UNIVERSITY OF MUMBAI

Syllabus for the

M. E. in Information Technology with specialization in Information and Cyber Warfare

Revised 2016

Choice Based Credit and Grading System

(As per Choice Based Semester 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 in Information Technology with specialization in Information and Cyber Warfare
Mumbai University

(With effect from 2016-2017)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-IT-ICW 101	IT Infrastructure Design	4	--	--	4	--	--	4
ME-IT-ICW 102	Advanced Computer Forensic Analysis	4	--	--	4	--	--	4
ME-IT-ICW 103	Internet of Things	4	--	--	4	--	--	4
ME-IT-ICW–DLOC 104	Department Level Optional Course-I	4	--	--	4	--	--	4
ME-IT-ICW-ILOC 105	Institute Level Optional Course-I	4	--	--	4	--	--	4
ME-IT-ICW 101L	Laboratory I	--	2	--	--	1	--	1
ME-IT-ICW 102L	Laboratory II	--	2	--	--	1	--	1
Total		**20**	**04**	**--**	**20**	**02**	**--**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration Theory			
		Test1	Test 2	Avg.					
ME-IT-ICW 101	IT Infrastructure Design	20	20	20	80	3	--	--	100
ME-IT-ICW 102	Advanced Computer Forensic Analysis	20	20	20	80	3	--	--	100
ME-IT-ICW 103	Internet of Things	20	20	20	80	3	--	--	100

ME-IT-ICW–DLOC 104X	DepartmentLevelOptional Course-I	20	20	20	80	3	--	--	100
ME-IT-ICW-ILOC 105X	Institute Level Optional Course-I	20	20	20	80	3	--	--	100
ME-IT-ICW 101L	Laboratory I	--	--	--	--		25	25	50
ME-IT-ICW 102L	Laboratory II	--	--	--	--		25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

 # 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.

Subject Code	Department Level Optional Course (DLOC)	Subject Code	Institute Level Optional Course (ILOC)
Semester I			
ME-IT – ICW DLOC-I-1041	Cyber Law	ME-IT -ICW ILOC-I--1051	Product Lifecycle Management
ME-IT – ICW DLOC-I-1042	Social Networks Analysis	ME-IT -ICW ILOC-I-1052	Reliability Engineering
ME-IT – ICW DLOC-I-1043	Data Science	ME-IT -ICW ILOC-I-1053	Management Information System
ME-IT – ICW DLOC-I-1043	Intrusion Detection System	ME-IT -ICW ILOC-I-1054	Design of Experiments
		ME-IT -ICW ILOC-I-1055	Operation Research
		ME-IT -ICW ILOC-I-1056	Cyber Security and Laws
		ME-IT -ICW ILOC-I-1057	Disaster Management and Mitigation Measures
		ME-IT -ICW ILOC-I-1058	Energy Audit and Management

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-IT-ICW 201	Network Security	4	--	--	4	--	--	4
ME-IT-ICW 202	Cryptography and PKI	4	--	--	4	--	--	4
ME-IT-ICW 203	Web Application Hacking	4	--	--	4	--	--	4
ME-IT-ICW–DLOC 204X	Department Level Optional Course-II	4	--	--	4	--	--	4
ME-IT-ICW–ILOC 205X	Institute Level Optional Course-II	4	--	--	4	--	--	4
ME-IT-ICW 203L	Laboratory III	--	2	--	--	1	--	1
ME-IT-ICW 204L	Laboratory IV	--	2	--	--	1	--	1
Total		**20**	**04**	**--**	**20**	**02**	**--**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration(thr)			
		Test 1	Test 2	Avg.					
ME-IT-ICW 201	Network Security	20	20	20	80	3	--	--	100
ME-IT-ICW 202	Cryptography and PKI	20	20	20	80	3	--	--	100

ME-IT-ICW 203	Web Application Hacking	20	20	20	80	3	--	--	100
ME-IT-ICW–DLOC 204X	Department Level Optional Course-II	20	20	20	80	3	--	--	100
ME-IT-ICW–ILOC 205X	Institute Level Optional Course-II	20	20	20	80	3	--	--	100
ME-IT-ICW 203L	Laboratory III	--	--	--	--		25	25	50
ME-IT-ICW 204L	Laboratory IV	--	--	--	--		25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

 # 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.

Subject Code	Department Level Optional Course (DLOC)	Subject Code	Institute Level Optional Course (ILOC)
Semester II			
ME-IT–ICW DLOC-II-2041	Cloud and IOT Security	ME-IT ICW ILOC-II-2051	Project Management
ME-IT–ICW DLOC-II-2042	Global Cyber Warfare	ME-IT ICW ILOC-II-2052	Finance Management
ME-IT–ICW DLOC-II-2043	Botnets	ME-IT ICW ILOC-II-2053	Entrepreneurship Development and Management
ME-IT–ICW DLOC-II-2044	Information Security and Risk Assessment	ME-IT ICW ILOC-II-2054	Human Resource Management
		ME-IT ICW ILOC-II-2055	Professional Ethics and CSR
		ME-IT ICW ILOC-II-2056	Research Methodology
		ME-IT ICW ILOC-II-2057	IPR and Patenting
		ME-IT ICW ILOC-II-2058	Digital Business Management
		ME-IT ICW ILOC-II-2059	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME IT – ICW-S301	Seminar	--	06	--	--	03	--	03
ME IT – ICW-D301	Dissertation I	--	24	--	--	12	--	12
Total		--	30	--	--	15	--	15

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Oral.	Total
		Test1	Test 2	Avg.				
ME IT – ICW-S301	Seminar	--	--	--	--	50	50	100
ME IT – ICW-D301	Dissertation I	--	--	--	--	100	--	100
Total		--	--	--	--	**150**	**50**	**200**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-IT-ICW-D401	Dissertation II	--	30	--	--	15	--	15
Total		--	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory						
		Internal Assessment			End Sem.Exam.	Term Work	Oral	Total
		Test1	Test 2	Avg.				
ME-IT-ICW-D401	Dissertation II	--	--	--	--	100	100	200
Total		--	--	--	--	**100**	**100**	**200**

* 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.

Semester I

Subject Code	Subject Name	Credits
ME-IT-ICW 101	**IT Infrastructure Design**	**04**

Course Objective:

- Provide knowledge of Enterprise wide Network Design.
- Provide Knowledge of Data center design includes Storage network
- Give insight into the implementation of SDN and how it will impact current Design practice
- Understand latest trend in SDN

Course Outcome: Students should be able to

- Design Enterprise wide network design considering various QoS Parameter
- Explain the design challenge of large scale data center
- Implementation of SDN and how it will impact current Design practice
- explain latest trend in SDN

Prerequisite: Basic knowledge of Networking techniques.

Module	**Detailed content**	**Hours**
Prerequisite	- Basic of Networking Topology - OSI Layer Basics - Basics of Internetworking Devices	3
I	Enterprise Network Design: Understanding Network Requirement analysis, Architecture and Design Process Network Architecture: Component Architecture –Routing, Network Management, Performance, Security. Architectural models: topological, flow model, Functional model Addressing And Routing Architecture, Network Management Architecture, Performance Architecture Border less Network Architecture. Network Design: Designing the network topology and solutions-Top Down Approach Network Structure Model: Hierarchical Network Model, Enterprise wide network Architecture model- Enterprise Edge Area. E-commerce, Internet Connectivity to remote, enterprise branch and enterprise Data center module. High Availability Network Services- Workstation to Router redundancy and LAN High Availability protocols, Route, Server Redundancy, Load Balancing., link Media Redundancy.	8
II.	Enterprise LAN Design: Ethernet Design Rule. 100 Mbps Fast Ethernet Design rules, gigabit Ethernet Design Rules, 10 Gigabit Ethernet Design rules, 10GE Media types Understanding Working of Repeater, hub, Bridge, routers, Layer2/3 Switch Campus LAN Design Best Practice	6

	Server Farm Design, DMZ design. Campus LAN QoS consideration Multicast Traffic Consideration	
III.	Data Center Design: Architecture Consideration: Infrastructure Model, Service Layers Model of Cloud computing. Cloud Reference Architecture Framework, Cloud Data Center Building Blocks. Cloud Data Center Technology Architecture Trust in Cloud Data Center The elements of cloud visibility The elements of cloud protection Cloud Control, Compliance and SLA. Telecommunications Infrastructure Standard for Data Centers ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers , NSI/NECA/BICSI-002 Data Center Design and Implementation Best Practices Purpose of TIA-942 Design Elements - Cabling Design, Facility Design, Network Design. Relationship of Spaces, Data Center Topology Data Center Tiers Basic Data Center Design Example.	10
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.	5
V.	SAN: Need for storage Network, Data Protection and RAID, Storage Network Architecture and IP storage, Storage Network Backup and Recovery, Storage and Network in Storage Network, Software for Storage Network, Adopting and Managing SAN.	7
VI.	Software Defined Network : Understanding SDN and Open Flow : SDN – Network Virtualization Techniques, SDN Building Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , PoX and NoX, NetApp Development on top of SDN, Open Flow in Cloud Computing. Case study: how SDN changed Traditional Enterprise network Design	9

References:

1. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.

2. CCDA Cisco official Guide
3. Cisco Cloud Computing - Data Center Strategy, Architecture, and Solutions by Kapil Bakshi - Cisco Systems White paper
4. https://en.wikipedia.org/wiki/TIA-942
5. "Data Center Top-of-Rack Architecture Design" . *White paper*. Cisco Systems. April 18, 2011. Retrieved July 10, 2013.
6. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky
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.

Subject Code	Subject Name	Credits
ME-IT-ICW 102	**Advanced Computer Forensic Analysis**	**04**

Course Objectives:

- Student will be able to understand the basic terminology of computer forensics
- Student will be able to extract and handle digital data that will be processed
- Student will be tackle micro threats and various methods of information warfare.
- Student will be understand surveillance tools and civilian casualties which may result in the case of attack..

Course Outcomes: The Learner will:

- Become aware of basic terminology of computer forensics
- Be able to extract and handle digital data
- Be able to tackle micro threats
- Handle surveillance tools and avoid civilian casualties.

Prerequisite:

1. Learner should be aware of current on- going technology related to cybercrime.

Sr. No.	**Module**	**Detailed Content**	**Hours**
I	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.	**4**
II	Types of Computer Forensics systems	Internet security, IDS, Firewall, Public key, net privacy systems, vendor and computer Forensics services	**8**
III	Computer Forensics evidence and capture	Data recovery, evidence collection and data seizure, duplication and preservation of digital evidence, computer image verification and authentication	**8**
IV	Computer Forensics Analysis	Discovery of electronic evidence, identification of data, Reconstructing past events, network: network forensic scenario, approach, email destruction, system testing	**8**

V	Counter Measures	**Fight against Macro Threats:** government preparations, industrial support, role of international organizations, super cyber protection agencies **Information Warfare Arsenal & Tactics of the Military:** Overview, Information warfare tools and tactics for: offensive ruinous, containment, defensive prevention, defensive ruinous and defensive response containment	**10**
VI	Surveillance Tools and Civilian Casualties	Monitoring, Cyber Surveillance, implications of cookies and integrated platforms Loss to Cyber Mass, destruction of personal assets. Privacy violation, uncovering secrete identities, monitoring of private affairs in cyber space.	**10**

Text Books:

1. Cyber Security : Belapure: wiley
2. By John R. Vacca Computer forensics: computer crime scene investigation, Volume 1

References:

1. EnCase Computer Forensics . Sybex
2. Computer Forensics: Incident Response Essentials, Warren G. Kruse II & Jay G. Heiser
3. Computer Forensics & Privacy, Michael Caloyannides
4. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, edited by Albert J. Marcella Jr. & Robert S. Greenfield

Subject Code	Subject Name	Credits
ME-IT-ICW 103	**Internet of Things**	**04**

Course Objective:

- Vision and Introduction to IoT.
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcome: Students should be able to

- Understand the vision of IoT from a global context.
- Determine the Market perspective of IoT.
- Use of Devices, Gateways and Data Management in IoT.
- Building state of the art architecture in IoT.
- Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints

Prerequisite: Student should have knowledge of wireless networks, network protocols

Sr. No.	Module	Detailed Content	Hours
I	**M2M to IoT**	The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.	**6**
II	**M2M to IoT – A Market Perspective**	Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. **M2M to IoT-An Architectural Overview**– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	**10**
III	**M2M and IoT Technology Fundamentals**	Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	**8**

IV	**IoT Architecture-State of the Art**	Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model	**8**
V	**IoT Reference Architecture**	**IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.	**10**
VI	**Implementation Examples**	- Industrial Automation , The Smart Grid, Smart Cities,	**6**

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** 1st Edition, Academic Press, 2014.

References:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-I-1041	**Cyber Law**	**04**

Course Objectives: The objective of this course is to

1) Equip students with basic concepts of technology and law, digital contracts, rights of netizens and E-governance and provide knowledge of cyber crime and Policies of internet law.

2) Impart knowledge of Information Technology Act and legal frame work of Right to Privacy, Data Security and Data Protection , Forensic analysis , inner investigation models for overcoming cyber crimes.

3) To identify the processes involved in collecting and presenting electronic evidence.

4) Develop competencies for dealing with frauds and deceptions (confidence tricks, scams) and other cyber crimes for example, child pornography etc. that are taking place via the Internet;

5) Emphases upon studying cyber space and various aspects of cyber laws and regulating them through relevant Acts.

6) Understand the range of options which may be available for dealing with online disputes, and how to choose amongst them

Course Outcomes: Students will be able to

1) Learn law and legal policies associated with the internet.

2) Understand IT security Policies , Business law and contracting for data security.

3) Apply law to emerging dangers.

4) Carry out investigations so that they will be judged as ethical and credible.

5) Bridge gaps between security professionals, law enforcement and prosecutors.

6) Evaluate the role and meaning of contracts for technology, including services, software and outsourcing.

Prerequisite: System and Web Security

Sr. No.	Module	Detailed Content	Hours
I	Fundamentals of Cyber law	Regulation of Information Society, Need for Cyber Laws, ICANN, UNCITRAL, Indian Scenario in regulation, Investigation and Ethics: Cyber Crime, Information Security and Law, Types & overview of Cyber Crimes, Cyber Law Issues in E-Business Management Indian IT Act, ISP and Intellectual property issues, Cyber squatters and Copy Right Protection , Patents, Data privacy and protection, Domain Name, Software piracy, Plagiarism, Issues in ethical hacking	12
II	ITSecurity Law and Policy	Security Policy, Ethical issues in data and software privacy, Computer Crime Laws, Honeypots & Entrapment, Active Defenses, Hacking Back	**6**
III	Electronic Records and Signature	Vicarious Liability, E-Discovery, Records Retention, Destruction, Email Retention, Forensics, Privacy Policies, Evidence Law, Signatures	**6**
IV	Contracts and formal legal documents in the Infotech World	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, Competition, Disputes, Non- Disclosure	**8**
V	Investigation and Ethics	Cooperation with investigations, Live Vs Post mordem investigation ,Numerous Examples of Fraud (Post-Mordems), Sarbanes-Oxley Act , Securities Fraud, Federal Sentencing Guidelines, IT Codes of Ethics, Hotlines, Reporting, Whistleblowing , Employee Monitoring, Entrapment, Raids & Seizures	**8**
VI	Cyber Defence	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	**8**

Text Books:

1) Vivek Sood, “Cyber Laws Simplified”, Mc Graw Hill

2) Anthony Reyes, “Cyber Crime Investigations: Bridging the Gaps Between Security Professionals, Law Enforcement, and Prosecutors.

3) 3 Brian Craig, *"Cyberlaw: The Law of the Internet and Information Technology",* 1st ed., Prentice Hall, 2012.
4) 4. Faiyaz Ahamad, " Cyber Law and Information Security" , Dreamtech Press

References:

1. Marcia P. Miceli, "Whistle-Blowing in Organizations"
2. Jonathan Rosenoer, " Cyber Law , The Law of internet, Springer 1.

Subject Code	Subject Name	Credits
ME-IT –ICW DLOC-I-1042	**Social Networks Analysis**	**04**

Course Objectives:

1 To understand the components of the social network

2 To model and visualize the social network

3 To mine the users in the social network

4 Understand human behaviour in social web and related communities

Course Outcomes:

Upon completion of the course, the student should be able to:

- Represent knowledge using ontology
- Predict human behaviour in social web and related communities
- Visualize social networks.
- Develop semantic web related applications

Prerequisite: 1) Networking 2) Graph Theory 3) Data Mining Techniques

Sr. No.	**Module**	**Detailed Content**	**Hours**
I	INTRODUCTION	Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks	**6**
II	MODELING AND VISUALIZATION	Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and	**9**

		relationships.	
III	MINING COMMUNITIES	Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.	**6**
IV	EVOLUTION	Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models.	**9**
V	Predicting Human Behaviour And Privacy Issues	Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on Courseive logic - Trust network analysis - Trust transitivity analysis - 9Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.	**9**
VI	Visualization And Applications Of Social Networks	Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks	**9**

REFERENCES:

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2011

2. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.

3. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st
edition, 2010.

4. John Scott.”Social Network Analysis-A Handbook”,II Edition,Sage Publication.

5. Stanley Wasserman,Katherine Faust,”Social Network Analysis-Methods and Applications”,Cambridge University Press.

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-I-1043	Data Science	**04**

Course Objectives:

- Provide Insights about the Roles of a Data Scientist and enable to analyze the Big Data.
- Understand the principles of Data Science for the data analysis and learn cutting edge tools and techniques for data analysis.
- Figure Out Machine Learning Algorithms.
- Learn business decision making and Data Visualization

Course Outcomes:

The student should be able:

- Demonstrate knowledge of statistical and exploratory data analysis data analysis techniques utilized in decision making.
- Apply principles of Data Science to the analysis of business problems.
- To use Machine Learning Algorithms to solve real-world problems.
- To provide data science solution to business problems and visualization.

Prerequisite: fundamentals of data base, basic programming skills

Sr. No.	Module	Detailed Content	Hours
	Prerequisite	Relational database, KDD process, Introduction to BIG data, What is Hadoop, Core components of Hadoop, Hadoop ecosystem.	**3**
I	An Introduction to Data Science	Definition, working, benefits and uses of Data Science, Data science vs BI, The data science process, Role of a Data Scientist,	**4**
II	Statistical Data Analysis & Inference	Populations and samples, Statistical modeling, probability distributions, fittings a model, Statistical methods for evaluation, Exploratory Data Analysis, Getting started with R, Manipulating and Processing data in R , working with function in R , Working with descriptive Statistics, Working with graph plot in R.	**8**

III	Learning Algorithms	k-nearest neighbor, Simple and multiple Linear Regression, Logistic Regression, Support vector machine, Model-Based Clustering, Clustering High-Dimensional Data,	**12**
IV	Data Visualization	Data Visualization basics, techniques, types, applications, tools, Data Journalism, Interactive dashboards,	**8**
V	Advance Analytical Methods	Text Analysis- Text analysis steps, A text analysis example, Collecting raw text and representing text, TF and TFIDF, Categorizing documents by topics, determining sentiments, Time series analytics- overview, ARIMA model,	**8**
VI	Business problems and data science solutions	Data Science and Business Strategy: Thinking Data-Analytically, Redux, Competitive Advantage with Data Science, Data Science Case Studies, Case Study: Global Innovation Network and Analysis.	**5**

Text Books:

1. Data science and big data analytics, EMC
2. Doing Data Science, *Rachel Schutt and Cathy O'Neil*
3. Introducing Data Science, Davy Cielen
4. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly. Copyright © 2013

References:

1. Regression Analysis by Example,

2. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann

3. An Introduction to Statistical Learning with Applications in R , Gareth James • Daniela Witten • Trevor Hastie, Robert Tibshirani, Springer

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

1. Exploratory Data Analysis and regression using R.
2. Text Analysis using R
3. Business problem : Data science solution.

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.

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-I-1044	**Intrusion Detection System**	**04**

Course Objectives:

1 To make students aware of Internal Contents of Packets in Hexadecimal.

2 Students will become aware of different Intrusion Detection Systems &Techniques

3 Students will learn about methodologies used to detect intrusions.

Course Outcome:

1. The students will demonstrate knowledge about different techniques in Intrusions.

2. Identify and analyse the stages in UDP, TCP packets data conversion from hexadecimal to decimal.

3. Demonstrate systematic understanding of the concepts of Intrusion Detection Systems.

DETAILED SYLLABUS :

Sr. No.	Module	Detailed Content	Hours
I	Intrusion Detection Systems :	IDS Introduction, Types of IDS : Host IDS, Network IDS, Target Based Assembly Detection, Signature and Anamoly Based Detection , Signature Writing Techniques.	06
II	Traffic Analysis :	Packet Dissection Using TCPdump, Dissecting the Whole Packet, Freeware Tools for Packet Dissection, Examining IP Header Fields, Introduction to Snort and Rules.	08
III	Intrusion Prevention, Detection & Response :	IP Data Flows, Behavioural Analysis, Anomaly Detection, Differentiation Between IDS and Netflow, Vulnerability Analysis, Attack Modeling and Simulation, Intrusion Detection and Response	08
IV	Wireless IDS/IPS :	Types , Wireless IDS Events, Intrusion Prevention Techniques , Honeypot, Other Wireless Threats.	06
V	Physical and Geo-spatial Intrusion Detection for IT :	Common Physical Access Control Components , Geographic Information System , Spatial Point Pattern Analysis , Point Intensity , Geocoding Techniques , Limitations.	08
VI	Visual Data Communications :	Visualization , Statistical Graphing Techniques , Technological Considerations ,Security Event Visualization	08

Text Book:

1 .Practical Intrusion Analysis: Prevention and Detection for the Twenty-First Century, Ryan Trost, Addison-Wesley Professional; 1 edition

Reference books

1.Rebecca Gurley Base " Intrusion Detection" MacMillan Technology Series(MTP Series) ISBN 1578701856, 9781578701858

2. Rafeeq Rehman " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID" Prentice Hall PTR ,2003 ISBN 0-13-140733-3

3.Network Intrusion Detection, Third Edition : By Stephen Northcutt, Judy Novak.

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I-1051	Product Life Cycle Management	03

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

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:**Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**ProductDesign:**Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**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	05
04	**Virtual Product Development Tools:**For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model	05

	building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
05	**Integration of Environmental Aspects in Product Design:**Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:**Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

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.

REFERENCES:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I-1052	**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

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**MaintainabilityandAvailability:**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.	05

06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

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.

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1053	Management Information System	03

Objectives:

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

Module	Detailed Contents	Hrs
01	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.	4
02	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	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

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.

REFERENCES:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1054	**Design of Experiments**	**03**

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

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^K Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^K Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design	07

	4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	
05	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

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.

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1055	Operations Research	03

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

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **LinearProgramming**: Introduction,LinearProgrammingProblem, 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.	14

	Introduction to Decomposition algorithms.	
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 Simulation	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
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.	05
06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

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.

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1056	Cyber Security and Laws	03

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
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime andinformation security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation ofMobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed byMobile Devices, Registry Settings for Mobile Devices, AuthenticationService Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures forHandling Mobile, Devices-Related Security Issues, OrganizationalSecurity Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** 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)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under	6

	the IT Act, 2000, IT Act. 2008 and its Amendments	
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

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.

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
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security,* Pearson Publication
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

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1057	**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.

Module	Detailed Contents	Hrs
01	**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.**	03
02	**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.**	09
03	**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**	06

	start with and how to proceed in due course of time, study of flowchart showing the entire process.	
04	**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 of GIS, Remote sensing and GPS in this regard.**	06
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.**	09
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.	06

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.

REFERENCES:

1. ‘Disaster Management’ by Harsh K.Gupta, Universities Press Publications.
2. ‘Disaster Management: An Appraisal of Institutional Mechanisms in India’ by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. ‘Introduction to International Disaster Management’ by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. ‘Disaster Management Handbook’ by Jack Pinkowski, CRC Press Taylor and Francis group.
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
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ME-IT -ICW ILOC-I--1058	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

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** 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& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers.	10

	Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
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

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.

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Semester II

Subject Code	Subject Name	Credits
ME-IT-ICW 201	**Network Security**	**04**

Course Objectives:

1 To provide students with contemporary knowledge in Network Security.

2 To equip students with skills to analyze different routing Algorithm Vulnerabilities.

3 To provide knowledge of secure network infrastructure services.

4 To equip students with skills to analyze security at Application layer.

Course Outcomes:

1) Understand different Security Principles .
2) Analyze Packet analysis and Packet sniffing in Hub and Switched environment.
3) Analyze different OS Security Issues.
4) Appreciate different technique of hacking wireless network.

Prerequisite: Computer Network.

DETAILED SYLLABUS :

Sr. No.	**Module**	**Detailed Content**	**Hours**
I	Introduction to Network Security	Secure Network Services, Security Principles, Security Attacks; Security Services; A model for Internetwork Security; Internet Standards and RFCs Kerberos, X.509 Directory Authentication Service Military and civil security, vulnerability and threat models, End-end security (COMSEC), l i n k encryption (TRANSEC), compartments. Privacy. Denial of service. Internet security model	**8**

II	Security at Network Layer	Routing algorithm vulnerabilities: route and sequence number spoofing, instability and resonance effects. Information hiding: DMZ networks, route aggregation and segregation ICMP redirect hazard: denial of service. ARP hazard: phantom sources, ARP explosions and slow links. Defending against Chernobyl packets and meltdown. Fragmentation vulnerabilities and remedies: (ICMP Echo overrun) IPSec: IP Security Overview, IP Security Architecture, Security Associations ,Security Association Database, Security Policy Database, Tunnel and Transport mode, AH and ESP, IP and IPv6, Encapsulating Security Payload, Internet Key Exchange	**10**
III	Security at Transport Layer	Secure network infrastructure services: DNS, NTP, SNMP SSL Architecture, SSL/TLS Basic Protocol, SSL Message Formats, Session Resumption, Computing the keys, Client Authentication, PKI as deployed by SSL, Version Numbers, Negotiating Cipher Suites, Negotiating Compression Methods, Exportability, Encoding, Mobile systems: Address Export and re-use. Session key management: Blind-key cryptosystems(NTP).	**8**
IV	Security at Application Layer	Security at Application Layer: PGP,S/MIMIE E-mail security, PGP, PEM, S/MIME, Secure binding of multimedia streams, Secure RTP. Secure RSVP.	**6**
V	Firewall	Firewalls: Network partitioning, firewall platforms. Packet analysis and Packet sniffing in Hub and Switched environment, Analysis of packet for security i.e Sync Scan, OS Fingerprinting .Secure SNMP, Secure routing interoperability: virtual networks (DARTnet/CAIRN). Transparent and opaque network services. Source masking and hidden channels. IDS, Honeypots,	**10**
VI	Wireless Network Security:	Introduction, How wifi works, WEP, Technique of hacking wireless network, counter measure **OS Security issues**: Windows and Linux environment	**6**

Text Books:

1. Stallings, W., "Cryptography and Network Security: Theory and Practice", Second Edition, John Wiley

2. Charles P. Pfleeger "Security in computing", Pearson Education

References:

1. Stalling W., "Network Security Essentials", Pearson

2. Garfinkel S., Spafford G., “Practical Unix and Internet Security”, O'Reilly

3. Blacharski D., “Network Security in a Mixed Environment”

4. Practical Packet Analysis: Using Wireshark to Solve Real-Word Network problems by Chris Sanders.

Subject Code	Subject Name	Credits
ME-IT-ICW 202	**Cryptography and PKI**	**04**

Course Objectives:

1. Students should be able to gain of firsthand experience public key encryption, public key

   Certification, authentication based on PKI.

2. To provide solid foundation of the principal of Cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithm

3. Students should be able appreciate the core techniques of cryptography and how they can be applied to meet various security objectives
4. Students should be able to understand both the importance of cryptographic key management, and the different key management requirements and practices associated with the use of different security techniques

Course Outcomes:

- Student will able to used tolls and write programs to create secure channel using PKI.
- Students will be able to appreciate how the techniques described are employed in practice in a variety of security applications, from SSL enabled websites through to disk encryption
- Compare and contrast a range of different cryptosystems from an applied viewpoint.
- List and elaborate the differences between secret key and public key cryptosystems.

DETAILED SYLLABUS :

Sr. No.	Module	Detailed Content	Hours
I	**Cryptography : Concepts and Techniques**	Introduction, Security Trends, Model for Network Security, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of	**08**

		Attacks	
II	**Symmetric Key Algorithms**	DES, 3DES, AES, IDEA, RC4, RC5, Confidentiality using symmetric encryption	**07**
III	**Introduction to Number Theory:**	Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms **Cryptography and RSA** Principles of Public-Key Cryptosystems, RSA, Key Management, Diffie- Helman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	**09**
IV	**Message Authentication and Hash Functions:**	Authentication Requirements, Authentication Functions, MAC, Hash Functions, Security of Hash Functions and MACs, SHA, HMAC	**08**
	Digital Signatures and Public Key Infrastructure (PKI)	**Digital Signatures and Public Key Infrastructure (PKI):** Digital Signatures, Elliptic Curve Digital Signature Algorithm Authentication Protocols, DSS, Authentication Elliptic Curve Digital Signature Algorithm Digital Certificates, Private Key Management, PKI Trust Models, Public Key Cryptography Standards, Revocation, Directories and PKI, PKIX and Security.	**10**
VI	**User Authentication and Kerberos**	User authentication Princilpes, Authentication Tokens, Certificate based authentication, Biometric authentication, Kerberos, Key Distribution Centre(KDC), Security Handshake Pitfalls	**06**

Text Books:

1. Information Security Principal and Practice: Mark stamp, Wiley
2. Cryptography and security, wiley, Shyamala, harini

References:

1. Stallings, W., "Cryptography and Network Security", Fourth Edition, Pearson
2. Introduction to Cryptography with coding Theory, Pearson,WadenTrappe
3. Forouzan B., "Cryptography and Network Security", Second Edition, Tata McGraw Hill
4. Bernard Menezes,"Network Security and Cryptography", Cengage Learning.
5. Charlie Kaufman, Radia Perlman and mike speciner "Network security, private communication in a public world" , Second Edition, Pearson

List of Experiments : Six Experiments based on each module. Laboratory Practical's/ Case studies

Subject Code	Subject Name	Credits
ME-IT-ICW 203	**Web Application Hacking**	**04**

Course Objectives

1 To make students aware of current hacking frauds carried during daily transaction Processes.

2 Students will become aware of different web applications, servers, clients, & databases which are vulnerable for hacking.

3 Students will learn about methodologies used to protect applications from Hackers.

Course Outcome:

1. The students will demonstrate knowledge about different tools and techniques in Ethical hacking and security.
2. Identify and analyse the stages an ethical hacker requires to take in order to compromise a target system.
3. Critically evaluate security techniques used to protect system and user data.
4. Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1	Web Application Technologies & Mapping :	Introduction, HTTP Protocol , Web Functionality, Encoding Schemes, Discovering Hidden Content, Analyzing the Application.	06
2	Attacking Authentication & Session Management :	Design Flaws in Authentication Mechanism, Weaknesses in Token Generation, Weaknesses in Session Token Handling .	
3	Attacking Data Stores :	Injecting into SQL, Injecting into NoSQL, Injecting into Xpath.	
4	Attacking Back-End Components :	Injecting OS Commands, Injecting into XML Interpreters, Injecting into Back-end HTTP Requests, Injecting into Mail Services.	
5	Attacking Users :	Inducing User Actions, Capturing Data Cross-Domain, Client-Side Injection Attacks, Local Privacy Attacks,	

		Attacking the Browser.	
6	Web Application Hacker's Toolkit & Methodology	Web Browsers, Other Tools, Map the Application's Content, Analyze the Application, Test Client-Side Controls, Test the Authentication Mechanism, Test for Input-Based Vulnerabilities, Test for Application Server Vulnerabilities.	

Text Books:

1. Botnet : The Killer Web App. Syngress Publications, Authors : Craig A. Schiller, Jim Binkley, David Harley, Gadi Evron, Tony Bradley, Carsten Willems, Michael Cross.

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-II-2041	**Cloud and IOT Security**	**04**

Course Objectives to learn:

1. The types of services offered through cloud computing, virtualization & IT infrastructure security capabilities
2. The current state of data security and the storage of data in the cloud, security management frameworks and the standards, privacy aspects to consider within the context of cloud computing.
3. All types of attacks and threats, privacy preservation in IOT, Trust model in IoT infrastructure.
4. Security issues in IoT data computations and social context based privacy in IoT platforms.

Course Outcomes: At the end of course student should be able to:

1. Understand IT infrastructure security capabilities and services offered through cloud computing.
2. Understand privacy aspect, data storage and security management frameworks and standards.
3. Understand to attacks threats and privacy preservation in IoT and trust model in IoT infra structure.
4. Understand social context based privacy in IoT and data computations security issues in IoT.

Prerequisite: Student should have knowledge of cloud computing, IoT, Network security.

DETAILED SYLLABUS :

Sr. No.	Module	Detailed Content	Hours
I	Introduction	Cloud Computing Defined , SPI Framework for Cloud Computing , Traditional Software Model , Cloud Services Delivery Model , Cloud Deployment Models ,Key Drivers to Adopting the Cloud , The Impact of Cloud Computing on Users , Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise, SECURITY-AS-A-[CLOUD] SERVICE	**8**
II	Cloud Security	INFRASTRUCTURE SECURITY:	**8**

		The Network Level , The Host Level , The Application Level DATA SECURITY AND STORAGE : Aspects of Data Security, Data Security Mitigation , Provider Data and Its Security	
III	Security Management & Privacy In Cloud	SECURITY MANAGEMENT IN THE CLOUD: Security Management Standards, Security Management in the Cloud , Availability Management , SaaS Availability Management , PaaS Availability Management , IaaS Availability Management , Access Control , Security Vulnerability, Patch, and Configuration Management. PRIVACY In cloud: Privacy, Data Life Cycle, Key Privacy Concerns in the Cloud. Protecting Privacy, Privacy Risk Management and Compliance in Relation to Cloud Computing.	**10**
IV	IOT Threats , Attacks &Privacy Preservation	Internet of Things (IoT) as Interconnection of Threats (IoT), Attack, Defense, and Network Robustness of Internet of Things , Privacy Preservation Data Dissemination, Privacy Preservation for IoT Used in Smart Buildings.	**8**
V	IOT Trust And Authentication	Trust and Trust Models for the IoT, Authentication in IoT.	**6**
VI	IOT Data Security And Social Awareness	Computational Security for the IoT and Beyond, Security Protocols for IoT Access Networks , Security and impact of IoT on mobile networks**.**	**8**

Text Books:

1. Cloud Security and Privacy An Enterprise perspective on Risk and Compliance , Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly
2. Security and Privacy in Internet of Things Models Algorithms and Implementations, Fe Hu, CRC Press.
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-II-2042	**Global Cyber Warfare**	**04**

Course Objectives:

1. This course addresses some of the unique and emerging policy, doctrine, strategy, and operational requirements of conducting cyber warfare at the nation-state level.

2. It provides students with a unified battle-space perspective and enhances their ability to manage and develop operational systems and concepts in a manner that results in the integrated, controlled, and effective use of cyber assets in warfare.

Course Outcomes:

On completion of this course, students should be able to:

- explain the theory of data, information and knowledge as they pertain to information warfare
- apply strategies of using information as a weapon and a target
- apply the principles of offensive and defensive information warfare for a given context
- discuss the social, legal and ethical implications of information warfare

Prerequisite: Student should have knowledge of cyber security and Information security.

DETAILED SYLLABUS :

Sr. No.	Module	Detailed Content	Hours
I	**Cyberspace as a Warfare Domain :**	Purpose, Plausibility, and Limits of Cyberwar ,Netcentricity ,Operational Cyberwar , A Conceptual Framework , Act of War, Relationship to IO. **Operational History of Cyber Warfare:** Cyber Crime , Future Threats , Rise of Nonstate Hacker, Noteworthy Events, Ex. Gaza Cyber war	**6**
II	**Responding to International Cyber Attacks**	Law of War, Nonstate actors and Law of War ,Analysing Cyber Attacks , Technological Limitations , Issues , Intelligence Component of Cyber Warfare ,Korean DDOS Attacks,One year after RU-GE War ,Ingushetia Conflict , Predictive Role of Intelligence ,Nonstate Hackers and Social Web ,Dark side of Social Networks, TwitterGate , Automating Process, False Identities,Components of Bulletproof Networks,SORM-2, Kremlin and Russian	**8**

		Internet.	
III	**Organized Crime in Cyber space :**	Subtle Threat ,Atrivo/Interchange,EST Domains,McColo, Russian Organized Crime and Kremlin Investigating Attribution **:** Using Open Source Internet Data , Autonomous System Network , Team Cymru and It's Darknet Report, Using WHOIS	**4**
IV	**Weaponizing Malware**	New Threat Landscape, StopGeogia.ru Malware Discussions , Twitter as DDoS Command Post against Iran , Social Engineering , Channel Consolidation, Adversary's Look at LinkedIn, BIOS Based Rootkit Attack , Malware for Hire , Targeted Attacks Against Military Brass and Government Executives.	**4**
V	**Role of Cyber in Military Doctrine**	Russian Federation, FEP ,Information wars, RF Military Policy, Art of Misdirection China Military Doctrine ,Anti-access Strategies , 36 Stratagems , US Military Doctrine	**4**
VI	**Russian Federation :Information Warfare Framework**	Russian Government Policy, Laws and Amendments, Government Structures, Russian Military of Defence ,Administrative Changes, Electronic Warfare Troops , Military Units , Russian Federation Ministry of Communications and Mass Communications US Department of Defence Cyber Command and Organizational Structure	**6**
VII	**Active Defence for Cyber**	Covert Action , Cyber Active Defence Under International Law ,Cyber Active Defences as Covert Action Under International Law,Cyber Attacks Under International Law : Nonstate Actors	**4**

Text Books:

1. Inside Cyber Warfare: Mapping the Cyber Underworld by Jeffrey Carr, 2nd edition, O,Reilly
2 Cyber deterrence and Cyberwar by Martin C. Libicki.

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-II-2043	**Botnets**	**04**

Course Objectives

1 To make students aware of Structure of Botnets.

2 Students will become aware of Command to Command & Peer to Peer Working.

3 Students will learn about methodologies used to detect Botnets.

Course Outcome:

1. The students will demonstrate knowledge about different techniques in Botnets.

2. Identify and analyse the stages in different types of Small scale & large attacks.

3. Demonstrate systematic understanding of the concepts of Botnets.

DETAILED SYLLABUS :

Sr. No.	**Module**	**Detailed Content**	**Hours**
I	Botnet Introduction	Botnets: Introduction, Conceptual History of Botnets, Botnet Life Cycle, C&C Botnets, P2P Botnets, Botnet Economics	8
II	Common Botnets	Common Botnets : SDBot, Rbot, Agobot, Spybot, Mytob	8
III	Botnet Detection	Tools and Techniques : Network Infrastructure, Intrusion Detection, Forensics Techniques and Tools for Botnet Detection	8
IV	Anomaly Detection Tools	Anomaly Detection Tools : TCP Anomaly Detection, UDP Anomaly Detection	8
V	IRC and Botnets	IRC and Botnets : Understanding IRC Protocol, Detecting IRC Botnet Client, Detecting an IRC Botnet Server, Sniffing IRC Messages, Sandbox Tools.	8
VI	Intelligence Resources & Responding to	Disassemblers, Confidentiality Agreements, Role of Intelligence Sources, Law Enforcement Issues,	8

	Botnets	Effective Practices, Reporting Botnets, Fighting Back.	

Text Books:

1. Botnet : The Killer Web App. Syngress Publications, Authors : Craig A. Schiller, Jim Binkley, David Harley, Gadi Evron, Tony Bradley, Carsten Willems, Michael Cross.

Subject Code	Subject Name	Credits
ME-IT–ICW DLOC-II-2044	**Information Security and Risk Assessment**	**04**

Course Objectives: to learn

1. Risks, threats, and known vulnerabilities can be identified and documented for the organization's production, infrastructure, and assets.
2. d Risks, threats, and known vulnerabilities can be prioritized based on impact or criticality of the IT asset or data asset that it impacts.
3. Compliancy with new information security laws, mandates, and regulations can be achieved by first conducting a risk assessment.

Course Outcomes: At the end of course student should be able to:

1. Understand Risks, threats, and known vulnerabilities can be identified and documented for the organization's production, infrastructure, and assets.
2. Understand Risks, threats, and known vulnerabilities can be prioritized based on impact or criticality of the IT asset or data asset that it impacts.
3. Understand Compliancy with new information security laws, mandates, and regulations can be achieved by first conducting a risk assessment.

Prerequisite: Student should have knowledge of information security.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
I	Introduction	The Need for an Information Security Program, Elements of an Information Security Program, Common Core Information Security Practices, Security Risk Assessment, Related Activities	**6**
II	Project Definition	Ensuring Project Success, Project Description	**6**
III	Project Preparation	Introduce the Team, Review Business Mission, Identify Critical Systems, Identify Assets, Asset Valuation, Identifying Threats, Determine Expected Controls	**8**

IV	Data Gathering	Sampling, The RIIOT Method of Data Gathering, Administrative Data Gathering, Technical Data Gathering., Physical Data Gathering,	**10**
V	Risk Analysis	Determining Risk, Creating Risk Statements, Team Review of Security Risk Statements, Security Risk Mitigation, Security Risk Assessment Reporting	**8**
VI	Security Risk Assessment Approaches.	Quantitative vs. Qualitative Analysis, Qualitative Analysis, Tools, Security Risk Assessment Methods, Relevant Standards and Regulations.	**10**

Text Books:

1. The Security Risk Assessment Handbook: Douglas LanDoll, Auerbach Publication.

2. Nina Godbole, “Information Systems Security”, Wiley

References:

1. Cyber Security: Sunit Belapur, Wiley.

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2051	**Project Management**	**03**

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

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & 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).	5
02	**Initiating Projects:** 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 & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** 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).	8
04	**Planning Projects:**	6

	Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** 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,	8
06	**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.	6

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.

REFERENCES:

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

2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2052	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

Module	Detailed Contents	Hrs
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 Paper; Project Finance. **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	05
06	**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	03

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.

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2053	Enterpreneurship 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

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**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	08
05	**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	08

06	**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	05

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.

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
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.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2054	Human Resource Management	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.

Module	Detailed Contents	Hrs
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	7

	• 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	
03	**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.	6
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5
05	**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.	6
06	**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	10

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.

REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2055	Professional Ethics and Corporat Social Responsibility (CSR)	03

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

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
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	08

	India	
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

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.

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2056	**Research Methodology**	**03**

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

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature	**08**

	d. Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

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.**

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4. Only Four question need to be solved.

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Course Code	Course Name	Credits
ME-IT-ICW ILOC-II-2057	IPR and Patenting	03

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

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**:Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:**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.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:**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	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia	08

	scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

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.**

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4. Only Four question need to be solved.

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,

12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
ME-IT ICW ILOC-II-2058	**Digital Business Management**	**03**

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

Module	Detailed content	Hours
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 B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals 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	06

	project, Legal, Ethics and Societal impacts of EC	
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 Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
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

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.

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, 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
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ME-IT-ICW **ILOC-II-2059**	**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

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	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.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

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.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Subject Code	Subject Name	Credits
ME-IT-ICW 101L	**Laboratory I (Core Course Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Two Laboratory Practical's to be conducted for each of the core subjects as suggested in the subject syllabus.**	24

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.

Subject Code	Subject Name	Credits
ME-IT-ICW 102L	**Laboratory II –(DLOC & ILOC Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Three Laboratory Practical's to be conducted for each of the DLOC & ILOC subjects as suggested in the subject syllabus.**	24

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

Subject Code	Subject Name	Credits
ME-IT-ICW 201L	**Laboratory III-(Core Course Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Two Laboratory Practical's to be conducted for each of the core subjects as suggested in the subject syllabus.**	24

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

Subject Code	Subject Name	Credits
ME-IT-ICW 202L	**Laboratory IV –(DLOC & ILOC Lab)**	**01**

Module	**Detailed content**	**Lab. Sessions**
1	**Three Laboratory Practical's to be conducted for each of the DLOC & ILOC subjects as suggested in the subject syllabus.**	24

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

Subject Code	Subject Name	Credits
ME-IT- ICW-S301	**Seminar**	**03**

Guidelines for Seminar

- Seminar should be based on thrust areas in Information Technology
- 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)

Subject Code	Subject Name	Credits
ME-IT-ICW-D301/ **ME-IT-ICW-D401**	**Dissertation (I and II)**	**12 + 15**

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
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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 accessed 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 accessed 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/Journal (desirably in Referred Journal should be ISI/Scopus/SCI indexing) (desirably in Referred Journal)