University of Mumbai

No. AAMS_UGS/ICC/2022-23/117

CIRCULAR :-

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology is invited to this office circular No.UG/225 of 2016-17 dated 13th January, 2017 relating to the revised syllabus of Master of Engineering (Information Technology with Specialization in Information & Cyber Warfare) (Sem.– I to IV) (CBCS) .

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Information Technology at its meeting held on 27th May, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 vide item No. 6.27 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.27 (R) and that in accordance therewith, the revised syllabus of M.E.(Information Technology) (Sem.– I to IV) (CBCS) (REV-2022 Scheme) has been brought into force with effect from the academic year 2022-23.(The circular is available on the University's website www.mu.ac.in).

(Dr. Shailendra Deolankar)
I/c Registrar

MUMBAI – 400 032
20th October, 2022

To

The Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology.

A.C/6.27(R)/11/07/2022

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No. AAMS_UGS/ICC/ 2022-23/117 20th October, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies in Information Technology,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Dr. Shailendra Deolankar)
I/c Registrar

Desktop/Circular of Engineering/Priya

Copy to :-

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publications Section),**
7. **The Deputy Registrar (Special Cell),**
8. **The Deputy Registrar, Fort/Vidyanagari Administration Department (FAD) (VAD), Record Section,**
10. **The Professor-cum- Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. **P.A. to Hon'ble Vice-Chancellor,**
2. **P.A. to Pro-Vice-Chancellor,**
3. **P.A. to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A. to Finance & Account Officer, (F. &. A.O.),**
6. **P.A. to Director, Board of Examination & Evaluation,**
7. **P.A. to Director, Innovation, Incubation and Linkages,**
8. **P.A. to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. Of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Welfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA,**

for information.

AC – 11 July, 2022
Item No. – 6.27 (R)

University of Mumbai

Revised Syllabus for

M.E. (Information Technology)

(Sem. - I to IV)

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai

Syllabus for Approval

O: _____ **Title of Course**	M.E. (Information Technology)
O: _____ **Eligibility**	After Passing Bachelor in Engineering
R: _____ **Passing Marks**	45%
No. of years/Semesters:	4 semesters
Level:	P.G. / ~~U.G./ Diploma / Certificate~~
Pattern:	~~Yearly~~ / Semester
Status:	~~New~~ / Revised
To be implemented from Academic Year:	With effect from Academic Year : 2022-23

Dr. Deven Shah
Chairman,
Ad-hoc Board of Studies in Information Technology

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and Technology

Dr Anuradha Majumdar
Dean,
Faculty of Science and Technology

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Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-ITC101	Data Science and Engineering	3	--	--	3	--	--	3
ME-ITC102	Blockchain Technology	3		--	3		--	3
ME-ITPE101X	Program Elective 1	3	--	--	3	--	--	3
ME-ITPE102X	Program Elective 2	3	--	--	3	--	--	3
IE101X	Institute Elective 1	3	--	--	3	--	--	3
ME-ITL101	Program Lab-I	--	2	--	--	1	--	1
ME-ITSBL101	Skill Based Lab-I	--	4$	--	--	2	--	2
Total		**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
ME-ITC101	Data Science and Engineering	20	20	20	80	3	--	--	100
ME-ITC102	Blockchain Technology	20	20	20	80	3	--	--	100
ME-ITPE101X	Program Elective 1	20	20	20	80	3	--	--	100
ME-ITPE102X	Program Elective 2	20	20	20	80	3	--	--	100
IE101X	Institute Elective 1	20	20	20	80	3	--	--	100
ME-ITL101	Program Lab-I	--	--	--	--	--	25	25	50
ME-ITSBL101	Skill Based Lab-I	--	--	--	--	--	50	50	100
Total		**--**	**--**	**100**	**400**	**--**	**75**	**75**	**650**

$ indicates work load of Learner (Not Faculty), for Skill Based Lab

Note 1: Skill Based Lab- I and II shall include activity / project based learning like

1) Mini project in engineering domains related to the specialization or interdisciplinary domains
2) Product Design
3) Application Software Development
4) Idea proposal and validation

 # Program Elective

Every student is required to take one Program Elective 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 program electives, which are closely allied to their disciplines.

 # Institute Elective

Every student is required to take one Institute Elective 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.

Course Code	Program Elective (PE)	Course Code	Institute Elective (IE)
Semester I			
ME-ITPE1011	Ethical Hacking and Digital Forensics	IE1011	Product Lifecycle Management
ME-ITPE1012	Data Preparation and Analysis	IE1012	Reliability Engineering
ME-ITPE1013	Metaverse	IE1013	Management Information System
ME-ITPE1014	Algorithm and Complexity	IE1014	Design of Experiments
ME-ITPE1021	Advances in Software Engineering	IE1015	Operation Research
ME-ITPE1022	Ad-hoc Networks	IE1016	Cyber Security and Laws
ME-ITPE1023	Storage Area Network	IE1017	Disaster Management and MitigationMeasures
ME-ITPE1024	ICT for Social Cause	IE1018	Energy Audit and Management
		IE1019	Development Engineering

Semester II

Course Code	Course Name	Teaching Scheme(Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-ITC201	Web X.0	3	--	--	3	--	--	3
ME-ITC202	Cloud Computing and Services	3		--	3		--	3
ME-ITPE201X	Program Elective 3	3	--	--	3	--	--	3
ME-ITPE202X	Program Elective 4	3	--	--	3	--	--	3
IE201X	Institute Elective 2	3	--	--	3	--	--	3
ME-ITL201	Program Lab-II	--	2	--	--	1	--	1
ME-ITSBL201	Skill Based Lab-II	--	4$	--	--	2	--	2
Total		**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
ME-ITC201	Web X.0	20	20	20	80	3	--	--	100
ME-ITC202	Cloud Computing and Services	20	20	20	80	3	--	--	100
ME-ITPE201X	Program Elective 3	20	20	20	80	3	--	--	100
ME-ITPE202X	Program Elective 4	20	20	20	80	3	--	--	100
IE201X	Institute Elective 2	20	20	20	80	3	--	--	100
ME-ITL201	Program Lab-II	--	--	--	--	--	25	25	50
ME-ITSBL201	Skill Based Lab-II	--	--	--	--	--	50	50	100
Total		**--**	**--**	**100**	**400**	**--**	**75**	**75**	**650**

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Note 1: Skill Based Lab- I and II shall include activity / project based learning like

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 # Institute Elective

Every student is required to take one Institute Elective 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	Program Elective (PE)	**Subject Code**	Institute Elective (IE)
Semester II			
ME-ITPE2011	Web Application Security	IE2011	Project Management
ME-ITPE2012	Machine and Deep Learning	IE2012	Finance Management
ME-ITPE2013	ARVR	IE2013	Entrepreneurship Development and Management
ME-ITPE2014	High Performance Computing	IE2014	Human Resource Management
ME-ITPE2021	Design Thinking	IE2015	Professional Ethics and CSR
ME-ITPE2022	Internet of Everything	IE2016	Research Methodology
ME-ITPE2023	Information Retrieval	IE2017	IPR and Patenting
ME-ITPE2024	Green IT	IE2018	Digital Business Management
		IE2019	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-ITMP301	Major Project: Dissertation -I	--	20	--	--	10	--	10
Total		**00**	**20**	**--**	**00**	**10**	**--**	**10**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)	Term Work	Pract/ Oral	Total
		Test-1	Test-2	Avg					
ME-ITMP301	Major Project: Dissertation -I	--	--	--	--	--	100	--	100
Total		**--**	**--**	**--**	**--**	--	**100**	**--**	**100**

Online Credit Courses

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-ITOCC301	Online Credit Course - I	--	--	--	--	--	--	3
ME-ITOCC301	Online Credit Course - II	--	--	--	--	--	--	3
Total		**--**	**--**	**--**	**00**	**00**	**00**	**06**

Note 2: It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by university. The learner shall opt for one course each from OCC- I and OCC-II. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. The credits earned with OCC- I and OCC-II shall be accounted in the third semester grade-sheet. The learner shall be allowed to take up these courses from his or her institute or organization/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner. University shall make a provision that credit earned with OCC-I and OCC-II shall be accounted in the third semester grade-sheet with actual names of the courses.

Online Credit Course – I

The learner shall opt for the course in the domain of Research Methodology **or** Research & Publication Ethics or IPR. The opted course shall be of 3 credits of equivalent number of weeks.

Online Credit Course –II

The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ME-ITMP401	Major Project : Dissertation -II	--	32	--	--	16	--	16
Total		**--**	**32**	**--**	**--**	**16**	**--**	**16**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
ME-ITMP401	Major Project : Dissertation -II	--	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	**--**	**100**	**100**	**200**

Total Credits: 68

Note 3: The Dissertation submission shall not be permitted till the learner completes all the credit requirements of ME course.

Semester I

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITC101	Data Science and Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ME-ITC101	Data Science and Engineering	20	20	20	80	--	--	--	100

Sr. No.	Course Objectives
The course aims:	
1	To know the fundamental concepts of data science
2	To understand the role of basic mathematics and statistics in data science.
3	To understand the EDA process.
4	To introduce students to the basic concepts and techniques of Machine Learning.
5	Explore different methods of data visualization.
6	To enable students to analyze data science methods for real world problems.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Elaborate the concept of data science and related terminology.	L2
2	Apply the concepts of mathematics and statistics to solve the data science problem.	L3
3	Apply EDA process before using the data.	L3
4	Apply machine learning techniques to solve the real world problems.	L3, L4
5	Identify and use appropriate data visualization technique.	L3
6	Analyze current trends in Data Science and REST API.	L4

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge of Basic Python/R Programming	02	
I	**An Introduction to Data Science**	**What is data science**? Basic terminology, Why data science?, Example – Sigma Technologies , The data science Venn diagram. **Types of Data**: Structured versus unstructured data, Quantitative versus qualitative data, **The four levels of data:** The nominal level, ordinal level, interval level and ratio level, The Five Steps of Data **Self-LearningTopics:** Applications and Case Studies of Data Science in various Industries	**04**	**CO1**
II	**Mathematics for DS**	**Linear Algebra**: Vector and Matrices **Probability:** Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables **Statistics:** Basic Statistics, what are statistics? How do we obtain and sample data? Obtaining data: Observational and Experimental, Sampling data: Probability sampling, Random sampling, Unequal probability sampling How do we measure statistics: Measures of center, Measures of variation, Measures of relative standing, The insightful part – correlations in data, The Empirical rule **Self-learning Topics:** Explore Pandas and Numpy libraries of Python	**08**	**CO2**
III	**EDA & Feature Engineering**	**Data Wrangling:** Read the data, slicing and dicing the data, filter the data, finding statistical inference, finding missing values, Finding missing values or invalid values, checking if dataset is imbalanced, checking data types- categorical Vs numeric, use of group by function **Data Preparation:** Identifying categorical features and converting their data types, encoding categorical variables, sampling of imbalance dataset, Transformation technique for skewed distributions, scaling and normalization of data	**06**	**CO3**
IV	**Machine learning**	**Learning with Regression:** Linear Regression, Logistic Regression. **Learning with Trees:** Bayes Classification, Decision Trees, Random Forest. **Clustering:** Choosing distance metrics, Different clustering approaches, hierarchical agglomerative clustering, K-means DBSCAN – Relative merits of each method – clustering tendency and quality. **Advanced Algorithm**: Gradient Boosting Algorithm **Self-Learning Topics** : Real world case studies on	**08**	**CO4**

		machine learning		
V	**Data Visualization**	**Data Visualization Need and Importance:** Find distribution features, Identify the outliers, Univariate, bivariate and multivariate analysis, correlation plots. **Data Visualization Options**: Interactive graphics, Plotting: Scatter Plots, Bar Plots, choosing right plots, 3D visualization **Self-Learning Topics** : Explore matplotlib and seaborn library	**06**	**CO5**
VI	**Case Studies in Data Science**	**Case Study 1 – Predicting stock prices based on social media:** Text sentiment analysis, Exploratory data analysis, Regression route, Classification route **Case Study 2-** The case of Lending club	**05**	**CO6**

Text Books

1. Sinam Ozdemir, "Principles of Data Science", Packt Publication,2016.
2. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, "Introducing Data Science", 2016
3. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
4. Dan Toomey, "R for Data Science", Packt Publication,2014

References:

1. Tom M.Mitchell, "Machine Learning",McGraw Hill
2. Joel Grus. "Data Science from Scratch. First Principles With Python." O'Reilly Media, 2015.
3. Jake Vander Plas, "Python Data Science Handbook", O'Reilly publication
4. Frank Kane, "Hands-On Data Science and Python Machine Learning", Packt Publication
5. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
6. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publication

Online References:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://www.coursera.org/specializations/jhu-data-science
3. https://www.coursera.org/learn/machine-learning
4. https://home.csulb.edu/~jchang9/files/jonathan_guzman_honors_thesis.pdf

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITC102	Blockchain Technology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITC102	Blockchain Technology	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To get acquainted with the concept of Distributed ledger system and Blockchain.
2	To learn the concepts of consensus and mining in Blockchain through the Bitcoin network.
3	To understand Ethereum and develop-deploy smart contracts using different tools and frameworks.
4	To understand permissioned Blockchain and explore Hyperledger Fabric.
5	To understand different types of crypto assets.
6	To apply Blockchain for different domains IOT, AI and Cyber Security.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concept of Blockchain and Distributed Ledger Technology.	L2
2	Interpret the knowledge of the Bitcoin network, nodes, keys, wallets and transactions.	L3
3	Implement smart contracts in Ethereum using different development frameworks.	L3
4	Develop applications in permissioned Hyperledger Fabric network.	L3
5	Interpret different Crypto assets and Crypto currencies	L3
6	Analyze the use of Blockchain with AI, IoT and Cyber Security using case studies.	L4

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Hash functions, Public – Private keys, SHA, ECC, Digital signatures,	02	
I	**Introduction to DLT and Blockchain**	Fundamental concepts of Distributed systems, Distributed Ledger Technologies (DLTs) Introduction, Types of Blockchains **Blockchain:** Origin, Phases, Components **Block in a Blockchain**: Structure of a Block, Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Tree. **Self-learning Topics:** Blockchain Demo	5	CO1
II	**Consensus and Mining**	What is Bitcoin and the history of Bitcoin, Bitcoin Transactions, Bitcoin Concepts: keys, addresses and wallets, Bitcoin Transactions, validation of transactions, PoW consensus **Bitcoin Network**: Peer-to-Peer Network Architecture, Node Types and Roles, Incentive based Engineering, The Extended Bitcoin Network, Bitcoin Relay Networks, Network Discovery, Full Nodes, Exchanging "Inventory", Simplified Payment Verification (SPV) Nodes, SPV Nodes and Privacy, Transaction Pools, Blockchain Forks **Self-learning Topics:** Study and compare different consensus algorithms like PoA, PoS, pBFT	8	CO2
III	**Permissionless Blockchain: Ethereum**	Components, Architecture of Ethereum, Miner and mining node, Ethereum virtual machine, Ether, Gas, Transactions, Accounts, Patricia Merkle Tree, Swarm, Whisper and IPFS, Ethash, End to end transaction in Ethereum, **Smart Contracts**: Smart Contract programming using solidity, Metamask (Ethereum Wallet), Setting up development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk. **Smart Contract Deployment**: Introduction to Truffle, Use of Remix and test networks for deployment **Other Permissionless Blockchain platforms Introduction:** IOTA, Hashgraph, EOS, etc. **Self-learning Topics:** Smart contract development using Java or Python	9	CO3
IV	**Permissioned Blockchain : Hyperledger**	Introduction to Framework, Tools and Architecture of Hyperledger Fabric Blockchain. **Components**: Certificate Authority, Nodes,	7	CO4

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	Fabric	Chain codes, Channels, Consensus: Solo, Kafka, RAFT Designing Hyperledger Blockchain **Other Permissioned Blockchain platforms Introduction:** CORDA, Quoram, etc. **Self-learning Topics:** Fundamentals of Hyperledger Composer		
V	**Crypto assets and Cryptocurrencies**	Fungible and Nonfungible tokens, ERC20 and ERC721 standards, comparison between ERC20 & ERC721, ICO, STO, Different Crypto currencies **Self-learning Topics:** Defi, Metaverse, Types of cryptocurrencies	4	CO5
VI	**Blockchain Applications & Research Areas**	Blockchain in IoT, AI , Cyber Security, **Research Areas**: Interoperability, Privacy, Performance, Oracles, Security of smart contracts and platforms **Self-learning Topics:** Applications of Blockchain in various domains Education, Energy, Healthcare, real-estate, logistics, supply chain	4	CO6

Text Books:

1. "Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN", 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press.
4. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, Ashwani Kumar, BPB publications
5. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication
6. Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond, Chris Burniske & Jack Tatar.

Reference:

1. Mastering Blockchain, Imran Bashir, Packt Publishing 2. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media
2. Blockchain Technology: Concepts and Applications, Kumar Saurabh and Ashutosh Saxena, Wiley.
3. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them, Antony Lewis.for Ethereum and Blockchain, Ritesh Modi, Packt publication.
4. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media

Online References:

1. NPTEL courses:
    a. Blockchain and its Applications,
    b. Blockchain Architecture Design and Use Cases

2. www.swayam.gov.in/
3. www.coursera.org
4. https://ethereum.org/en/
5. https://www.trufflesuite.com/tutorials
6. https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h
7. Blockchain demo: https://andersbrownworth.com/blockchain/
8. Blockchain Demo: Public / Private Keys & Signing: https://andersbrownworth.com/blockchain/public-private-keys/

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE1011	Ethical Hacking & Digital Forensics	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE1011	Ethical Hacking & Digital Forensics	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To understand computer forensic technology.
2	To identify types of computer forensic systems.
3	To explore the procedures for identification, preservation, and extraction of digital evidence.
4	To explore the electronic evidence, identification of forensic data.
5	To learn how to investigate attacks on mobile platforms.
6	To explore various hacking techniques.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the computer forensic technology.	L2
2	To discuss the types of computer forensics systems.	L2
3	Understand the process of collection, analysis and recovery of the digital evidence	L2, L4
4	Understand the process of computer analysis.	L2
5	Identify various security aspects with respect to mobile technology.	L1
6	Understand various hacking tools and techniques.	L2

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Ethical Hacking terminology, Legal implication of hacking, Impact of hacking.	**2**	
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 **Self-learning Topics:** Relevant law to combat computer crime –Information Technology Act	**5**	**CO1**
II	Foot Printing & Social Engineering	Information gathering Methodologies, Competitive Intelligence, DNS Enumerations, Social Engineering attacks. Types of Computer Forensics systems: Internet security, IDS, Firewall, Public key. **Self-learning Topics:** Types of IDS and Firewall	**6**	**CO2**
III	Incident and Incident Response and Storage	Introduction to Incident, Incident Response Methodology, Steps, Activities in Initial Response Phase after detection of an incident. Initial Response and Forensic Duplication: Initial Response & Volatile Data Collection from Windows system, Initial Response & Volatile Data Collection from Unix system, Forensic Duplication: Forensic duplication as Admissible Evidence, Forensic Duplication Tool Requirements. Digital Forensics: Introduction – Evidential potential of digital devices: closed vs. open systems, evaluating digital evidence potential, Device handling: seizure issues, device identification, networked devices and contamination. **Self-learning Topics:** dd, WinHex, Helix3Pro	**7**	**CO3**
IV	Network Forensics	Collecting Network Based Evidence, Investigating Routers, Network protocols, Email Tracing, Internet Fraud. **Self-learning Topics:** tcpdump, snort	**6**	**CO4**
V	Mobile Phone Forensics	Crime and mobile phones, evidence, forensic procedures, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems. **Self-learning Topics:** Wireshark, Autopsy, SIFT.	**6**	**CO5**
VI	Hacking	Scanning & Enumeration: Port Scanning, Network Scanning, Vulnerability	**7**	**CO6**

		Scanning, NMAP Scanning tool, OS Fingerprinting, Enumeration. System Hacking: Password cracking techniques, Key loggers, Escalating privileges, Hiding Files, Steganography Technologies, Countermeasures. Sniffers & SQL Injection: Active and passive sniffing, ARP Poisoning, Session Hijacking, DNS Spoofing, Conduct SQL Injection attack, Countermeasures. **Self-learning Topics**: IP Spoofing, Buffer Overflow, Password attacks.		

Text Books:

1. Kevin Mandia, chirs Proise, "Incident Response and Computer Forensic"
2. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition
3. Peter Stepheson,"Investigating Computer Crime: A handbook for corporate investigation"
4. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic: The fascinating world of Digital Evidences" Wiley India Pvt Ltd 2017.

References:

1. Mari E-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.

2. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition

3.Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer.

4. Handbook of Computer Crime Investigation, edited by Eoghan Casey.

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE1012	Data Preparation and Analysis	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ME-ITPE1012	Data Preparation and Analysis	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To know the fundamental concepts of data science
2	To understand the EDA process.
3	To explore different methods of data visualization.
4	To understand the role of statistics and machine learning in data science.
5	To learn data ethics associated with data management.
6	To enable students to analyze the recent trends in data collection and analysis techniques for real world problem.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the core concept and technologies related with data.	L2
2	Apply EDA process before using the data.	L3
3	Identify and use appropriate data visualization techniques.	L1
4	Apply the concepts of statistics and machine learning techniques to solve the real world problem.	L3
5	Identify the data ethics to be followed while providing solution to real world problem.	L1
6	Analyze recent trends available for data collection and analysis.	L4

DETAILED SYLLABUS:

Module	Detailed Contents	Hrs
1	**Introduction** Introduction to core concepts and technologies, Types of data - Example applications. Applications of Data Science - Recent trends in various data collection and analysis techniques. Self-learning Topics: study applications of data science.	3
2	**Data Gathering and Preparation** Understanding how to create the data set, Data collection methods. Sources of data - Data collection and APIs - Exploring and fixing data - Data storage and management Self-learning Topics: Study and list the different APIs	7
3	**Data Cleaning** Importance of data 'cleaning', validity and quality. Data Quality, Addressing Data Quality Issues, Consistency checking, Heterogeneous and missing data, Data Transformation and Segmentation Self-learning Topics: Identify the issues in data cleaning.	7
4	**Data visualization** Designing visualizations, Visualization Tools(Area Plots, Histograms ,Bar Charts, Pie Charts, Box Plots, Scatter Plots, Waffle Charts, Word Clouds), Visualizing Geospatial Data, visualizing time series data, Importance of data visualization Dashboards Self-learning Topics Case study on data visualization	7
5	**Data Analysis** Introduction-Terminology and concepts - Introduction to statistics - Central tendencies and distributions – Variance - Distribution properties, Basic machine learning algorithms - Linear regression – SVM - Naive Bayes. Self-learning Topics: case study on data analysis	7
6	**Ethics in data management** Principles of data ethics, The Five Cs: consent, clarity, consistency, control (and transparency), and consequences (and harm) Developing ethical and professional safeguards, Doing good data analysis, Owners of the data, Valuing different aspects of privacy, Getting informed consent Self-learning Topics: case study on data management.	8

Text Books

1. Sinam Ozdemir, "Principles of Data Science", Packt Publication,2016.
2. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, "Introducing Data Science", 2016
3. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
4. Dan Toomey, "R for Data Science", Packt Publication,2014

References:

1. Tom M.Mitchell, "Machine Learning",McGraw Hill
2. Joel Grus. "Data Science from Scratch. First Principles With Python." O'Reilly Media, 2015.
3. Jake Vander Plas, "Python Data Science Handbook", O'Reilly publication
4. Frank Kane, "Hands-On Data Science and Python Machine Learning", Packt Publication
5. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
6. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publication
7. Katherine O'Keefe, Daragh O Brien, "Ethical Data and Information Management: Concepts, Tools and Methods", Kogan Page

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Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE1013	Metaverse	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE1013	Metaverse	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To study the concepts of Metaverse.
2	To study Metaverse and Web 3.0, Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), NFT in Blockchain.
3	To study the Metaverse technologies and protocols.
4	To study and identify the required infrastructure for Metaverse.
5	To study various case studies of Metaverse.
6	To study of Metaverse Immersive technology and Interfaces.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To Understand the concepts of Metaverse.	L2
2	To understand and study Metaverse and Web 3.0, Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), NFT in Blockchain.	L2, L3
3	To Understand the Metaverse technologies and protocols.	L2
4	To Identify the required infrastructure for Metaverse.	L1
5	To Understand different case studies of Metaverse.	L1
6	To Understand Metaverse Immersive technology and Interfaces	L2

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Concepts of Blockchain Technology.	02	
I	**Introduction:**	What is the Metaverse? Evaluation of Technology: Web, AR VR, 3D spaces, Immersive learning , Blockchain , Decentralised commerce Self-learning Topics: Study different technology in Metaverse with application.	**03**	**CO1**
II	**Fundamental Concepts of AR, VR, MR and Blockchain:**	Building block technology of metaverse , How Gaming + Web 3.0 + Blockchain are Changing the Internet: Future of Internet: How Metaverse is different from Internet, Potential of Metaverse characteristics that characterise metaverse The Different Shapes of the Metaverse: Games, NFTs (assets), Blockchain Protocols, Cryptocurrencies, etc Self-learning Topics: Case study on Metaverse and ARVR	**07**	**CO2**
III	**Metaverse Technologies and Protocols:**	Metaverse technologies, principles, affordances and challenges Blockchain Protocols and Platforms Involved in the Metaverse Metaverse-Related Tokens Blockchain NFT need for metaverse: working principle of blockchain, NFT based virtual assets in metaverse, case study How NFTs are Unlocking the Metaverse Potential working of ERC721 NFT Self-learning Topics: Case study on Metaverse and Blockchain	**06**	**CO3**
IV	**Metaverse Infrastructure:**	Access the metaverse, necessary hardware Understanding Decentraland , native token MANA, creating own Avatar. Using metamask to access Decentraland, owning land to have direct access of metaverse. Self-learning Topics: Case study on Metaverse and Infrastructure	**06**	**CO4**

V	**Case studies of Metaverse:**	Various usecase of metaverse Industries Disrupted by the Metaverse: Fashion, Marketing, Brands, Finance, Gaming, Architecture, Virtual Shows/Concerts, Art Galleries and Museums Virtual Business and market, Investing In the Metaverse and Profit Asset Classes Inside the Metaverse Metaverse Land Ownership - Property Investment Self-learning Topics: Case study on Metaverse application	**07**	**CO5**
VI	**Metaverse Immersive technology and Interfaces:**	3d Reconstruction, AI technology to analyses 3D Scan Virtual Reality (VR) and Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR), Metaverse vs VR what is difference, IoT to bridge gap between physical world and internet Metaverse Interfaces: Personal Computer, Mobile Phone, AR Glasses, VR Goggles, Neuralink Self-learning Topics: Case study on Metaverse and MR	**08**	**CO6**

Text & Reference Books:

1. Mystakidis, Stylianos, " Metaverse",Journal=Encyclopedia,2022, https://www.mdpi.com/2673-8392/2/1/31

2. All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda, Technical Report · October 2021

Online References:

1. **https://www.udemy.com/course/complete-metaverse-course-everything-about-ar-vr-and-nfts/**

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ME-ITPE1014	Algorithm and Complexity	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE1014	Algorithm and Complexity	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To analyze asymptotic performance of algorithms using space and time complexities..
2	To teach problem formulation and problem solving skills and write rigorous correctness proofs for algorithms.
3	To acquire knowledge and gain familiarity with major applied algorithms.
4	To apply important algorithmic design paradigms and methods of analysis.
5	To solve complex problems in real-life applications.
6	To synthesize efficient algorithms in common engineering design situations.

Course Outcomes

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Analyze various algorithms with practical applications along with their resource requirements.	L4
2	Explore advanced design and analysis techniques.	L2, L4
3	Explain major graph algorithms and their analyses.	L2
4	Analyze linear programming and string matching algorithms.	L4
5	. Identify NP-complete problems and offer solutions to solve such problems.	L1
6	Analyze approximation algorithms.	L4

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping

0	Prerequisite	Role of algorithms in computing Algorithms as a technology	02	
I	Introduction to algorithm and complexity	Design and analysis fundamentals of algorithms Performance analysis and space and time complexities Growth of functions: Asymptotic analysis—Big oh, omega, and theta notations Mathematical background for algorithm and complexity Recurrence equations and method of solving recurrences, i.e., substitution method, recursion-tree method and master method **Self-learning topics:** Probabilistic analysis and randomized algorithms Sorting and order statistics (i.e., heap sort and quick sort)	05	**CO1**
II	Advanced design and analysis techniques	Dynamic programming: Matrix-chain multiplication, longest common subsequence, 0/1 Knapsack problem, Travelling salesman problem Greedy algorithms: An activity-selection problem, elements of the greedy strategy, Huffman codes **Self-learning topics:** Amortized analysis	08	**CO2**
III	Graph algorithms	Introduction Single-source shortest path: Bellman–Ford algorithm, Dijkstra's algorithm All-pairs shortest path: Floyd–Warshall algorithm, Johnson's algorithm for sparse graphs Maximum flow: Flow networks, Ford–Fulkerson algorithm, maximum bipartite matching **Self-learning topics:** Breadth-first search and Depth-first search Minimum spanning trees	08	**C03**
IV	Linear programming and string matching	Linear programming: Standard and slack forms, formulating problems as linear programs, simplex algorithm, duality, and initial basic feasible solution. String matching: Naïve string-matching algorithm, Rabin–Karp algorithm, string matching with finite automata, and Knuth–Morris–Pratt algorithm **Self-learning topics:** DFT and FFT,	08	**C04**

V	NP-completeness	Polynomial time NP-completeness and reducibility NP-complete problems: Clique problem, Hamiltonian-cycle problem **Self-learning topics:** • Polynomial-time verification	04	**C05**
VI	Approximation algorithms	• Vertex-cover problem • Travelling salesman problem • Set-covering problem • Subset-sum problem **Self-learning topics:** • Randomization and linear programming	04	**C06**

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI, India, Third Edition.

2. Herbert S. Wilf, "Algorithms and Complexity", University of Pennsylvania, Taylor & Francis Group, 2020.

3. Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, "Computer Algorithms", Computer Science Press.

References:

1. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.
2. Harsh Bhasin, "Algorithms: Design and Analysis", Oxford University Press.
3. Vijay V. Vazirani, "Approximation Algorithms", Springer.

Online Reference:

1. Design and Analysis of Algorithms, Link: https://nptel.ac.in/courses/106101060

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ME-ITPE1021	Advances in Software Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of 2 Tests					
ME-ITPE1021	Advances in Software Engineering	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To familiarize students with advance topics in software engineering
2	Understand limitations and advantages of process models
3	Familiarize with agile development
4	Know importance of process improvement
5	Understand software quality
6	Understand software engineering principles

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand different types of process models	L2
2	Apply agile development	L3
3	Analyze requirements for complex projects	L4
4	Create architectural design	L6
5	Evaluate quality of software	L5
6	Understand importance of process improvement	L2

DETAILED SYLLABUS:

Sr. No.	Module	Detailed content	Hours	CO-PO Mapping
	Prerequisite:	Introduction – Basic knowledge of software engineering principles, Programming skills, Proficiency in any programming language.	**02**	
I	Process Models	Generic process Model, Prescriptive process model, Specialized process model. **Self-learning topics:** Personal and Team Process Models	**05**	**CO1**
II	Agile development	What is agile process, Extreme programming, ASD, Scrum, DSDM, Crystel FDD, LSD, AM, AUP **Self-learning topics:** Extreme Programming (XP), Scrum	4	**CO2**
II I	Principles that guide practice and Understanding requirements	Core principles, principles thar guide framework activities, Requirements engineering, establishing groundwork, eliciting requirements, building requirements model, negotiating requirements, Validating requirements. **Self-learning topics:** Prioritizing requirements (Kano diagram) - real life application case study.	**4**	**CO3**
IV	Architectural Design	Software architecture, Architectural genres, Architectural styles, Architectural design, Design patterns, Pattern based software design, Architectural patterns, User interface design patterns. **Self-learning topics:** Software Architecture Design Tools	**8**	**CO4**
V	Quality Management	Quality concepts, Review techniques, Software quality assurance, testing strategies, Formal modeling, and verification, product metrics. **Self-learning topics:** Software Testing real life case study using tools like JIRA	**8**	**CO5**
VI	Software process improvement	What is SPI, The SPI process, CMMI, SPI frameworks, SPI ROI, SPI trends, cleanroom software engineering. **Self-learning topics:** Software Process Improvement and Capability Determination (SPICE)	**8**	**CO6**

Textbook

1. Software Engineering, A Practitioner's Approach, Seventh Edition, Roger s. Pressman

Reference Book.

1. An integrated approach to Software Engineering, Pankaj Jalote
2. Software Engineering, Tenth Edition, Ian Sommerville

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ME-ITPE1022	Adhoc Networks	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of 2 Tests					
ME-ITPE1022	Adhoc Networks	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	Understand the basic concepts of ad-hoc networks
2	Explain the MAC Protocols.
3	Be familiar with ad-hoc routing protocol.
4	Gain knowledge of different multicast routing in ad-hoc network
5	Learn the Transport layer– security protocols
6	Be aware of the applications and Recent Developments in Ad Hoc Networks

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define the basic concepts of ad-hoc networks.	L1
2	Classify and Explain the MAC Protocols.	L2
3	Classify and Explain the ad-hoc routing protocols	L2
4	Describe the different multicast routing in ad-hoc network	L2
5	Describe the Transport layer– security protocols	L2
6	List and Explain applications and Recent Developments in Ad Hoc Networks	L4

DETAILED SYLLABUS:

Sr. No.	Module	Detail Content	Hours	CO Mapping
	Prerequisite:	Introduction – Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum –Radio Propagation Mechanisms.	**2**	

I	**Introduction**	Wireless Network. Characteristics of the Wireless channel. Cellular and Ad-Hoc Wireless Networks, Applications of Ad-HocWireless Networks/MANET/Wireless Sensor Network/VANET.Wireless Internet Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Mobility, Hidden and Exposed terminal Problems, Characteristics of an Ideal Routing Protocol for Ad-Hoc Wireless Networks **Self Study Topic: Read recent articles on top wireless technology trends, 5G**	**7**	**CO1**
II	**Medium access protocols**	MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. Multichannel MAC Protocol, Multichannel CSMA MAC Protocol, Power Control MAC Protocol for Ad Hoc Networks IEEE standards: 802.11a, 802.11b, 802.11g, 802.11p, 802.15. HIPER LAN **Self Study Topic: Work on the implementation and evaluation of the MAC protocol standards using a WSM simulation tool**	**8**	**CO2**
III	**Ad hoc routing protocols**	Introduction: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols: Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Cluster Switch Gateway Routing (CSGR), Source–Initiated On–Demand Approaches, Ad hoc On– Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA),Signal Stability Routing (SSR)– Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP). **Self Study Topic: Work on the implementation and evaluation of the Ad hoc routing protocols standards using a WSM simulation tool**s.	**8**	**CO3**

IV	**Multicast routing in ad-hoc networks**	Introduction – Issues in Designing a Multicast Routing Protocol — Classification of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Energy–Efficient Multicast Routing Protocol **Self Study Topic: Work on the implementation and evaluation of the Multicast routing in ad-hoc networks using a WSM simulation tool**	**5**	**CO4**
V	**Transport layer– security protocols**	Introduction – Issues in Designing a Transport Layer Protocol for Ad hoc Wireless Networks – Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks, Security in Ad-hoc Wireless Networks **Self Study Topic:Work on the implementation and evaluation of the Multicast routing in ad-hoc networks using a WSM simulation tool**	**5**	**CO5**
VI	**Applications and Recent Developments in Ad Hoc Networks**	Applications and Opportunities: Academic Environment Applications, Defense Applications, Industrial Environment Applications, Healthcare Applications, Search and Rescue Applications, Vehicular Ad Hoc Networks Highlights of the Most Recent Developments in the Field **Self Study Topic: Read recent articles on Top wireless technology applications and developments.**	**4**	**CO6**

Text book

1. S. Sarkar, T. Basavraju and C. Puttamdappa, "Ad hoc mobile wireless networks principles, protocols and applications" , second edition, CRC Press, 2016.
2. Al-Sakib Khan Pathan, Muhammad Mostafa Monowar, Zubair Md. Fadlullah, "Building Next-Generation Converged Networks: Theory and Practice, CRC Press, 2013.
3. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic, "Mobile Ad Hoc Networking: The Cutting Edge Directions", John Wiley 2013.
4. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007

References

1. C. K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR, 2001.
2. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000
3. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004
4. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE1023	Storage Area Network	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ME-ITPE1023	Storage Area Network	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	Understand and analyze the basics of storage network, storage technologies and various storage architectures.
2	Define and understand virtualization with respect to storage network.
3	Understand SAN Management and its various aspects.
4	Describe disaster recovery for storage network and understand strategies, parameters and Quality of Service for Business Continuity in storage infrastructure.
5	Understand and analyze security aspects for storage area network.
6	Be aware of the applications and Recent Developments in Ad Hoc Networks

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain storage technologies and storage architectures.	L1
2	Describe and apply virtualization in storage network.	L1
3	Apply SAN Management with its various parameters.	L3
4	Understand and apply disaster recovery and Business Continuity in storage network.	L2
5	Understand and apply storage security and its importance.	L2
6	Apply various storage network concepts like Implementation, SAN	L3

	Management, Virtualization, Disaster Recovery and Security to design storage area network for an organization.	

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basics of Networking and storage devices, Local File systems, Network File systems and file servers, Shared Disk File systems, Direct attached storage (DAS)	**2**	--
I	**Need for Storage Network**	Basics of Storage Network:- Intelligent Storage Systems (ISS), Data protection (RAID implementation methods). RAID arrays ,RAID technologies, RAID levels, RAID impact on disk performance & RAID comparison, SCSI, SAN: FC SAN FC Protocol Stack, IP Storage, Infiniband, Virtual Interfaces, Comparison of NAS, FC SAN and iSCSI SAN. **Self-learning Topics:** Limitations of traditional server centric architecture, Storage centric architecture and its advantages. Network Attached Storage (NAS)	**09**	**CO1**
II	**Storage Virtualization**	Definition, Storage virtualization on block and file level, Storage virtualization on various levels of Storage network, Symmetric and Asymmetric Virtualization. Basics of Software Defined Storage and it's types **Self-learning Topics: VSAN**	**06**	**CO2**
III	**Managing SAN**	Storage Management tasks, What Gets Managed in SAN? Zoning, Virtualization: Allocating Capacity rather than Disk, SAN Management and Quality of online storage device: Storage capacity, Data availability and I/O performance, SAN Management and Asset Utilization, **Self-learning Topics: Storage planning and capacity planning**	**05**	**CO3**
IV	**Business Continuity**	**Strategies of Business Continuity:** High availability, Disaster Recovery, Continuous business operation **Parameters of Business Continuity:** Availability, characteristics of Availability (MTBF,MTTR and MTTF), characteristics	**06**	**CO4**

		of failure (RTO and RPO), Network Recovery Objective (NRO) **Quality of Service for Business Continuity**: Service level Agreements (SLAs),High availability versus disaster recovery, The seven-Tier Model, Tier 0 to Tier 7 **Self-learning Topics: General Conditions, BC Terminology**		
V	**Storage Security**	**Overview of Storage Security**: Define storage security, Storage security framework: Security attributes (Confidentiality, Integrity, Availability, Accountability), **Security Elements:** Assets(Information, Hardware, Software, Network Infrastructure), Threats, Vulnerabilities **Security Controls:** Technical (implemented in hardware, software and firmware), Non-Technical: Administrative(Policies, Standards), FC SAN security, Basic SAN Security Mechanisms, Securing Switch Ports **Self-learning Topics: NAS security**	**06**	**CO5**
VI	**Designing Storage Area Network**	A case study to design a storage area network for an organization considering the following guidelines: SAN Implementation, SAN Management, SAN Virtualization, SAN Disaster Recovery and Security **Self-learning Topics: Study the Storage Area Network Design of your college/industry campus.**	**05**	**CO6**

Text Books:

1. Ulf Troppens, Rainer Erkens, Wolfgang Muller-Friedt, Rainer Wolafka, Nils Haustein, “Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, ,iSCSI, Infiniband and FCoE”, Second Edition, Wiley

2. Richard Barker and Paul Massiglia, “Storage Area Network Essentials A Complete Guide to Understanding and Implementing SANs”, Wiley.

3. EMC Education Services, “Information Storage and Management,” Second Edition, Wiley

4. Martin Hosken, "VMware Software-Defined Storage: A Design Guide to the Policy-Driven, Software-Defined Storage Era"

References:

1.Vaishali D. Khairnar and Nilima M. Dongre**,"** Storage Network Management and Retrieval", Wiley

2. Robert Spalding, “Storage Networks: The Complete Reference”, McGraw Hill Education

3. W. Curtis Preston, “Using SANs and NAS”, O‟Reilly

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE1024	ICT for Social cause	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE1024	ICT for Social cause	20	20	20	80	--	--	--	100

Course Objectives

Sr.No	The course aims:
1	To appreciate various theoretical and disciplinary perspectives towards developing ICT system for development of society.
2	To illustrate different ways by which information can be communicated.
3	To demonstrate an understanding for acquiring data securely for developing an ICT system.
4	To illustrate data storage techniques and formulate knowledge from the raw data.
5	To formulate policies and strategies for ICT system.
6	To design various application using ICT.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To identify opportunities and challenges for developing ICT systems.	L1
2	To identify and access the ways by which information can be communicated.	L1

3	To identify methods of capturing data securely for developing an ICT system.	L1
4	To store and analyze the data captured and generate knowledge from the raw data.	L4
5	To devise policies and strategies for ICT system.	L4
6	To design various application using ICT,	L6

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to ICT	2	
I	**Introduction and Basics of ICT**	Review of ICT history and growth, importance of ICT in societal development identifying opportunities for using ICT, learning from failures Drivers and barriers for ICT development ICT in developing countries – opportunities for developments and challenges Creating an ICT – handling text, data and media. **Self-learning Topics**: Application of ICT	4	CO1
II	**Communication Techniques in ICT**	Radio and TV Techniques, Mobile Techniques – CDMA, Mobile wireless WiMAX, Advanced wireless technologies, Bluetooth Satellite Techniques – architecture AND working principles GPS/GPRS Cloud computing –Introduction, cloud services, Cloud service providers, collaborative techniques like sharing ideas through blogs, forums, online communities etc safe transmission of data **Self-learning Topics:** Study different ICT techniques.	8	CO2

III	**Data acquisition in ICT**	Recognition systems RFID,OMR Location recognition Data acquisition process for MEMS devices Sensors – Programming, communication with cloud. Acquiring data from internet and social media. Formation of social groups and interaction analysis Facebook, Twitter, Blogs, Forums, mailing lists etc controlling access to confidential information **Self-learning Topics:** Case study on data acquisition in ICT	7	CO3
IV	**Data and Knowledge Management in ICT**	Data storage and management content management system identity management Knowledge elicitation Knowledge representation and visualization techniques Knowledge Engineering Methodology Auditing knowledge management Data storage and disposal of data Linking knowledge management to business performance **Self-learning Topics:** case study on Data and Knowledge Management in ICT	7	CO4
V	**Defining policies for administering ICT**	ICT policies and e-Strategies, approach to ICT policy formulation and e-Strategy development, e-Readiness assessment, identifying priority areas and developing action plans. National Policy on ICT in India. **Self-learning Topics:** study ICT policy.	6	CO5
VI	**ICT applications**	Study of ICT applications in various domains such as Agriculture, Healthcare, Education, social studies, Finance, Law, life science. **Self-learning Topics:** Study of ICT applicationsin different area.	5	CO6

Text Books:

1. Lechman, E. (2015). ICT Diffusion in Developing Countries: Towards a New Concept of Technological Takeoff. Germany: Springer International Publishing.,

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2. Affordability Issues Surrounding the Use of ICT for Development and Poverty Reduction. (2018). United States: IGI Global.

3. Koh, S. C. L., Maguire, S. (2009). Information and Communication Technologies Management in Turbulent Business Environments. United Kingdom: Information Science Reference.,

4. The Development Dimension ICTs for Development: Improving Policy Coherence. (2010). Ukraine: OECD Publishing.,

5. Gorica, K., Kordha Tolica, E., Sevrani, K. (2015). Information Society Development Through ICT Market Strategies: Albania Versus Other Developing Countries. Germany: Springer International Publishing.

6. ICT Futures :Delivering Pervasive Realtime And Secure Services Edited By Paul Warren , John Davies, David Brown , Wiley Publication

7. ICT Policy Formulation and e-Strategy Development Strategy Development - A Comprehensive Guidebook by Richard Labelle, Asia-Pacific Development Information Programme

Online References:

1. BLI-224: ICT Fundamentals - https://onlinecourses.swayam2.ac.in/nou22_lb08/preview

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	**Course Name**	**Theory**	**Practical**	**Tutorial**	**Theory**	**Practical & Oral**	**Tutorial**	**Total**
ME-ITL101	Program Lab-I	--	2	--	--	1	--	01

Course Code	**Course Name**	**Examination Scheme**						
		Theory Marks				**Term Work**	**Practical/ Oral**	**Total**
		Internal assessment			**End Sem. Exam**			
		Test1	**Test 2**	**Avg. of 2 Tests**				
ME-ITL101	Program Lab-I	--	--	--	--	25	25	50

Lab Objectives:

Sr. No	**Lab Objectives**
1	To understand the concept of maths in data science
2	To understand the concept of ML algorithms
3	To understand the concept of data visualization
4	To develop and deploy smart contracts on local Blockchain
5	To deploy smart contracts on Ethereum test network.
6	To develop and publish smart contracts crypto currency

Lab Outcomes:

Sr. No	**Lab Outcomes**	**Cognitive levels of attainment as per Bloom's Taxonomy**
1	Understand and apply the concept of maths in Data Science	L1,L2,L3
2	Understand and apply the concept of ML algorithms	L1,L2,L3
3	Understand and apply the concept of data visualization	L1,L2,L3
4	Understand and apply the concept of smart contracts on local Blockchain	L1,L2,L3
5	Understand deploy and publish smart contracts on Ethereum test network	L1,L2,L3,L4
6	Understand develop and pyblish smart contracts	L6

Prerequisite: Computer Networks.

DETAILED SYLLABUS:

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Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Mathematics for DS	Explore Pandas and Numpy libraries of Python.	**05**	LO1
II	Machine Learning Algorithms	**Learning with Regression:** Linear Regression, Logistic Regression. **Learning with Trees:** Bayes Classification, Decision Trees, Random Forest.	**04**	LO2
III	Data Visualization	**Data Visualization Options**: Interactive graphics, Plotting: Scatter Plots, Bar Plots, choosing right plots, 3D visualization	**04**	LO3
IV	Local Blockchain	Introduction to Truffle, establishing local Blockchain using Truffle.	**05**	LO4
V	Smart Contracts	Solidity programming language, chain code (Java/JavaScript/Go), deployment on Truffle local Blockchain	**04**	LO4,LO5
VI	Deployment and publishing smart contracts on Ethereum test network	Ethereum Test networks (Ropsten/Gorelli/Rinkeby), deployment on test networks, Web3.js/Web3.py for interaction with Ethereum smart contract	**04**	LO6

Text Books:

1. "Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN", 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press.
4. Sinam Ozdemir, "Principles of Data Science", Packt Publication,2016.
5. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, "Introducing Data Science", 2016
6. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
7. Dan Toomey, "R for Data Science", Packt Publication,2014

References:

1. Tom M.Mitchell, "Machine Learning",McGraw Hill
2. Joel Grus. "Data Science from Scratch. First Principles With Python." O'Reilly Media, 2015.
3. Jake Vander Plas, "Python Data Science Handbook", O'Reilly publication
4. Frank Kane, "Hands-On Data Science and Python Machine Learning", Packt Publication
5. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
6. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publication

Online References:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://www.coursera.org/specializations/jhu-data-science
3. https://www.coursera.org/learn/machine-learning
4. https://home.csulb.edu/~jchang9/files/jonathan_guzman_honors_thesis.pdf

Term Work:

Term Work shall consist of at least 10 practical based on the above list. Also Term Work Journal must include Assignement as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	**Course Name**	**Theory**	**Practical**	**Tutorial**	**Theory**	**Practical & Oral**	**Tutorial**	**Total**
ME-ITSBL101	DeVops & Adv-DeVops Lab (SBL-I)	--	4	--	--	2	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
ME-ITSBL101	DeVops & Adv-DeVops Lab (SBL-I)	--	--	--	--	50	50	100

Lab Objectives:

Sr. No	Lab Objectives
1	To understand DevOps practices which aims to simplify Software Development Life Cycle
2	To be aware of different Version Control tools like GIT, CVS or Mercurial
3	To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment
4	To understand DevOps practices and cloud native environments to achieve continuous software delivery pipelines and automated operations that address the gap between IT resources and growing cloud complexity.
5	To Use Kubernetes services to structure N-tier applications.
6	To understand that security and speed in software development are not inversely-related objectives Internalizing the contribution of tools and automation in DevSecOps

Lab Outcomes:

Sr. No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements	L1,L2
2	To obtain complete knowledge of the "version control system" to effectively track changes augmented with Git and GitHub	L1,L2
3	To understand the importance of Jenkins to Build and deploy Software Applications on server environment	L1,L2
4	To understand the fundamentals of Cloud Computing and be fully proficient with Cloud based DevOps solution deployment options to meet your business requirements	L1,L2
5	To deploy single and multiple container applications and manage application deployments with rollouts in Kubernetes	L1,L2,L3

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6	To identify and remediate application vulnerabilities earlier and help integrate security in the development process using SAST Techniques.	L1,L2,L3

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, and Software Engineering.

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DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Introduction to Devops	Understanding of the process to be followed during the development of an application, from the inception of an idea to its final deployment. Learn about the concept of DevOps and the practices and principles followed to implement it in any company's software development life cycle. Learn about the phases of Software Lifecycle. Get familiar with the concept of Minimum Viable Product (MVP) & Cross-functional Teams. Understand why DevOps evolved as a prominent culture in most of the modern-day startups to achieve agility in the software development process **Self-Learning Topics: Scrum, Kanban, Agile**	**04**	LO1
II	Git	In this module you will learn: • GIT Installation, Version Control, Working with remote repository • GIT Cheat sheet • Create and fork repositories in GitHub • Apply branching, merging and rebasing concepts. • Implement different Git workflow strategies in real-time scenarios • Understand Git operations in IDE **Self-Learning Topics: AWS Codecommit, Mercurial, Subversion, Bitbucket, CVS**	**04**	LO1, LO2
III	Continuous Integration using Jenkins	In this module, you will know how to perform Continuous Integration using Jenkins by building and automating test cases using Maven / Gradle / Ant. • Introduction to Jenkins (With Architecture) • Introduction to Maven / Gradle / Ant. • Jenkins Management Adding a slave node to Jenkins • Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server	**04**	LO1, LO3

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		Self-Learning Topics: Travis CI, Bamboo, GitLab, AWS CodePipeline		
IV	DevOps on Cloud	Learn about various cloud services and service providers, also get the brief idea of how to implement DevOps over Cloud Platforms. • Introduction to high availability architecture and auto-scaling • Set up the DevOps infrastructure on the cloud • Work and set up IDE on Cloud9 • Deploy projects on AWS using Code Build, CodeDeploy, and CodePipeline **Self-Learning Topics:** AWS Codestar	**06**	LO4
V	Kubernetes	In this module, you will learn how Kubernetes automates many of the manual processes involved in deploying, managing, and scaling containerized applications. Install and configure Kubernetes Spin Up a Kubernetes Cluster Check the Nodes of Your Kubernetes Cluster Installing kubectl to manage cluster and deploy Your First Kubernetes Application **Self-Learning Topics:** • Using Services and Ingresses to Expose Deployments • Perform logging, monitoring, services, and volumes in Kubernetes.	**04**	LO4,LO5
VI	DevOps Security	In this module, you will learn to identify and remediate application vulnerabilities earlier and help integrate security in the development process using tools like SonarQube / Gitlab / • Perform static analysis on application source code and binaries. • Spot potential vulnerabilities before deployment • Analysis of java / web-based project • Jenkins SonarQube / Gitlab Integration **Self-Learning Topics:** Snyk, OWASP ZAP,	**04**	LO6

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		Analysis Core Plugin		

Text books

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", AddisonWesley-Pearson Publication.
4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.
5. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, by Ryan Russell-Yates Packt Publishing (September 29, 2018)
6. AWS Certified SysOps Administrator Official Study Guide: Associate Exam by Stephen Cole (Author), Gareth Digby (Author), Chris Fitch (Author), Steve Friedberg (Author), Shaun Qual
7. AWS Certified Solutions Architect Official Study Guide: Associate Exam by Joe Baron
8. Terraform: Up & Running - Writing Infrastructure as Code, Second Edition by Yevgeniy Brikman , O'Reilly
9. Kubernetes: Up and Running - Dive into the Future of Infrastructure, Second Editionby Brendan Burns,O'Reilly
10. Going Serverless with AWS Lambda: Leveraging the latest services from the AWS cloud by Ajay Pherwani , Shroff/X-Team;
11. Learning Nagios, Packt Publishing.

References:

1. Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication
4. Puppet 5 Essentials - Third Edition: A fast-paced guide to automating your infrastructure by Martin Alfke Packt Publishing; 3rd Revised edition (September 13, 2017)
5. Learning Aws - Second Edition: Design, build, and deploy responsive applications using AWS by Amit Shah Aurobindo Sarkar
6. Mastering Aws Lambda by Yohan Wadia Udita Gupta

Guidelines for Mini Project as per above syllabus.

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement how to contribute to open source mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of recent contribute to open source mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand contribute to open source problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report using open source tools to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the open source Mini Projects.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 30
    - Marks awarded by review committee : 10
    - Quality of Project Report :05

Term Work:

Term Work shall consist of at least 10 practical based on the above list. Also Term Work Journal must include Mini-Project as mentioned in above syllabus.

Term Work Marks: 50 Marks (Total marks) = 45 Marks (Mini-project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Credits
IE1011	**Product Life Cycle Management**	**03**

Course Objectives: Students will try :

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

Course Outcomes: Students 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,	05

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	Digital mock-up, Model 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

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Course Code	Course Name	Credits
IE1012	**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	**Maintainability and Availability:** 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:

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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.

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Course Code	Course Name	Credits
IE1013	**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.

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End Semester Theory Examination:

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

1. Question paper will comprise of total six question
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

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Course Code	Course Name	Credits
IE1014	**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** Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06
02	**Fitting Regression Models** Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08
03	**Two-Level Factorial Designs** The 2^2 Design The 2^3 Design The General 2^k Design A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs** The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07

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05	**Response Surface Methods and Designs** Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07
06	**Taguchi Approach** Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods 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

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Course Code	Course Name	Credits
IE1015	**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 **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts,	05

	Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
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
IE1016	**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 and information 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, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyber line** Phishing, Password Cracking, Key loggers 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 the IT Act, 2000, IT Act. 2008 and its Amendments	6
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
IE1017	**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: 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 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 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
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	06

	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.	
05	Financing Relief Measures: 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. International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 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
IE1018	**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 ofsome common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation ofsome 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. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10

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

Course Code	Course Name	Credits
IE1019	**Development Engineering**	**03**

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure toimplications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to…

1. Demonstrateunderstanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	**08**
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	**06**
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	**07**

4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	**10**
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based onapproximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington

9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150
10. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Semester II

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITC201	WEB X.0	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITC201	WEB X.0	20	20	20	80	--	--	--	100

Course Objectives:

Sr.No	The course aims:
1	To understand the digital evolution of web technology.
2	To learn Type Script and understand how to use it in web applications.
3	To learn the fundamentals of Node.js.
4	To make Node.js applications using the express framework.
5	To enable the use of AngularJS to create web applications that depend on the Model-View-Controller Architecture.
6	To gain expertise in a leading document-oriented NoSQL database, designed for speed, scalability, and developer agility using MongoDB and Mongoose.

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts related to web analytics and semantic web.	L1, L2
2	Understand how Type Script can help you eliminate bugs in your code and enable you to scale your code.	L1, L2
3	Develop back-end applications using Node.js.	L1,L2,L3
4	Construct web based Node.js applications using Express.	L1,L2,L3
5	Understand Angular Js framework and build dynamic, responsive single-page web applications.	L1,L2,L3

6	Apply MongoDB for frontend and backend connectivity using Mongoose and REST API.	L1, L2, L3

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Introduction to HTML5,CSS3, Basics of JavaScript**	02	-
I	Introduction to WebX.0	Evolution of WebX.0; **Web Analytics 2.0**: Introduction to Web Analytics, Web Analytics 2.0, Clickstream Analysis, Strategy to choose your web analytics tool, Measuring the success of a website; **Web3.0 and Semantic Web**: Characteristics of Semantic Web, Components of Semantic Web, Semantic Web Stack, N-Triples and Turtle, Ontology, RDF and SPARQL **Self-learning Topics**: Semantic Web Vs AI, SPARQL Vs SQL.	04	CO1
II	TypeScript	Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Inheritance and Modules **Self-learning Topics**: Javascript Vs TypeScript	06	CO2
III	Node.js	Introducing the Node.js-to-Angular Stack (MEAN Stack), Environment setup for Node.js , First app, Asynchronous programming, Callback concept, Event loops, REPL, NPM, Event emitter, Buffers, Streams, Networking module, File system, Web module. **Self-learning Topics:** Node.js with MongoDB.	06	CO3
IV	Express	Introduction to Express ,Installing Express,Creating First Express application,The application, request, and response objects, Configuring Routes, Understanding Middleware, cookies, Session, Authentication **Self-learning Topics:** Express Js Templates	06	CO4
V	Introduction to AngularJS	Overview of AngularJS, Need of AngularJS in real websites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS	06	CO5

		expressions,AngularJS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency injection, AngularJS Services, Form Validation, Routing. **Self-learning Topics:** MVC model, DOM model.		
VI	MongoDB and Building REST API using MongoDB	**MongoDB**: Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. **Mongoose:** Installation and connecting to MongoDB, understanding and extending Mongoose Schema, Define custom model methods and validation, Mongoose Middleware and DBRef. **REST API**: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (Create, Read, Update, Delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints. **Self-learning Topics**: MongoDB vs SQL Databases	09	CO6

Text Books:

1.Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc.
2. Amos Q. Haviv, "MEAN Web Development" , PACKT Publishing
3.Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development:The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional
5. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint.
4. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions.

References:

1. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications.
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications.

Online References:

1.https://www.coursera.org
2. https://udemy.com
3. https://www.tutorialspoint.com/meanjs/meanjs_overview.htm

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITC202	Cloud Computing and Services	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ME -ITC202	Cloud Computing and Services	20	20	20	80	--	--	--	100

Course Objectives:

Sr.No	The course aims:
1	To learn the perspective of cloud computing and virtualization
2	To understand the idea behind mobile cloud computing
3	To determine the meaning of mobile offloading
4	To assess the concept of green cloud computing
5	To explore the resource allocation techniques and various business models
6	To analyze various cloud and mobile computing environments for real world application

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concepts behind cloud computing and virtualization.	L2
2	Apply the knowledge of mobile cloud computing to various applications	L3
3	Determine the various techniques of loading in cloud computing applications.	L4
4	Design applications to make the systems energy efficient.	L6
5	Select the required cloud computing resources and develop a business model.	L1,L2,L3
6	Apply various techniques to develop various high ended mobile cloud computing applications	L3

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Cloud Computing models, Virtualization, Primary and Secondary services offered by the cloud.	02	--
I	Introduction to Cloud Computing and virtualization	Virtualization: Need for virtualization, Features and types of virtualization, Hypervisors and its types. Cloud Computing**:** Introduction to Cloud Computing, Layers and Types of Clouds, Features of Cloud computing system , Cloud Infrastructure Management, Infrastructure as a Service , Platform as a Service , software as a service, Challenges and Risks, Secondary services. **Self-learning Topics:** Case study on Service model Dockers, OSGi (Application level virtualization library)	06	CO1
II	Mobile cloud computing	Mobile cloud computing: Need for Mobile cloud computing system, Definition, Architecture, Challenges, Characteristics and Benefits of Mobile cloud computing. Mobile cloud computing service framework Mobile cloud solutions, Mobile cloud service models, Mobile Cloud computation, Mobile Cloud storage, Mobile Cloud security and privacy, Mobile Cloud Computing context awareness, Mobile as a service consumer, Mobile as a service provider, Mobile as service broker. **Self-learning Topics:** Mobile cloud computing platforms and software.	06	CO2
III	Offloading in Mobile Cloud Computing	Definition of offloading, composition, migration Introduction to offloading , Offloading Decision, Types of Offloading, Topologies of Offloading, Offloading in Cloud Computing and in Mobile Cloud Computing: Similarities and Differences, Adaptive Computation Offloading from Mobile Devices, Cloud Path Selection for Offloading, Mobile Data Offloading Using Opportunistic Communication, Three-Tier Architecture of Mobile Cloud Computing, Requirements of Data Offloading, Performance Analysis of Offloading Techniques Multi-Cloud Offloading in	06	CO3

		Mobile Cloud computing environment, Mobile cloud computing offloading models **Self-learning Topics:** Mobile cloud offloading framework: clonecloud, Thinkair, MAUI, Cuckoo, weblet		
IV	Green Mobile Cloud Computing	Introduction**,** Requirements and issues , Devices used, Computational offloading, Resource management, Service provisioning, Green location sensing, Energy saving. **Self-learning Topics:** Measures taken by IT industries towards green computing and challenges in adopting green computing.	06	CO4
V	Resource allocation and business model for mobile cloud computing	Resource allocation in mobile cloud computing: Simple, dynamic and adaptive resource allocation models. Challenges and issues in resource allocation, Techniques in mobile cloud computing. Mobile cloud computing business models: Advantages, issues and applications. Business Models for social mobile cloud **Self-learning Topics:** Business model requirements, cloud computing business model	06	CO5
VI	Applications of Mobile cloud computing	Mobile cloud media computing applications: Location identification, Human Tracking, Mobile learning applications, Cloud streaming applications, Vehicle monitoring and Biometric applications. Tips for creating cloud mobile applications, Context aware mobile computing system, **Self-learning Topics:** Cross cloud communication applications, Elastic application models	07	CO6

Text Books:

1. Cloud Computing: Principles and Paradigms,Rajkumar Buyya , James Broberg,Andrzej M. Goscinski
2. Cloud computing by Kailesh Jayaswal,jagannath kallakurchi, donald j Houde
3. Mobile cloud computing : foundation and service model by Dijiang Huang and Huijun Wu
4. Mobile computing architecture, algorithm and application by Debashis De

References:

1. Cloud computing Bible by barrie Sosinsky.
2. Cloud computing by Dr Kumar Saurabh

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2011	Web Application Security	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2011	Web Application Security	20	20	20	80	--	--	--	100

Course Objectives:

Sr.No	The course aims:
1	To reveal the underlying in web application.
2	To understand the browser security principles.
3	To understand web applications vulnerabilities.
4	To understand web application mitigations.
5	To identify and aid in fixing any security vulnerabilities during the web development process.
6	To understand the security principles in developing a reliable web application.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To understand the security principles in developing a reliable web application	L2
2	Identify the various types of security issues in web browser.	L3
3	Identify the various types of threats in developing a web application.	L4
4	Identify the various types of mitigation measures of web applications.	L6
5	Apply the security principles in developing a reliable web application.	L1,L2,L3

6	**1.** Use industry standard tools for web application security.	L3

Prerequisite: Introduction to Information & Network Security.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Overview of Web Applications: Introduction history of web applications interface ad structure benefits and drawbacks of web applications Web application Vs Cloud application	2	
I	Web Application Security Fundamentals	Security Fundamentals: Input Validation - Attack Surface Reduction Rules of Thumb- Classifying and Prioritizing Threads **Self-learning Topics:** Cookies, Access Control.	**4**	**CO1**
II	Browser Security Principles	Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection **Self-learning Topics:** HTTPS, HTTP Proxies.	**4**	**CO2**
III	Web Application Vulnerabilities	Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application - Session vulnerabilities and testing - Cross-site request forgery **Self-learning Topics:** SSH Tunneling Cleaning traces ,Cleaning the event log Advanced phishing attacks	**8**	**CO3**
IV	Web Application Mitigations	HTTP request, HTTP response, rendering and events , html image tags, image tag security, issue, java script on error , Javascript timing , port scanning , remote scripting , running remotecode, frame and iframe , browser sandbox, policy goals, same origin policy, library import, domain relaxation **Self-learning Topics:** Nikto, OWASP ZAP.	**7**	**CO4**
V	Secure Website Design	Secure website design: Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management, Sensitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines,	**8**	**CO5**

		Forms and validity, Technical implementation **Self-learning Topics:** Wapiti**,** SQL Map		
VI	Cutting Edge Web Application Security	Clickjacking - DNS rebinding - Flash security - Java applet security - Single-sign-on solution and security - IPv6 impact on web security **Self-learning Topics:** https://owasp.org/www-community/Free_for_Open_Source_Application_Security_Tools	**6**	**CO6**

Text Books:

1. Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Profe ssional, 2011.

2. Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011

References:

1. OReilly Web Security Privacy and Commerce 2nd Edition 2011

2. Professional Pen Testing for Web application, Andres andreu, wrox press

3. Carlos Serrao, Vicente Aguilera, Fabio Cerullo, "Web Application Security" Springer; 1st Edition.

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2012	Machine and Deep Learning	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2012	Machine and Deep Learning	20	20	20	80	--	--	--	100

Course Objectives:

Sr.No	The course aims:
1	To introduce the basics of machine learning and foster their abilities in applying different machine learning algorithms to real world problems.
2	To introduce the concept of Bayesian and computational learning.
3	To define and apply metrics to measure the performance of various learning algorithms.
4	To become familiar with Deep Learning Concepts and Architectures.
5	To become familiar with various deep learning networks
6	To explore trends and applications of Deep learning.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand, choose and apply different machine learning algorithms to real world problems.	L2

2	Apply Bayesian and computational learning in deriving effective learning rules.	L3
3	Evaluate performance of learning algorithms.	L4
4	Understand the basics of Deep Learning	L6
5	Describe the architecture of various deep networks	L1,L2,L3
6	Identify various trends and applications of Deep Learning	L3

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Data Mining**,** Linear Algebra, Calculus and Basics of Probability	02	-
I	**Introduction to Machine Learning**	Introduction to Machine Learning, Machine learning types, **Supervised Learning**: Linear Regression(LR) and Logistic Regression (LogR), Support Vector Machine(SVM), Decision tree , **Unsupervised Learning**: k-means and hierarchical clustering, choosing the number of clusters ;**Methods of Dimensionality reduction**: subset selection, Principal component analysis (PCA), Feature embedding **Self-learning Topics:** Implementation of the above algorithm, Dimensionality Reduction using Feature extraction, Feature selection	5	CO1

II	**Bayesian and computation learning:**	Bayesian Theorem, Concept learning, Maximum likelihood and least square error hypothesis , maximum likelihood hypothesis for predicting probability, minimum length description, Bayesian optimal classifier,Gibbs Algorithm,NB classifier, Learning to classify text, Bayesian Belief Network(BBN), EM algorithm, Probably Learning an Approximately Correct Hypothesis, sample complexity for finite and infinite hypothesis space, The mistake bounds model of learning .**Self-learning Topics:** Implementation of NB classifier	5	CO2
III	**Advanced ML Classification Techniques and Model Evaluation**	**Metrics for Classification:** Model evaluation, Holdout Method and Random Sub sampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves. **Ensemble Classifiers**: Introduction to Ensemble Methods, Bagging, Boosting, XG boost, Ada boost, Random forests, Improving classification accuracy of Class-Imbalanced Data, Model performance improvement using Hyper parameter tuning. **Self-learning Topics:** Improving the performance of classifiers	8	CO3
IV	**Introduction to Deep Learning**	Introduction to Deep Learning, Machine Learning Vs Deep Learning, Working of Deep Learning, Perceptrons, Artificial Neural Network (ANN), Architecture of Neural network ,Problems and use cases(examples), single layer and Multilayer networks, back propagation and regularization ,batch normalization. **Self-learning Topics: Issues in ANN**	6	CO3, CO4

V	**Deep Networks**	Introduction to Convolution Neural Network (CNN), Components of CNN ,Architecture of CNN, Properties of CNN, Applications of CNN; **Recurrent Neural Network (RNN):**Introduction to RNN, Simple RNN, LSTM Implementation, Deep RNN; **Autoencoder**: Introduction, Architecture, Applications, properties and hyperparameters, **Types of autoencoder**: Denoising autoencoder, Sparse Autoencoder, Contractive Autoencoder. **Self-learning Topics:** Restricted Boltzmann Machine (RBM)	6	CO5
VI	**Trends and applications in Deep Learning**	Generative adversarial networks (GAN); Transfer learning; Deep Learning for text and voice(Natural Language Processing); Deep Learning for image and video(Computer vision) **Self-learning Topics:** ImageNet Large Scale Visual Recognition Challenge (ILSVRC).	7	CO6

Text Books:

1. Ethem Alpaydin-Introduction to Machine Learning-The MIT Press:

2. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville published by MIT Press

3. Anuradha Srinivasaraghavan, Vincy Joseph, “Machine Learning”, Wiley.

4. Data Mining: Concepts and Techniques (The Morgan Kaufmann Series in Data Management Systems) by Jiawei Han, Micheline Kamber and Jian Pei

References:

1..Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning by Chris Albon . O'Reilly Media; 1st edition

2.Deep learning with Python, Second Edition by Francois Chollet ,Manning Publications

3. Hands–On Machine Learning with Scikit–Learn and TensorFlow by Aurelien Geron ,O'Reilly Media

4. Tom M. Mitchell. Machine Learning, McGraw-Hill Education

Online References:

1.https://nptel.ac.in/courses/106106139

2.https://machinelearningmastery.com/practical-machine-learning-problems/

1.https://www.deeplearningbook.org/

2.https://www.tensorflow.org/tutorials/images/transfer_learning

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2013	ARVR	03	--	--	03	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2013	ARVR	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the concepts of Augmented Reality, VR and related technologies.
2	To understand the AR tracking system and use of computer vision in AR/VR/MR.
3	To describe the technology for multimodal user interaction and authoring in AR.
4	To use different AR toolkits and apply them to develop AR applications.
5	To demonstrate AR Applications using Mobile AR Toolkits and SDKs.
6	To understand the use of AR/MR in interdisciplinary immersive applications.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and compare different Augmented Reality, VR and Mixed Reality Technologies.	L1, L2
2	Apply concepts of Computer Vision for tracking in AR, VR and MR Systems.	L3
3	Model different interfaces and authoring in AR/MR.	L3
4	Design AR/MR applications using open source platforms and toolkits.	L6
5	Design Mobile based AR Applications.	L6
6	Apply insights of AR/MR in different applications.	L3

DETAILED SYLLABUS:

Module	Title	Description	Hours	CO
0	**Pre-requisite**	Basics of Computer Graphics, Coordinate Systems, VR Introduction, Tracking in VR	**02**	--
I	**Introduction to Augmented Reality, Virtual Reality and Mixed Reality**	Definition and Scope, A Brief History of Augmented Reality, AR Architecture, Related Fields of AR (like Mixed Reality, Virtual Reality, Immersive Reality, Extended Reality) and Their comparison, General Architecture of Mixed Reality System, Algorithm Steps in Mixed Reality. What is VR, Modern VR Experiences. Bird's Eye View, Geometry Virtual Words. Light and optics. **Self-Learning Topics**: How AR/VR/MR are related to Ubiquitous Computing, Multidimensional Systems.	**05**	CO1
II	**Tracking and Computer Vision for AR, VR and MR**	Multimodal Displays; Visual Perception; Spatial Display Model; Visual Displays; Tracking, Calibration and Registration; Coordinate Systems; Characteristics of Tracking Technology; Stationary Tracking Systems; Mobile Sensors; Optical Tracking; Sensor Fusion; Marker Tracking; Multiple Camera Infrared Tracking; Natural Feature Tracking by Detection; Incremental Tracking; Simultaneous Localization and Tracking; Outdoor Tracking. Visual Perception, Visual Rendering, Motion in real and virtual worlds. **Self-Learning Topics**: Indoor Tracking, Full Body Tracking	**07**	CO2
III	**Interaction, Modeling and Annotation and Authoring**	Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Multi-view Interfaces, Haptic Interaction, Multimodal Interaction, Specifying Geometry, Specifying Appearance, Semi-automatic Reconstruction, Free-form Modeling, Annotation, Requirement of AR Authoring, Elements of Authoring, Stand-alone Authoring Solutions, Plug-in Approaches, Web Technology **Self-Learning Topics**: Case Study on Object Annotation in Real Time, Avatar Modeling.	**06**	CO3
IV	**Software Architecture in AR and AR Development Toolkits**	AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Data Flow, Scene Graphs; Developer Support: Parameter Configuration, Declarative Scripting, Procedural Scripting, Mixed Language Programming, Runtime Reconfiguration, Choosing an AR Platforms and Toolkits; AR Non-programming Frameworks, AR Programming Frameworks, Programming AR using ARToolkit. **Self-Learning Topics**: Commercial AR Frameworks, AR Related Markup Languages	**06**	CO4

V	**Mobile AR**	Types of Mobile Apps, AR Browsers for Smartphones, Point of Interests (POI) in Mobile AR, POI Authoring and Publishing Tools, AR Applications for Android, AR Games for Android, Mobile AR Toolkits and SDKs, Developing Mobile AR Applications, AR Application Development for Android Smartphone **Self-Learning Topics**: AR Applications for iOS, AR Games for iOS, AR Application Development for iOS Smartphone	**08**	CO5
VI	**Applications of AR/MR and Human Factors, Legal and Social Considerations**	Applications of AR/MR in: Edutainment, Medical, Military, Production and Manufacturing, Navigation, Astronomical Observation, E-commerce; What are Human Factors, Physical Side Effects, Visual Side Effects, Legal Considerations, Moral and Ethical Considerations. **Self-Learning Topics**: Applications of AR/MR in Civil Construction and Architecture, Collaboration, Information Control and Big Data Visualization	**05**	CO6

Textbooks:

1. Dieter Schmalsteig and Tobias Hollerer, "Augmented Reality- Principles and Practice", Pearson Education, Inc. 2016 Edition.
2. Chetankumar G Shetty, "Augmented Reality- Theory, Design and Development", Mc Graw Hill, 2020 Edition.
3. Alan B. Craig, "Understanding Augmented Reality – Concepts and Applications", Morgan Kaufmann, Elsevier, 2013 Edition
4. Steven M. LaVelle," Virtual Reality", Cambridge University press, 2019

References:

1. Borko Furht, "Handbook of Augmented Reality", Springer, 2011 Edition.
2. Erin Pangilinan, Steve Lukas, and Vasanth Mohan, "Creating Augmented and Virtual Realities-Theory and Practice for Next-Generation Spatial Computing", O'Reilly Media, Inc., 2019 Edition.
3. Jens Grubert, Dr. Raphael Grasset, "Augmented Reality for Android Application Development", PACKT Publishing, 2013 Edition.

Online Resources:

Sr. No.	Website Name
1.	www.nptel.ac.in
2.	www.coursera.org

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2014	High Performance Computing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2014	High Performance Computing	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn fundamental concepts of parallel processing
2	To learn utilization of high performance computing resources using programming frameworks
3	To learn usage of modern processor technology as a high performance computing platform
4	To learn and appreciate core design issues in parallel computing
5	To study application of high performance computing to practical problems
6	To understand factors limiting performance of high performance computing systems

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Memorize and Understand classes of parallel computer architectures and GPU architecture	L1, L2
2	Understand standardized, multi-platform communication methods for parallel programming.	L2
3	Understand CUDA architectural details	L2
4	Analyze fundamental issues in parallel computing	L2
5	Study and develop basic applications using OpenCL	L1
6	Design and Develop GPU based solutions to solve computationally intensive problems in various fields	L6

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Concepts of Computer Organization and Architecture, Concepts of Operating System, Concepts of Distributed Computing	2	
I	Introduction to Parallel Processing Concepts	Introduction to Parallel Processing, Parallel Architecture, Parallel Platforms, Performance measures Processor Architecture, Interconnect, communication, Memory Organization, GPU Architecture: Evolution of GPU Architectures, Typical GPU architecture, CPU- GPU interaction, Address Spaces, Software Architecture **Self-learning Topics:** NPTEL Course on GPU Architectures and Programming	**6**	CO1
II	Parallel Programming with MPI, OpenMP	Building blocks of MPI, Overlapping communication and computation, collective communication operations OpenMP Threading Building blocks; An Overview of Memory Allocators, Parallel programming model 2.3 Combining MPI and OpenMP, Shared memory programming **Self-learning Topics:** NPTEL Course on Introduction to parallel programming with OpenMP and MPI	**8**	CO2
III	CUDA: GPU Parallel Development Environment	Compute Unified Device Architecture (CUDA) Architecture, CUDA programming model, execution model Thread organization: Concept of threads, Blocks, grid, thread index generation, warp Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory **Self-learning Topics:** http://www.nvidia.com/object/cuda_home_new.html	**8**	CO3, CO6
IV	Fundamental Design Issues in Parallel Computing	Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms to Parallel Architectures, Performance Analysis of Parallel Algorithms	**6**	CO4
V	OpenCL Basics	OpenCL Standard, Kernels – Host Device Interaction – Execution Environment, Memory	**6**	CO5, CO6

		Model, Basic OpenCL Examples **Self-learning Topics:** http://www.openCL.org		
VI	Fundamental Limitations Facing Parallel Computing	Bandwidth Limitations, Latency Limitations Latency Hiding/Tolerating Techniques and their limitation, **Self-learning Topics:** **Case study of HPC**	**3**	CO4, CO6

Text Books:

1. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 1993
2. "Parallel Programming in C with MPI and OpenMP", Michael J. Quinn, McGraw-Hill International Editions, Computer Science Series, 2008.
3. "Introduction to Parallel Computing", AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , Pearson Education, Second Edition, 2007
4. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007
5. "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", Shane Cook, First Edition, Morgan Kaufmann, 2012.

References:

1. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.
2. "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison - Wesley, 2010.
3. "High Performance Computing: Paradigm and Infrastructure", Lawrence Yang, Minyi Guo, Wiley, 2006

Online References:

1. https://cuda-tutorial.readthedocs.io/en/latest/
2. CUDA: docs.nvidia.com/cuda

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ME-ITPE2021	Design Thinking	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2021	Design Thinking	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To stress the importance of good design.
2	To recognize the latest and future issues and challenges in innovation.
3	To expose the student with state of the art perspectives, ideas, concepts, and solutions related to the design and innovation using design thinking principles.
4	To develop an advanced innovation and growth mindset form of problem identification and reframing, and insight generation.
5	To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions.
6	To propose a concrete, feasible, viable and relevant innovation project/challenge with Implementation

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand good features of designs.	L2
2	Understand importance of innovation in day to day life	L2
3	Illustrate and analyze user needs and formulate design and innovation using design thinking principles.	L4
4	Interpret and evaluate the data collected during the process of problem identification and reframing, and insight generation.	L5
5	Evaluate designs based on theoretical frameworks and methodological	L5

	approaches.	
6	Design innovative applications that are usable, effective and efficient for intended users	L6

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Software Engineering concepts and anyprogramming Language	2	
I	**Introductio nto design**	Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience, Necessity of UI/UX, **Self-learning Topics:** Study of Various interactiveday to day application	5	CO1
II	**Design Thinking Backgroun d**	Definition of design thinking, business uses of design thinking, variety of approaches within the design thinking discipline, design thinking mindset **Self-learning Topics:** Design thinking in businessapplication	5	CO2
III	**Design Thinking Approach**	Fundamental Concepts: Empathy, ethnography, divergent thinking convergent thinking,visual thinking, assumption testing, prototyping, and validation within design Thinking, Design Thinking Resources Human resource, preferred space prepared, materials commonly used, dynamic between design thinking teams and the organization 3.3 Design Thinking Processes Design thinking approaches, Double Diamond (approach, School), 5 Stage approach, Growth	8	CO3

		approach, role of project management within design thinking **Self-learning Topics:** Study of Various resources for design thinking		

IV	**Design Thinking inPractice**	4.1 Process Stages of Designing for Growth 4.2 Design Thinking Tools and Methods need to use tools and methods, visualization , journey mapping , value chain analysis , mind mapping , brainstorming, concept development assumption testing, rapid prototyping customer co-creation, learning launch. **Self-learning Topics:** Study of concept development with any application	7	CO4 / CO5
V	UX Evaluation, The Interaction Cycle and the User Action Framework	UX Goals, Metrics and Targets, UX Evaluation Techniques.-Formative vs summative ,Analysis, The interaction cycle, The user action framework adding a structured knowledge base to the interaction cycle, Interaction cycle and user action framework content categories, Role of affordances within the UAF, Practical value of the UAF. **Self-learning Topics:** Study of UI and UX goals with any application	7	CO5
VI	Design Thinking Applicatio n	This section explores practical case study related to product development in a design thinking effort.Any domain is preferable. **Self-learning Topics:** Study of any domain application	5	CO5/ CO6

Text Books:

1. "Designing for growth: A design thinking tool kit for managers", by Jeanne Liedtka and Tim Ogilvie., 2011, ISBN 978-0-231-15838-1
2. "The design thinking playbook: Mindful digital transformation of teams, products, services, businesses and ecosystems", by Michael Lewrick, Patrick Link, Larry Leifer., 2018, ISBN 978-1-119-46747-2
3. "Presumptive design: Design provocations for innovation", by Leo Frishberg and Charles Lambdin., 2016, ISBN: 978-0-12-803086-8

4. "Systems thinking: Managing chaos and complexity: A platform for designing business architecture.", "Chapter Seven: Design Thinking", by Jamshid Gharajedaghi, 2011, ISBN 978-0-12-385915-0
5. Interaction Design, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
6. Human Computer Interaction, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale

References:

1. Karmic Design Thinking by Prof. Bala Ramadurai, available at Amazon (paperback), Amazon(e-book),

   Flipkart, Pothi, halfpricebooks.in.

2. Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn

3. Change by Design by Tim Brown.

4. The UX Book, by Rex Hartson and Pardha S Pyla

5. Donald A. Norman, "The design of everyday things", Basic books.

6. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.

Online References: https://nptel.ac.in/courses/110106124

https://onlinecourses.nptel.ac.in/noc22_mg32/preview

https://onlinecourses.nptel.ac.in/noc21_ar05/preview

https://nptel.ac.in/courses/124/107/124107008/

https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/

https://nptel.ac.in/courses/107/103/107103083/

https://www.youtube.com/watch?v=6C2Ye1makdY&list=PLW-zSkCnZ-gD5TDfs1eL5EnH2mQ0f9g6B

https://xd.adobe.com/ideas/process/

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	Pract	Tut	Total
ME-ITPE2022	**Internet of Everything**	03	--	--	03	--	--	03
		Examination Scheme						
		Theory Examination				Term Work	Pract	Oral
		Internal Assessment			End Sem Exam			
		Test 1	Test 2	Avg				
		20	20	20	80	--	--	--

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To describe the concepts of Objects in IOT, IOT Identifier, IOT Technologies.
2	Discuss and elaborate RFID architecture, RFID Tag and Reader along with the protocols used to solve the RFID issues faced in RFID applications.
3	. Describe the connecting and networking nodes in a secure communication with the help of protocols such as MQTT, CoAP, and REST.
4	. Explain Hadoop MapReduce and demonstrate its usage for real time batch data Analysis using Apache Oozie, Apache Spark and Apache Storm.
5	Summarize the use of ML algorithms in IoT Based application in Healthcare and Smart Transportation.
6	Elaborate and show how the analysis and the evaluation is carried out over the data received through sensors in IOE to ensure security in IOE applications.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the Objects in IOT, list the IOT Identifiers and know the different technologies. **Self-Learning Topics**: History of IOT, Compare IOT & IOE	L1
2	Explain RFID architecture, list the Components, identify RFID Tag and Reader along with the protocols used to solve the RFID issues faced in RFID applications. **Self-Learning Topics:** Binary search Algorithms	L2
3	Design applications using the communication protocols such as MQTT, CoAP, and REST. **Self-Learning Topics:** Industrial WSN Standards	L6
4	Use Hadoop MapReduce for real time batch data Analysis using Apache	L3

	Oozie, Apache Spark and Apache Storm. **Self-Learning Topics:** Apache Hadoop Setup	
5	Recall the ML algorithms used in IoT Based applications in Healthcare and Smart Transportation. **Self-Learning Topics:** Deep Learning in IOT	L1
6	Analysis and evaluate the data received through sensors in IOE and Security in IOE applications. **Self-Learning Topics:** Trust based Recommender Systems in IoT	L4

Sr. No.	**Module**	**Detailed Contain**	**Hours**	**CO Mapping**
0	**Prerequisites:**	IOT Lab, Sensor Lab, Wireless Network.	**2**	
1.	Introduction to IOE	Introduction and History of IOT, Objects in IOT IOT Identifier, IOT Technologies **Self-Learning Topics:** History of IOT, Compare IOT & IOE	**5**	**CO1**
2.	Radio-frequency identification (RFID) Technology	Introduction to RFID and Principles of RFID RFID Components and RFID Tag and Reader RFID Transponder and RFID architecture RFID Middleware Protocols: Tree protocols, Tree splitting algorithms, Binary search Algorithms RFID Challenges and Applications **Self-Learning Topics:** Binary search Algorithms	**7**	**CO2**
3.	Wireless Sensor Networks	Connecting and networking nodes, Securing communication, standards, IP Addressing Protocols - MQTT, CoAP, REST **Self-Learning Topics**: Industrial WSN Standards	**6**	**CO3**
4.	Hadoop MapReduce	Introduction to Hadoop MapReduce, Architecture of Hadoop and Hadoop Ecosystem Hadoop MapReduce for Batch Data Analysis Apache Oozie, Apache Spark, Apache Storm Real-time Data Analysis Using Apache Storm **Self-Learning Topics:** Apache Hadoop Setup	**7**	**CO4**
5	**IoT with ML**	Machine Learning in IoT Based Healthcare Applications, General Architecture of H-IoT Overview of Algorithms and Security of health data, Machine Learning in IoT Based Smart Transportation, ML algorithms to support Smart Transportation **Self-Learning Topics:** Deep Learning in IOT	**6**	**CO5**
6.	**Security in IoE**	Common Challenges in OT Security. How IT and OT Security Practices and Systems Vary Formal Risk Analysis Structures: OCTAVE and FAIR Convergence of IoE and Blockchain its security challenges **Self-Learning Topics:** Trust based Recommender	**6**	**CO6**

		Systems in IoT		

Text Books

1.Hakima Chaouchi, Internet of Things connecting objects to the web. Wiley.

2. Arshdeep Bhaga and Vijay Madisetti, Internet of Things - A Hands-on-Approach.

3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet Of Things" Edition, Pearson Education, Cisco Press, 2017

Reference Books

1. Samuel Greengard, The Internet of Things (MIT Press).

2. Hakima Chaouchi, The Internet of Things - Connecting objects to the web. Wiley Publications.

3. Herve chabanne, RFID and the Internet of Things. Wiley Publications.

Reference Papers

1. H. K. Bharadwaj et al., "A Review on the Role of Machine Learning in Enabling IoT Based Healthcare Applications," in IEEE Access, vol. 9, pp. 38859-38890, 2021, doi: 10.1109/ACCESS.2021.3059858.

2. Zantalis, F.; Koulouras, G.; Karabetsos, S.; Kandris, D. A Review of Machine Learning and IoT in Smart Transportation. Future Internet 2019, 11, 94. https://doi.org/10.3390/fi11040094

3. L. Wei, J. Wu, C. Long and Y. -B. Lin, "The Convergence of IoE and Blockchain: Security Challenges," in IT Professional, vol. 21, no. 5, pp. 26-32, 1 Sept.-Oct. 2019, doi: 10.1109/MITP.2019.2923602.

Useful Links:

1 https://nptel.ac.in/courses/106/105/106105166/
2 https://nptel.ac.in/courses/108/108/108108098/
3 https://nptel.ac.in/courses/106/105/106105195/
4 https://www.coursera.org/specializations/IoT

Assessment:
Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2023	Information Retrieval	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
ME-ITPE2023	Information Retrieval	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	**To** learn the fundamentals of the information retrieval system.
2	To classify various Information retrieval models.
3	To understand application of IR principles in data structures.
4	. To apply text processing techniques and operations in information retrieval system.
5	To understand text search techniques.
6	To make the students understand various techniques of searching multimedia elements.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define and describe the objectives of the basic concepts of the Information retrieval system.	L1
2	Evaluate the taxonomy of different information retrieval models.	L5
3	Apply IR principles to locate relevant information large collections of data.	L3
4	Design different document clustering algorithms.	L6
5	Apply their knowledge of searching techniques to documents.	L3
6	Apply various multimedia elements with the right techniques	L3

DETAILED SYLLABUS:

Sr. No.	Module	Data sDetailed Content	Hours	CO Mapping
0	Prerequisite	**Data Structures**	2	
I	Introduction	Introduction to Information Retrieval Systems ,Definition of Information Retrieval System - Objectives of Information Retrieval Systems - Functional, Information versus Data Retrieval, A Taxonomy of Information Retrieval Models. The Retrieval Process- Ad Hoc and Filtering. Classic Information Retrieval :Basic Concepts, Boolean Model ,Vector Model. Brief Comparison of Classic Models ,Alternative Set Theoretic Models :Fuzzy Set Model, Search engines and Web browsers **Self-learning Topics:** Corpus linguistics , Brown Corpus	5	CO1
II	Retrieval System Functions and Indexing	Search Capabilities - Browse Capabilities - Indexing Process –Automatic Indexing- Statistical Indexing – Natural Language – Concept Indexing - Hypertext Linkages- Information Extraction **Self-learning Topics:** Part of speech.	7	CO2
III	Query Languages and Data structures in Information Retrieval	Query Languages for IR ● Keywords ● Boolean Queries ● Context Queries ● Natural Language Queries ● Structural Queries Stemming Algorithms - Inverted File Structure - N-Gram Data Structures - PAT Data Structure - Signature File Structure - Hypertext and XML Data Structures - Hidden Markov Models **Self-learning Topics:** Advanced Query Operations , Automatic Local Analysis, Automatic Global Analysis	6	CO3
IV	Document and Term Clustering	Introduction to Clustering - Thesaurus Generation - Item Clustering - Hierarchy of Clusters **Self-learning Topics:** Text Compression, Comparing Text Compression Technique	4	CO4
V	Search Techniques	Search Statements and Binding - Similarity Measures and Ranking -	8	CO5

		Relevance Feedback - Selective Dissemination of Information Search - Weighted Searches of Boolean Systems - Searching the INTERNET and Hypertext – Introduction to Text Search Techniques - Software Text Search Algorithms. **Self-learning Topics:** cross-language retrieval		
VI	Visualization & Multimedia Information Retrieval	Introduction to Information Visualization - Cognition and Perception and vision- Information Visualization Technologies and techniques .Spoken Language Audio Retrieval –Non-Speech Audio Retrieval - Graph Retrieval - Imagery Retrieval - Video Retrieval, 3D retrieval, music retrieval **Self-learning Topics:** LIRE (Luce-ne Image Retrieval)	7	CO6

Text Books:

1. Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley
2. Information storage and retrieval by Robert R Korthage, wiley publication.
3. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer AcademicPublisher.
4. Michael W. Berry " Survey of Text Mining: Clustering, Classification and Retrieval", Springer Verlag,

References:

1. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press.
2. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman.
4. Text Information Retrieval Systems. C.T. Meadow, B.R. Boyce, D.H. Kraft, C.L. Barry.

Online References:

1) **https://nlp.stanford.edu/IR-book/**

2) **https://en.wikipedia.org/wiki/Information_retrieval**

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ME-ITPE2024	Green IT	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ME-ITPE2024	Green IT	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand what Green IT is and How it can help improve environmental Sustainability
2	To understand the principles and practices of Green IT.
3	To understand how Green IT is adopted or deployed in enterprises.
4	. To understand how data centers, cloud computing, storage systems, software and networks can be made greener.
5	To measure the Maturity of a Sustainable ICT world.
6	To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement	L1
2	Identify IT Infrastructure Management and Green Data Center Metrics for software development	L1
3	Recognize Objectives of Green Network Protocols for Data communication	L1
4	Use Green IT Strategies and metrics for ICT development.	L3
5	Illustrate various green IT services and its roles	L3
6	Use new career opportunities available in IT profession, audits and others with special skills.	L3

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and EcoLabeling, Enterprise Green IT Strategy , Green IT: Burden or Opportunity? Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Software: Introduction, EnergySaving Software Techniques, Evaluating and Measuring Software Impact to Platform Power	6	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics	6	CO1 CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards	6	CO1 CO3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT.	6	CO1 CO4
V	Green it services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	6	CO1 CO4 CO5
VI	Managing and regulating green it	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centres, Social Movements and Greenpeace	7	CO1 CO5 CO6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT,WILEY 1st Edition-2018
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable

Assessment:

Internal Assessment Test:

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 inquestion papers of end semester examination.

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	**Course Name**	**Theory**	**Practical**	**Tutorial**	**Theory**	**Practical & Oral**	**Tutorial**	**Total**
ME-ITL201	Program Lab-II	--	2	--	--	1	--	01

Course Code	**Course Name**	**Examination Scheme**						
		Theory Marks				**Term Work**	**Practical/ Oral**	**Total**
		Internal assessment			**End Sem. Exam**			
		Test1	**Test 2**	**Avg. of 2 Tests**				
ME-ITL201	Program Lab-II	--	--	--	--	25	25	50

Lab Objectives:

Sr. No	**Lab Objectives**
1	AngularJS Framework for Single Page Web Applications.
2	AJAX for Rich Internet Applications.
3	REST API and MongoDB for Frontend and Backend Connectivity.
4	To understand the concept of cloud computing and virtualization.
5	To understand the concept of mobile computing.
6	To understand the concept of mobile offloading.

Lab Outcomes:

Sr. No	**Lab Outcomes**	**Cognitive levels of attainment as per Bloom's Taxonomy**
1	Implement Single Page Applications using AngularJS Framework.	L1, L2, L3
2	Develop Rich Internet Applications using AJAX.	L1, L2, L3
3	Create REST Web services using MongoDB.	L1, L2, L3, L4
4	Understand and apply the concept of cloud computing and virtualization	L1,L2,L3
5	Understand and apply the concept of mobile computing	L1,L2,L3
6	Understand and apply the concept of mobile offloading	L1,L2,L3

Prerequisite: Computer Networks, HTML/HTML5, CSS/CSS3, JavaScript, Python

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	AngularJS	Perform **Any 2** from the following 1. Create a simple HTML "Hello World" Project using AngularJS Framework and apply ng-controller, ng-model and expressions. 2. Events and Validations in AngularJS. (Create functions and add events, adding HTML validators, using $valid property of Angular, etc.) 3. Create an application for like Students Record using AngularJS	**05**	LO1
II	Rich Internet Application using AJAX	Perform **Any 3** from the following 1. Write a JavaScript program for a AJAX. 2. Write a program to use AJAX for user validation using and to show the result on the same page below the submit button. 3. Design and develop small web application using AJAX, HTML and JSP.	**04**	LO2
III	MongoDB and Building REST API using MongoDB	Perform **Any 1** from the following 1. Build a RESTful API using MongoDB. 2. Build a TypeScript REST API using MongoDB.	**04**	LO3
IV	Cloud computing and virtualization	1) Demonstrate database as a cloud computing service 2) Demonstrate memory virtualization in single machine 3) Demonstrate virtualization by using VMware 4) Demonstrate the installation of open source cloud platform	**05**	LO4
V	Mobile cloud computing	5) 5)Demonstrate how to built ML/AL capabilities on cloud for	**04**	LO5

		mobile applications 6) 6) Explain how mobile offline data synchronization can be done using any cloud platform		
VI	Mobile offloading	) Demonstrate how cloud can be used to implement push notifications for mobile apps. 8) Demonstrate how cloud platform can be used to device testing of mobile apps 9) Demonstrate the user sign-up and sign-in management using any cloud platform 10) Demonstrate how server less architecture can be used to build APIs for mobile applications 11) Demonstrate how speech recognition can be implemented for mobile apps using cloud platform 12) Demonstrate how the user engagements and analytics of mobile apps can be managed by cloud services 13) Demonstrate and explain how cloud can be used for content delivery on mobile phones	**04**	LO6

Text Books:

1. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", Wiley Publishing, Inc, 1st Edition, 2009.
2. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc., 2019 Edition.
3. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd., 2015 Edition.
4. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2019 Edition.
5. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions, 2019 Edition.
6. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly, 2018 Edition.
7. Cloud Computing: Principles and Paradigms,Rajkumar Buyya , James Broberg,Andrzej M. Goscinski
8. Cloud computing by Kailesh Jayaswal,jagannath kallakurchi, donald j Houde
9. Mobile cloud computing : foundation and service model by Dijiang Huang and Huijun Wu
10. Mobile computing architecture, algorithm and application by Debashis De

References:

1. John Davies, Rudi Studer and Paul Warren, "Semantic Web Technologies Trends and Research in Ontology-based Systems", Wiley, 2006 Edition.
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications, 2020 Edition.
3. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress, 2014 Edition.

4. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional, 2018 Edition.
5. Cloud computing Bible by barrie Sosinsky.
6. Cloud computing by Dr Kumar Saurabh

Term Work:

Term Work shall consist of at least 10 practical based on the above list. Also Term Work Journal must include Assignement as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	**Course Name**	**Theory**	**Practical**	**Tutorial**	**Theory**	**Practical & Oral**	**Tutorial**	**Total**
ME-ITSBL201	Design Thinking Lab (SBL)	--	4	--	--	2	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
ME-ITSBL201	Design Thinking Lab (SBL)	--	--	--	--	50	50	100

Lab Objectives:

Sr. No	Lab Objectives
1	Understand the design thinking process.
2	Understand and prepare a detail journey map for your problem.
3	Understand and design a mock-up and innovation model of your problem.
4	Understand the different technologies and apply it.
5	Understand and create a prototype
6	Use testing software by apply different test modes.

Lab Outcomes:

Sr. No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Understand and apply the design thinking process.	L1,L2,L3
2	Prepare a detail journey map for your problem.	L1,L2,L3
3	Design a mock-up and innovation model of your problem.	L6
4	Understand the different technologies and apply it.	L1,L2
5	create a prototype for your problem	L6
6	Use testing software by apply different test modes.	L1,L2,L3,L4

Prerequisite: Any programming language.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Introduction	Concept of design thinking, what is design thinking, core elements of design thinking. Key principles	**06**	LO1

		and mindset. Mindset & attitudes. Five different phases of Design thinking.		
II	Deconstructing stereotypes through creative collaboration & Immersion.	. Structure of the project Focus: gender equality Results of the creative collaboration. Immersion, Reframing, Exploratory Research, Desk Research.	**04**	LO2
III	A step-by-step guide	A thousand and one methods Facilitate your team Be curious! Be compassionate! Be creative! Be constructive!	**04**	LO3
IV	Analysis and Synthesis	Insight Cards, Affinity Diagram, Conceptual Map, Guiding Criteria, Personas, Empathy Map, User's journey, Blueprint.	**06**	LO4
V	Ideation	Brainstorming, Co-creation workshop, Idea Menu, Decision Matrix.	**05**	LO4,LO5
VI	Prototyping and tesing	Paper Prototyping, Volumetric Model, Staging, Storyboard, Service Prototyping. Use tools for testing.	**05**	LO6

Text & Refernces Books:

1. An introduction to design thingking, standard.
2. A practical guide for design thinking, 2019
3. Design thinking a guide book
4. Design Thinking Business Innovation.
5. Handbook of Design Thinking tips and tools for how to design thinking.
6. Design Thinking Handbook, Eli Woolery.

Guidelines for Mini Project as per above syllabus.

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement how to contribute to open source mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of recent contribute to open source mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.

- Students in a group shall understand contribute to open source problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report using open source tools to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the open source Mini Projects.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 30
    - Marks awarded by review committee : 10
    - Quality of Project Report :05

Term Work:

Term Work shall consist of at least 10 practical based on the above list. Also Term Work Journal must include Mini-Project as mentioned in above syllabus.

Term Work Marks: 50 Marks (Total marks) = 40 Marks (Mini-project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Credits
IE2011	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:** 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	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting,	8

	engaging with all stakeholders of the projects. Team management, communication and project meetings. **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. **Project Contracting** Project procurement management, contracting and outsourcing,	
06	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **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

REFERENCES:

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

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.

Course Code	Course Name	Credits
IE2012	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)	10

	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.	
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

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.

Assessment:

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

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

1. Question paper will comprise of total six question
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4. Only Four question need to be solved.

Course Code	Course Name	Credits
IE2013	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

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

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.**

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4. Only Four question need to be solved.

Course Code	Course Name	Credits
IE2014	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 • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and	6

	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.	
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

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, 15thedition, 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

Assessment:

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End Semester Theory Examination:

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Course Code	Course Name	Credits
IE2015	**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 India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

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

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.**

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4. Only Four question need to be solved.

Course Code	Course Name	Credits
IE2016	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** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research **Issues** and Problems in Research Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	09
02	**Types of Research** Basic Research Applied Research Descriptive Research Analytical Research Empirical Research **2.6** Qualitative and Quantitative Approaches	07
03	**Research Design and Sample Design** Research Design – Meaning, Types and Significance 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 **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	08

	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** Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	**04**

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

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.

Course Code	Course Name	Credits
IE2017	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 scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
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	07

	Patent databases: Important websites, Searching international databases	

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

Assessment:

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End Semester Theory Examination:

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Course Code	Course Name	Credits
IE2018	**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 project, Legal, Ethics and Societal impacts of EC	06

3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business 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

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

Assessment:

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

End Semester Theory Examination:

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

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

Course Code	Course Name	Credits
IE2019	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

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

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.

8. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
9. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

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.**

5. Question paper will comprise of total six question
6. All question carry equal marks
7. 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)
8. Only Four question need to be solved.

\I	**Process Models**	Generic process Model, Prescriptive process model, Specialized process model.	**4**
II	**Agile development**	What is agile process, Extreme programming, ASD, Scrum, DSDM, Crystel FDD, LSD, AM, AUP	**4**
III	**Principles that guide practice and Understanding requirements**	Core principles, principles thar guide framework activities, Requirements engineering, establishing groundwork, eliciting requirements, building requirements model, negotiating requirements, Validating requirements.	**4**

IV	**Architectural Design**	Software architecture, Architectural genres, Architectural styles, Architectural design, Design patterns, Pattern based software design, Architectural patterns, User interface design patterns.	**8**
V	**Quality Management**	Quality concepts, Review techniques, Software quality assurance, testing strategies, Formal modeling, and verification, product metrics.	**8**
VI	**Software process improvement**	What is SPI, The SPI process, CMMI, SPI frameworks, SPI ROI, SPI trends, cleanroom software engineering	**8**

Textbook

2. Software Engineering, A Practitioner's Approach, Seventh Edition, Roger s. Pressman

Reference Book.

3. An integrated approach to Software Engineering, Pankaj Jalote
4. Software Engineering, Tenth Edition, Ian Sommerville

Assessment

Internal: Assessment consists of two tests out of which; one should be compulsory class test (on minimum 03 Modules) and the other is either a class test or assignment or seminar or paper reading.

End Semester Examination: End semester examination will be on complete syllabus for 80 marks.