcomes:** Learner will be able to…

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model’s optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
</table>
| 01     | **Introduction to Operations Research:** Introduction, , Structure of the Mathematical Model, Limitations of Operations Research  
**Linear Programming:** Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method,  
**Duality:** Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis  
**Transportation Problem:** Formulation, solution, unbalanced Transportation problem, Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method.  
**Assignment Problem:** Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem  
**Integer Programming Problem:** Introduction, Types of Integer Programming Problems, Gomory’s cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms. | 14  |
| 02     | **Queuing models:** queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population | 05  |
| 03     | **Simulation:** Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of | 05  |
| 04 | **Dynamic programming.** Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems. |
| 05 | **Game Theory.** Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. |
| 06 | **Inventory Models:** Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, |

**REFERENCES:**


**Assessment:**

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**End Semester Theory Examination:**
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
### Course Code and Course Name

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<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-ISILOC-11056</td>
<td>Cyber Security and Laws</td>
<td>03</td>
</tr>
</tbody>
</table>

### Objectives:
1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

### Outcomes:
Learner will be able to…
1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

### Module Detailed Contents Hrs

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction to Cybercrime:</strong> Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.</td>
<td>4</td>
</tr>
<tr>
<td>03</td>
<td><strong>Tools and Methods Used in Cyberline</strong>&lt;br&gt;Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)</td>
<td>6</td>
</tr>
<tr>
<td>05</td>
<td><strong>Indian IT Act.</strong>&lt;br&gt;Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments</td>
<td>6</td>
</tr>
<tr>
<td>06</td>
<td><strong>Information Security Standard compliances</strong>&lt;br&gt;SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.</td>
<td>6</td>
</tr>
</tbody>
</table>

### REFERENCES:
1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
8. Websites for more information is available on: The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in
9. Website for more information, A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

**Assessment:**

**Internal:**
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**End Semester Theory Examination:**
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

**In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
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4. Only Four question need to be solved.
Course Code | Course Name | Credits
---|---|---
ME-ISILOC-I1057 | Disaster Management and Mitigation Measures | 03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to…

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do’s and don’ts in such extreme events and act accordingly.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.</td>
<td>03</td>
</tr>
<tr>
<td>02</td>
<td>Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.</td>
<td>09</td>
</tr>
<tr>
<td>03</td>
<td>Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.</td>
<td>06</td>
</tr>
<tr>
<td>04</td>
<td>Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications</td>
<td>06</td>
</tr>
</tbody>
</table>
of GIS, Remote sensing and GPS in this regard.

05  Financing Relief Measures:
   5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO’s in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO’s and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.
   5.2 International relief aid agencies and their role in extreme events.

06  Preventive and Mitigation Measures:
   6.1 Pre-disaster, during disaster and post-disaster measures in some events in general
   6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication
   6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.
   6.4 Do’s and don’ts in case of disasters and effective implementation of relief aids.

REFERENCES:

5. ‘Disaster management & rehabilitation’ by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. ‘Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Assessment:

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Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
Course Code | Course Name | Credits
--- | --- | ---
ME-ISISOC-I1058 | Energy Audit and Management | 03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to…

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td><strong>Energy Audit Principles:</strong> Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring&amp; targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)</td>
<td>08</td>
</tr>
<tr>
<td>03</td>
<td><strong>Energy Management and Energy Conservation in Electrical System:</strong> Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. <strong>Energy efficiency measures in lighting system, Lighting control:</strong> Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.</td>
<td>10</td>
</tr>
<tr>
<td>04</td>
<td><strong>Energy Management and Energy Conservation in Thermal Systems:</strong> Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam</td>
<td>10</td>
</tr>
</tbody>
</table>

| 05 | **Energy Performance Assessment:**  
On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method. Financial Analysis. | 04 |
| 06 | **Energy conservation in Buildings:**  
Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources | 03 |

**REFERENCES:**

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science  
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System  
8. www.energymanagertraining.com  
9. www.bee-india.nic.in

**Assessment:**

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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-ISL101</td>
<td>Laboratory I (Core Course Lab)</td>
<td>01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Lab. Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two Laboratory Practical’s to be conducted for each of the core subjects as suggested in the subject syllabus.</td>
<td>24</td>
</tr>
</tbody>
</table>

**Modality and Assessment:**

1. Each Laboratory assignment will be done in a group of two students. The Faculty teaching each core subject will be required to propose and evaluate the respective Laboratory assignments. These will be essentially hands-on practical and not theory / research review types of assignments.

2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners.
### Module 1

<table>
<thead>
<tr>
<th>Detailed content</th>
<th>Lab. Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Laboratory Practical’s to be conducted for each of the DLOC &amp; ILOC subjects as suggested in the subject syllabus.</td>
<td>24</td>
</tr>
</tbody>
</table>

**Modality and Assessment:**

1. Each mini project assignment will be done by individual student. The Faculty teaching elective subject will be required to propose and evaluate the respective mini projects. These will be essentially hands-on practical and not theory / research review types of projects

2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners
### Module Detailed content

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Security Problem in TCP/IP Protocol Suite:</strong> Identification of Security issues in Ethernet, ARP, IP, TCP, Application and Routing protocols.</td>
<td>06</td>
</tr>
<tr>
<td>5</td>
<td><strong>Security at Application Layer: PGP, S/MIMIE</strong> E-mail security, PGP, PEM, S/MIME, Secure binding of multimedia streams, Secure RTP, Secure RSVP.</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td><strong>Firewalls and IDS</strong> Firewalls: Network partitioning, firewall platforms, partitioning models and methods, Secure SNMP, Secure routing interoperability: virtual networks (DARTnet/CAIRN). Transparent and opaque network services. Source masking and hidden channels. IDS, Honeypots, Honey nets,</td>
<td>06</td>
</tr>
<tr>
<td>7</td>
<td><strong>Wireless Network Security:</strong> Introduction, How wifi works, WEP, Technique of hacking wireless network, countermeasure</td>
<td>04</td>
</tr>
<tr>
<td>8</td>
<td><strong>Network Packet analysis:</strong> Packet analysis and Packet sniffing in Hub and Switched environment, Analysis of packet for security i.e Sync Scan, OS Fingerprinting</td>
<td>04</td>
</tr>
<tr>
<td>9</td>
<td><strong>NOS Security issues:</strong> Windows and Linux environment</td>
<td>04</td>
</tr>
</tbody>
</table>

### References:

4. Garfinkel S., Spafford G., “Practical Unix and Internet Security”, O'Reilly
6. Practical Packet Analysis: Using Wireshark to Solve Real-Word Network problems by Chris Sanders

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

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<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1      | Introduction to Web applications  
Cookies , Session , Headers , Same-origin , Terminology Tools | 02 |
| 2      | Gathering Information On Target  
Finding Owner, IP Addresses And Email Addresses  
WHOIS tools  
DNS queries and zone transfers  
Using Nslookup  
Infrastructure  
Fingerprinting The Webserver  
Fingerprinting Webserver Modules  
Typical HTTP Services Ports  
Fingerprinting Frameworks And Applications  
Fingerprinting Third-Party Add-Ons  
Fingerprinting Custom Applications  
Mapping The Attack Surface  
Enumerating Resources  
Crawling The Website  
Finding Hidden Files  
Finding Back Up And Source Code Files  
Enumerating users accounts with Burp Proxy  
Relevant Information Through Misconfigurations  
Directory Listing  
Log And Configuration Files  
Google Hacking | 08 |
| 3      | Vulnerability Assessment  
Vulnerability Assessment vs Penetration testing  
Assessing vulnerabilities with using open source tools  
Browsing anonymously  
HTTP Proxies, Verifying proxy anonymity ,HTTP_VIA /HTTP_X_FORWARDED_FOR , Tor Network  
Tunneling for anonymity , SSH Tunneling  
Cleaning traces ,Cleaning the event log | 10 |
| 4      | Understanding OWASP top 10 | 2 |
| 4      | Cross site scripting  
What it is—Basics  
Anatomy of a XSS exploitation  
The three types of XSS  
Reflected XSS  
Persistent XSS  
DOM-based XSS  
Finding XSS  
Finding XSS in PHP code  
XSS Exploitation  
XSS, Browsers and same origin policy  
Real world attacks  
Cookie stealing through XSS  
Defacement | 6 |
Advanced phishing attacks

5

Introduction to SQL Injection
How dangerous is a SQL Injection, How SQL Injection works
How to find SQL Injections, How to find SQL Injections
Finding Blind SQL Injections, SQL Injection Exploitation
Exploiting INBAND (Union) SQL Injections
Exploiting Error Based SQL Injection, Dumping database data
Reading remote file system, Accessing the remote network
Exploiting Blind SQL injection, Optimized Blind SQL injection
Time Based Blind SQL Injection
Tools
Sqlmap, BSQL Hacker, Pangolin
Tools taxonomy

6

Introduction
Session attacks, HTTP Session Fixation
Finding HTTP Session Fixation, Preventing HTTP Session Fixation
CSRF
Finding CSRF, Exploiting CSRF, Preventing CSRF
File inclusion vulnerabilities, Local File Inclusion, Remote File Inclusion
Web 2.0 Attacks
How Ajax works, Defeating httpOnly—XST & Ajax
Dissecting Ajax API’s, Reverse engineering Ajax applications logic
Exposed administrative functions

7

Application Security: Understanding SOA for EAI, WS-Security Standards

8

Application Security basics: Reverse Engineering, Attack vectors, input Validation, Secure SDLC- Data classification, Secure requirement-Secure Architecture. Factors in Developing An Application Security Program-Policies, procedures, baselines and guidelines, ROI on application security

9


10

Database Security and Auditing: Database Application Security Model, Administration of Users, Profiles, Password policy, Privileges and roles, Virtual Private Database, Database Auditing model

References:
1. The Web Application Hacker’s handbook, Defydd Stuttard, Wiley Publishing
2. Professional Pen Testing for Web application, Andres andreu, wrox press
7. Database Security and Auditing, Hassan, Cengage Learning

Assessment:

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

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<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to assessing Network Vulnerabilities: type and procedure of network vulnerability assessment</td>
<td>08</td>
</tr>
<tr>
<td>2</td>
<td>Principles of Security: Information Classification, Policy framework, role based security in an organization</td>
<td>04</td>
</tr>
<tr>
<td>4</td>
<td>Risk Assessment Methodologies: Defense –in depth approach, risk analysis, Asset valuation approach, Quantitative and Qualitative risk-assessment approaches. Scoping the project, Understanding the attacker.</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Open source tools used for Assessment and Evaluation, and exploitation framework</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Final Report Preparation and Post Assessment Activists</td>
<td>06</td>
</tr>
</tbody>
</table>

**Reference books:**
1. Network Security assessment, Chris McNab, O'reilly
2. Inside Network Security Assessment, Michael Gregg, Pearson
6. Cyber Security: Sunit Belapur, Wiley

**Assessment:**

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### Subject Code: ME-ISDLOC-II2041  
**Law of Data Security and Investigations**  
**Credits:** 04

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
</table>
Overview of Indian IT Act, Ethical Issues in Intellectual property rights, Copy Right, Patents, Data privacy and protection, Domain Name, Software piracy, Plagiarism, Issues in ethical hacking. | 08   |
| 3      | **E-Records, E-Discovery and Business Law:** Vicarious Liability, E-Discovery, Records Retention, Destruction, Email Retention, Forensics, Privacy Policies, Evidence Law, Signatures | 08   |
| 4      | **Contracting for Data Security and Other Technology:** Click Through Agreements, Contract Formation, Battle of the Forms, Liability, Breach, Bonds, Assent, Warranty, Remedies, Liens, Ownership Issues, Subpoenas, Documentation, Audits, Exceptions, Maintenance, Termination, Escrow, Investigations, Competition, Disputes, Non-Disclosure | 10   |
| 5      | **The Law of IT Compliance: How to conduct investigations:** Cooperation with investigations, Numerous Examples of Fraud (Post-Mordems), SOX, Securities Fraud, Federal Sentencing Guidelines, Codes of Ethics, Hotlines, Reporting, Whistleblowing, Employee Monitoring, Entrapment, Raids & Seizures | 10   |
| 6      | **Applying Law to Emerging Dangers: Cyber Defense**  
Sony Root Kit Case Study, Crisis Communications, Choicepoint Case Study, Relationship with Law Enforcement, TJX Case Study, Publicity, Safely Monitoring Threats w/o Incurring Liability, Factors Mitigating Legal Risk, Public Accountability, Political Diplomacy, Strategic Legal Procedures, Competitive Boundaries | 10   |

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<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Strategic Planning Process:</strong>&lt;br&gt;Value of strategic planning, implementation of strategic planning, overall planning process and strategic matrix model, horizon analysis, visioning, environmental scans (SWOT, PEST, Porter's 5 forces), historical analysis, mission, vision, and value statements, planning process core, candidate initiatives, the prioritization process, resource and IT change management in planning, how to build the roadmap, setting up assessments, Institutional assessment, revising the plan.</td>
<td>08</td>
</tr>
<tr>
<td>3</td>
<td><strong>Legal Issues:</strong>&lt;br&gt;Computer crimes, Disk Protection, Intellectual property, E-commerce law, Data Protection issues, Information Security Audits.</td>
<td>08</td>
</tr>
<tr>
<td>4</td>
<td><strong>Security Policy Development:</strong>&lt;br&gt;positive and negative tone, consistency of policy bullets, the role of policy, awareness and training, the SMART approach to policy development and assessment, ISMS as governing policy, Policy versus procedure, Organizational Assumptions, Beliefs and Values (ABVs), Relationship of mission statement to policy, Organizational culture</td>
<td>08</td>
</tr>
<tr>
<td>5</td>
<td><strong>Security Policy Assessment:</strong>&lt;br&gt;Using the principles of psychology to implement policy, How policy protects people, organizations and information, Case study, the process to handle a new risk (Sexting), Policy header components and how to use them, Issue-specific policies, Behavior related polices, acceptable use, ethics, Warning banners, Policy development process, Policy review</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td><strong>Management and Leadership Skills:</strong>&lt;br&gt;Leadership building blocks, Coaching &amp; training, Change management, Team development, Motivating, Developing the vision, Leadership development, Building competencies, Importance of communication, Self-direction, Brainstorming, Relationship building, Teamwork concepts, Leader qualities, Leadership benefits</td>
<td>08</td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td>1</td>
<td>Incident Handling Overview and preparation – Incident Handling Phase 2 identification, Incident Handling phase 3 containment Incident Handling: Recovering and improving capabilities, Type of incidents</td>
<td>06</td>
</tr>
<tr>
<td>2</td>
<td>Hacking Methodology: Enumeration, Scanning, Gaining Access, Maintaining access, Clearing Tracks</td>
<td>06</td>
</tr>
<tr>
<td>3</td>
<td>Reconnaissance, Scanning Host discovery, Network devices discovery, service discovery</td>
<td>08</td>
</tr>
<tr>
<td>4</td>
<td>Backdoors and Trojan horses, Buffer Overflows</td>
<td>04</td>
</tr>
<tr>
<td>5</td>
<td>Covering Tracks: Networks and Systems</td>
<td>06</td>
</tr>
<tr>
<td>6</td>
<td>Denial of Service Attacks, Exploiting System using Netcat</td>
<td>08</td>
</tr>
<tr>
<td>7</td>
<td>Format String Attacks</td>
<td>04</td>
</tr>
<tr>
<td>8</td>
<td>IP address Spoofing, Network sniffing</td>
<td>06</td>
</tr>
<tr>
<td>9</td>
<td>Password Attacks, rootkits</td>
<td>04</td>
</tr>
<tr>
<td>10</td>
<td>Session Hijacking and Defenses</td>
<td>04</td>
</tr>
<tr>
<td>11</td>
<td>Virtual Machine Attacks, Web application attacks, Worms, Bots &amp; Bot-nets</td>
<td>04</td>
</tr>
</tbody>
</table>

Reference Books:


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<th>Module</th>
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<tbody>
<tr>
<td>1</td>
<td>Overview of computer Forensics Technology- Introduction to computer forensics, use of forensics in law enforcement, employment proceedings, computer Forensics services. Types of computer Forensics Technology- Military, law, spyware and Adware, Biometrics security systems.</td>
<td>06</td>
</tr>
<tr>
<td>2</td>
<td>Types of Computer Forensics systems</td>
<td>08</td>
</tr>
<tr>
<td>3</td>
<td>Computer Forensics evidence and capture</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Computer Forensics Analysis     Discovery of electronic evidence- electronic document discovery, identification of data- Time keeping, forensic identification and analysis of technical surveillance devices. Reconstructing fast events</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>The information warfare Arsenal and Tactics of terrorists and Rogues</td>
<td>08</td>
</tr>
<tr>
<td>6</td>
<td>Civilian casualties</td>
<td>08</td>
</tr>
</tbody>
</table>

Reference BOOKS:

2. By John R. Vacca Computer forensics: computer crime scene investigation, Volume 1
3. EnCase Computer Forensics . Sybex
5. Computer Forensics & Privacy, Michael Caloyannides

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End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.
Objectives:
1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…
1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Project Management Foundation:</strong> Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical &amp; atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).</td>
<td>5</td>
</tr>
<tr>
<td>02</td>
<td><strong>Initiating Projects:</strong> How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development &amp; growth (forming, storming, norming &amp; performing), team dynamics.</td>
<td>6</td>
</tr>
<tr>
<td>03</td>
<td><strong>Project Planning and Scheduling:</strong> Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).</td>
<td>8</td>
</tr>
<tr>
<td>05</td>
<td><strong>5.1 Executing Projects:</strong> Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. <strong>5.2 Monitoring and Controlling Projects:</strong></td>
<td>8</td>
</tr>
</tbody>
</table>
Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit.

5.3 Project Contracting
Project procurement management, contracting and outsourcing.

6.1 Project Leadership and Ethics:
Introduction to project leadership, ethics in projects.
Multicultural and virtual projects.

6.2 Closing the Project:
Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
4. Gopalan, Project Management, Wiley India

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
### Course Code | Course Name | Credits
--- | --- | ---
ME-ISILOCII2052 | Finance Management | 03

**Objectives:**
1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

**Outcomes:** Learner will be able to…
1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
</table>
| 01 | **Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System.  
**Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.  
**Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market  
**Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges | 06 |
| 02 | **Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.  
**Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting. | 06 |
| 03 | **Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.  
**Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis. | 09 |
| 04 | **Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)  
**Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity’s Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. | 10 |
| 05 | **Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial | 05 |
**Capital Structure:** Factors Affecting an Entity’s Capital Structure; Overview of Capital Structure Theories and Approaches—Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure

**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity’s Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon’s Approach, Walter’s Approach, and Modigliani-Miller Approach

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4. Only Four question need to be solved.
Course Code | Course Name | Credits
--------- | ---------- | ----
ME- ISILOCII2053 | Entrepreneurship Development and Management | 03

Objectives:
1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…
1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

<table>
<thead>
<tr>
<th>Module</th>
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</thead>
<tbody>
<tr>
<td>03</td>
<td>Women’s Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td>Indian Environment for Entrepreneurship: key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc</td>
<td>08</td>
</tr>
<tr>
<td>05</td>
<td>Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing</td>
<td>08</td>
</tr>
<tr>
<td>06</td>
<td>Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business</td>
<td>05</td>
</tr>
</tbody>
</table>

REFERENCES:
1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

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4. Only Four question need to be solved.
### Course Code: ME-ISILOCII2054  
**Course Name:** Human Resource Management  
**Credits:** 03

#### Objectives:
1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today’s organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

#### Outcomes: Learner will be able to…
1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today’s emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
</table>
| 01     | **Introduction to HR**  
- Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.  
- Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues. | 5 |
| 02     | **Organizational Behavior (OB)**  
- Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues  
- Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness  
- Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior.  
- Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor);  
- Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.  
- Case study | 7 |
Organizational Structure & Design
- Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.
- Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.
- Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.

Human resource Planning
- Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale.
- Training & Development: Identification of Training Needs, Training Methods

Emerging Trends in HR
- Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment
- Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.

HR & MIS
Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries

Strategic HRM
Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals

Labor Laws & Industrial Relations
Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act

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<tr>
<td>ME-ISILOCII2055</td>
<td>Professional Ethics and Corporate Social Responsibility (CSR)</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**
1. To understand professional ethics in business
2. To recognized corporate social responsibility

**Outcomes:** Learner will be able to...
1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

<table>
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<tr>
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<tbody>
<tr>
<td>01</td>
<td><strong>Professional Ethics and Business:</strong> The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business</td>
<td>04</td>
</tr>
</tbody>
</table>
| 02     | **Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy  
**Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources | 08  |
| 03     | **Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm’s Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy  
**Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.  | 06  |
| 04     | **Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection.  
Trajectory of Corporate Social Responsibility in India | 05  |
| 05     | **Corporate Social Responsibility:** Articulation of Gandhian Trusteeship  
Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India | 08  |
| 06     | **Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013. | 08  |

**REFERENCES:**

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.

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<tbody>
<tr>
<td>ME-ISILOCII2056</td>
<td>Research Methodology</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**
1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

**Outcomes:** Learner will be able to…
1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction and Basic Research Concepts</strong>&lt;br&gt;1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology&lt;br&gt;1.2 Need of Research in Business and Social Sciences&lt;br&gt;1.3 Objectives of Research&lt;br&gt;1.4 Issues and Problems in Research&lt;br&gt;1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical</td>
<td>09</td>
</tr>
<tr>
<td>02</td>
<td><strong>Types of Research</strong>&lt;br&gt;2.1 Basic Research&lt;br&gt;2.2 Applied Research&lt;br&gt;2.3 Descriptive Research&lt;br&gt;2.4 Analytical Research&lt;br&gt;2.5 Empirical Research&lt;br&gt;2.6 Qualitative and Quantitative Approaches</td>
<td>07</td>
</tr>
<tr>
<td>03</td>
<td><strong>Research Design and Sample Design</strong>&lt;br&gt;3.1 Research Design – Meaning, Types and Significance&lt;br&gt;3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors</td>
<td>07</td>
</tr>
<tr>
<td>04</td>
<td><strong>Research Methodology</strong>&lt;br&gt;4.1 Meaning of Research Methodology&lt;br&gt;4.2 Stages in Scientific Research Process:&lt;br&gt; a. Identification and Selection of Research Problem&lt;br&gt; b. Formulation of Research Problem&lt;br&gt; c. Review of Literature&lt;br&gt; d. Formulation of Hypothesis&lt;br&gt; e. Formulation of research Design&lt;br&gt; f. Sample Design&lt;br&gt; g. Data Collection&lt;br&gt; h. Data Analysis&lt;br&gt; i. Hypothesis testing and Interpretation of Data&lt;br&gt; j. Preparation of Research Report</td>
<td>08</td>
</tr>
<tr>
<td>05</td>
<td><strong>Formulating Research Problem</strong>&lt;br&gt;5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of</td>
<td>04</td>
</tr>
<tr>
<td>06</td>
<td>Outcome of Research</td>
<td>04</td>
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<tr>
<td></td>
<td>6.1 Preparation of the report on conclusion reached</td>
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<tr>
<td></td>
<td>6.2 Validity Testing &amp; Ethical Issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.3 Suggestions and Recommendation</td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:


Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
### Course Code: ME-ISILOCII2057

### Course Name: IPR and Patenting

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-ISILOCII2057</td>
<td>IPR and Patenting</td>
<td>03</td>
</tr>
</tbody>
</table>

**Objectives:**
1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

**Outcomes:** Learner will be able to...
1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td><strong>Introduction to Intellectual Property Rights (IPR):</strong> Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. <strong>Importance of IPR in Modern Global Economic Environment:</strong> Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development</td>
<td>05</td>
</tr>
<tr>
<td>02</td>
<td><strong>Enforcement of Intellectual Property Rights:</strong> Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement <strong>Indian Scenario of IPR:</strong> Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.</td>
<td>07</td>
</tr>
<tr>
<td>03</td>
<td><strong>Emerging Issues in IPR:</strong> Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td><strong>Basics of Patents:</strong> Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc.), Process Patent and Product Patent, Precautions while patenting, Patent specification, Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent</td>
<td>07</td>
</tr>
<tr>
<td>05</td>
<td><strong>Patent Rules:</strong> Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)</td>
<td>08</td>
</tr>
</tbody>
</table>

**REFERENCE BOOKS:**

Assessment:

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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
Objectives:
1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..
1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1      | **Introduction to Digital Business**-  
Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts  
Difference between physical economy and digital economy,  
**Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services)  
Opportunities and Challenges in Digital Business, | 09 |
| 2      | **Overview of E-Commerce**  
**E-Commerce**- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement  
Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing  
EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC | 06 |
| 3      | **Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system  
**Application Development**: Building Digital business Applications and Infrastructure | 06 |
| 4 | Managing E-Business - Managing Knowledge, Management skills for e-business, Managing Risks in e-business  
| 5 | E-Business Strategy - E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition  
(Process of Digital Transformation) | 04 |
| 6 | Materializing e-business: From Idea to Realization - Business plan preparation Case Studies and presentations | 08 |

References:

2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance
10. Measuring Digital Economy- A new perspective  
DOI: 10.1787/9789264221796-en OECD Publishing

Assessment:

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
Course Code | Course Name | Credits
--- | --- | ---
ME-ISILOCII2059 | Environmental Management | 03

Objectives:
1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…
1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed Contents</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.</td>
<td>10</td>
</tr>
<tr>
<td>02</td>
<td>Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.</td>
<td>06</td>
</tr>
<tr>
<td>03</td>
<td>Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.</td>
<td>05</td>
</tr>
<tr>
<td>04</td>
<td>Scope of Environment Management, Role &amp; functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility.</td>
<td>10</td>
</tr>
<tr>
<td>05</td>
<td>Total Quality Environmental Management, ISO-14000, EMS certification.</td>
<td>05</td>
</tr>
<tr>
<td>06</td>
<td>General overview of major legislations like Environment Protection Act, Air (P &amp; CP) Act, Water (P &amp; CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.</td>
<td>03</td>
</tr>
</tbody>
</table>

REFERENCES:
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press

**Assessment:**

**Internal:**
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
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<tr>
<th>Module</th>
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<th>Lab. Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- Working With Wireshark in Hub Environment for Packet Sniffing</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>- Packet sniffing in Switch Environment</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>- Vulnerability Scanning technique using NESSUS</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>- REST Architecture : Web Mash up using PHP</td>
<td>02</td>
</tr>
<tr>
<td>4</td>
<td>- Version Control – Software Configuration Management in Linux</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>- Customization of Linux Live CD</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>- Working with LVM in Linux</td>
<td>01</td>
</tr>
<tr>
<td>7</td>
<td>- Exploring atleast two linux based web designing tools (Bluefish, Komodo etc.)</td>
<td>02</td>
</tr>
<tr>
<td>8</td>
<td>- Exploring Content Management system on Linux</td>
<td>02</td>
</tr>
</tbody>
</table>

**Reference Book:**
1. Linux Network Security. SPD
2. CMS design using PHP and Jquery, PACT
3. Wordpress MU beginners guide, PACT

**Assessment:**

**End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners
<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL204</td>
<td>Laboratory IV</td>
<td>01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module</th>
<th>Detailed content</th>
<th>Lab. Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 Mini Project based on any one of the selected level optional courses (DLOC &amp; ILOC) subject.</td>
<td>24</td>
</tr>
</tbody>
</table>

**Modality and Assessment:**

1. Each mini project assignment will be done by individual student. The Faculty teaching elective subject will be required to propose and evaluate the respective mini projects. These will be essentially hands-on practical and not theory / research review types of projects

2. **End Semester Examination:** Practical/Oral examination is to be conducted by pair of internal and external examiners
### Guidelines for Seminar

- Seminar should be based on thrust areas in Information Security.
- Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literatures (at least 10 papers from Refereed Journals) and understand the topic and compile the report in standard format and present in front of Panel of Examiners. (pair of Internal and External examiners appointed by the University of Mumbai)
- **Seminar should be assessed based on following points**
  - Quality of Literature survey and Novelty in the topic
  - Relevance to the specialization
  - Understanding of the topic
  - Quality of Written and Oral Presentation

### IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years’ experience in Industries.

2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.

3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

4. Students should publish at least one paper based on the seminar work in reputed International / National Conference/Journal (desirably in Referred Journal should be ISI/Scopus/SCI indexing)

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISD301</td>
<td>Seminar</td>
<td>03</td>
</tr>
<tr>
<td>Subject Code</td>
<td>Subject Name</td>
<td>Credits</td>
</tr>
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</tr>
<tr>
<td>ISD301 / ISD401</td>
<td>Dissertation (I and II)</td>
<td>12 + 15</td>
</tr>
</tbody>
</table>

**Guidelines for Dissertation**

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

**Guidelines for Assessment of Dissertation I**

- Dissertation I should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
- Dissertation I should be assessed through a presentation by a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

**Guidelines for Assessment of Dissertation II**

- Dissertation II should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization or current Research / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai
- Students should publish at least one or two paper based on the work in reputed International / National Conference (desirably in Referred Journal should be ISI/Scopus/SCI indexing)