Item No: 4.A.4
A.C. Date: 07/07/2023

SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Technology
(Formerly known as K J Somaiya Institute of Engineering and Information Technology)
An Autonomous Institute permanently affiliated to University of Mumbai

Autonomy Syllabus Scheme-II

for

Bachelor of Technology (B.Tech.)

in

Artificial Intelligence and Data Science (AI-DS)

(Last Year)
(Semester VII)

Including
Honours Degree Program

With effect from A.Y. 2023-24

Somaiya Ayurvihar Complex, Eastern Express Highway, Sion (East), Mumbai. 400 022, India
Telephone: (91-22)44444400, 44444404 email: principal.tech@somaiya.edu, Web: https://kjsit.somaiya.edu.in/en

From the Principal's Desk:

The challenges and demands of the dynamic industry increasingly require technocrats to be skilled, adaptive, and innovative. The National Educational Policy 2020 (NEP 2020) framed by the Government of India intends to induce a paradigm shift by re-conceptualising the higher education. Recent academic reforms recommended by the AICTE and UGC have also effectually upscaled the higher education system in India. It is further the role of HEIs to offer high-quality educational opportunities and enable the next generation to succeed globally. Hence, to adhere to the status quo, and enhance the academic standards and quality of engineering education further, it is essential to assimilate innovation and recurrent revision in curriculum, teaching-learning methodology, examination, and assessment system.

In congruence with it, the University of Mumbai has adapted Outcome-Based Education (OBE) system and has revised the engineering curriculum thrice in the last decade — as Rev 2012, Rev 2016, and the recent Rev 2019, 'C' scheme focusing on cutting-edge technology courses.

K. J. Somaiya Institute of Technology (KJSIT), being an autonomous institute possesses more flexibility in adapting newer approaches to reach higher levels of excellence in engineering education. The Syllabus Scheme-I implemented under the academic autonomy conferred to KJSIT w.e.f. A.Y. 2021-22 already comprises of state-of-the-art courses and laboratory sessions on emerging areas of technology. With an ideology that the root of innovation is 'interest', the curriculum offered a wide range of elective courses grouped into core and inter-disciplinary domains. At par with international engineering education, it followed a learner-centric approach, where the students could choose to study courses concerning areas of their interests.

This curriculum introduces Skill-Based Learning (SBL), Activity-Based Learning (ABL), and Technology-Based Learning (TBL) as eXposure (SAT) courses that assure X factor in all the students of the institute. The SAT courses were practiced across the first three years of engineering, focusing on graduate attributes like work responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. that could not be copiously imbibed through regular engineering courses. The inclusion of induction program for the First Year students is deliberated as per the guidelines of AICTE and helps students belonging to diverse backgrounds to adjust in the new academic environment.

However, sustained initiatives are required to assure efficiency, academic excellence, and growth. Hence, KJSIT Syllabus Scheme –II introduces 03 newer dimensions to Scheme – I: Internship, SBL of Foreign and Indian Languages, and Honours Degree that shall be implemented w.e.f. from A.Y. 2022-23 across all the branches and all 04 years of engineering.

1. **Internship:** Firstly, the redesigned Scheme-II incorporates 14 Credits for Internship (cumulative 600-700 Hours), which shall be mandatory for all the students and is to be pursued during all 04 years of graduation. Based on the AICTE Internship Policy, this initiative shall enable graduates to respond to the current needs of the industry and equip them with skills required at national and global level. The students shall gain practical understanding and training on cutting-edge technologies and industry practices in a suitable industry or organization. While innovation and entrepreneurship are emerging as fulcrums of higher education, the internship will also provide an exposure to innovation, entrepreneurial, and incubation opportunities through various related activities, and instill a start-up spirit in the students.

   Further, the students of KJSIT already have an exposure to the work culture and trends in industries

through live / collaborative projects / product developments, etc. and they often contribute significantly to the society through various projects. Under autonomy too, through the component of Project-Based Learning included in the syllabus, the students develop Mini, Minor, and Major projects in Second, Third, and Last Year respectively concerning healthcare, agriculture, societal / industrial need-based problems, etc. Through duality of Major Project development and newly introduced activities / components as a part of Internship, the students shall learn about research methodology, IP and IPR — resulting into generation of quality research articles, copyrights, and patents.

2. **Honours Program**: Another major initiative through the Scheme–II is the introduction of B.Tech. with Honours program for students who are desirous of pursuing focused interest in 06 emerging areas of technology recognized by AICTE: Internet of Things, Artificial Intelligence & Machine Learning, Cyber Security, Virtual and Augmented Reality, Data Science, and Blockchain. This Honours program is of high-end industry standards and shall offer multi-fold opportunities for the learners such as additional credits, specialization in the chosen domain, job-ready skills, multidisciplinary knowledge, etc.
3. **Foreign and Indian Languages**: As another initiative, the Skill-Based Learning (SBL) in Scheme – II shall also comprise of developing verbal and written communication skills in Foreign and Indian Languages, which is a blooming trend and future necessity for various career prospects. The students shall acquire these skills through MOOC courses, giving them opportunities to learn the target language from beginners to advanced level. These SBL and the TBL courses shall acquaint students with skills of digital age learning from online platforms, along with time management ability, ethics, and professionalism.

Through joint efforts of all stakeholders, newer initiatives, strategic planning, and efficient execution of neoteric educational practices with hi-tech wizardry, KJSIT is endeavouring to become a role model for all autonomous institutes across the nation.

Dr. S. K. Ukarande
Principal and Chairman - Academic Council

Preamble by Member Secretary, Academic Council:

K J Somaiya Institute of Technology (KJSIT) has been granted academic autonomy by University Grants Commission (UGC) from Academic Year 2021-22 for 10 years. UGC states the benefits of granting academic autonomy to higher education institutes as 'the freedom to modernize curricula, making it globally competent, locally relevant and skill oriented to promote employability'.

We, autonomous KJSITs Board of Studies in Computer Engineering (CE), Artificial Intelligence and Data Science (AI-DS), Electronics and Telecommunication (ET) and Information Technology (IT) had prepared Autonomy Scheme-I curricula from Academic Year 2021-22 for 4 years undergraduate (UG) and 2 years of post-graduation (PG) in Engineering and Technology disciplines, exercising academic freedom, meeting the needs of Industry 4.0, addressing the world wide challenges and providing globally required exposure to our UG and PG learners, focusing sound theoretical background supported by practical experiences in the relevant areas of engineering and technology.

Industry 4.0 demands modern and industry-oriented education, up-to-date knowledge of analysis, interpretation, designing, implementation, validation, and documentation of not only computer software and systems but also electronics and communication systems, hardware devices and tools, trained professionals, ability to work in teams on multidisciplinary projects, etc from engineering graduates. KJSITs autonomy Scheme-I syllabus was framed looking at the overall demands of Industry 4.0 and society to successfully acquaint learners with life-long experiential learning, professional ethics with universal human values, needed skill sets, in line with the objectives of higher and technical education, AICTE, UGC and various accreditation and ranking agencies, by keeping an eye on the technological developments and innovations.

It provides unique learning experiences to learners through extracurricular activities, innovations, and research with the introduction of Skill Based, Activity Based, Technology based and Project Based learning, showcasing learners' creativity, interest and talent by developing additional skill sets, social involvement and contributions through activities, case studies, field visits, internships, creative learning, innovative mini, minor and major project developments. This helped in strengthening learners' profile with increased chances of employability and avenues for start-ups. It is also provided with Value addition learning through MOOCs platforms such as IBM-ICE, Coursera, NPTEL, SWAYAM, Spoken Tutorial, Udemy etc.

We are happy to present the additional exposure to our learners under the Autonomy Academic Scheme-II, implemented w.e.f academic year 2022-23 for developing the intellectual climate of our country, bringing academic excellence in higher education system with the introduction of additional credit and audit courses for

1. Internships,
2. Skill Based Learning and
3. Honours Degree Programs in 6 emerging areas of technologies.

These additions are targeted for promoting academic, professional and personal development of learners through hands-on working experience under internships, exposure to foreign and Indian Regional Languages through MOOCs and award of specialization through Honours Degree Program. Internships will channelize learners' working experience with Industries, Government Sectors, NGO, MSMEs, Long term Rural Developments, and Research, Innovation, IPRs and Entrepreneurial setup. Two innovative courses on skill based implementing NEP 2020 guidelines and Honours Degree Program along with Regular B.Tech degree will boost the knowledge of graduating engineers in emerging areas of technologies contributing largely for industrial and personal automation, cyber, digitization, digital currency, security and artificial intelligence sector.

We are sure that with Scheme-I in academic year 2021-22, Scheme-II from Academic Year 2022-23 and Scheme-II B from Academic Year 2023-24, the blend of innovative learning components in the

curriculum shall strengthen the research and entrepreneurial culture of the institute benefitting the graduating engineers immensely.

We would like to place on record our gratitude to the faculty, alumni, students, industry experts, academicians and stakeholders, helping continuously strengthen the academics, making KJSIT as one of best engineering colleges across nation and top most choice of engineering aspirants.

Dr. Sunita R Patil
Member Secretary, Academic Council and Vice Principal, KJSIT, Sion

Preface by Board of Studies in Artificial Intelligence and Data Science:

We, the members of Board of Studies of B. Tech in Artificial Intelligence and Data Science (AI-DS) are very happy to present Autonomy Syllabus Scheme-II of Last Year of B. Tech in Artificial Intelligence with effect from the Academic Year 2023-24. We are assured that you will discover this syllabus interesting and challenging.

AI-DS is one of the newest programme amongst engineering students. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas like human intelligence and its applications in industry, defense healthcare, agriculture and many other areas. It is envisioned to deliver a modern, industry-oriented education in AI-DS. It aims at creating skilled engineers who can successfully acquaint with the demands of the industry worldwide. We have included internships under Autonomy Syllabus Scheme-II from SEM-II to SEM-VIII of B.Tech AI-DS. Also honor degree courses introduced in this Syllabus Scheme-II of AI-DS. They obtain skills and experience in up-to-date knowledge to analysis, design, employ, technologies, software and systems.

In this course, the students may have career opportunities in healthcare, business, e-Commerce, social networking companies, biotechnology, genetics and other areas. For holistic development of students Foreign and Regional Indian language and other skill-based courses introduced first time in this new scheme. At the beginning of every course, we have added two theory lectures for prerequisites and course outline and at the end one theory lecture added for coverage of course conclusion which includes recap of modules, outcomes, applications, and summarization. We have mapped course outcomes, PBL outcomes, Skills outcomes, Activity outcomes and TBL outcomes module wise throughout the syllabus. Faculty in this program adopted collaborative, co-operative and online teaching learning techniques during coverage of the course; this will help students to understand each course in depth. The designed syllabus promises to achieve the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

We would like to show our appreciation to the faculties, students, industry experts and stakeholders assisting us in the design of this syllabus.

Board of Studies in Artificial Intelligence and Data Science are,

Sr. No.	Name	Designation	Sr. No.	Name	Designation
1	Dr. Milind U. Nemade	Head of the Department concerned (Chairman)	11	Prof. Vidya Sagvekar	Member
2	Dr. Michel Mistry	Experts from outside parent university nominated by Academic council	12	Prof. Sejal Shah	Member
3	Dr. Sanjay Shitole		13	Prof. G. R. Phadke	Member
4	Dr. Madhav Chandane	One expert to be nominated by the Vice-Chancellor	14	Prof. Sarika Mane	Member
5	Mr. Akhil Hada	One Representative from Industry /Corporate Sector/ Allied area relating to Placement	15	Prof. Sheetal Jagtap	Member
6	Dr. Vaishali Wadhe	Member	16	Prof. Devanand Bathe	Member
7	Prof. Pankaj Deshmukh	Member	17	Prof. Ganesh Wadmare	Member
8	Prof. Medha Asurlekar	Member	18	Dr. Hariram Chavan	Other Member
9	Dr. Sunita Patil	Other Member	19	Dr. Radhika Kotecha	Other member
10	Dr. Namrata Gharat	Other member			

SEMESTER-VII-B.TECH.(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

Semester- VII-Credit Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credit Assigned		Course Category
		(TH–P–TUT)	Total	(TH–P–TUT)	Total	
AIC701	Deep Learning	3–0–0	03	3–0–0	03	PC
AIC702	Natural Language Processing	3–0–0	03	3–0–0	03	PC
AIDLC703X	Department Level Elective-3	3–0–0	03	3–0–0	03	DLE
AIDLC704X	Department Level Elective-4	3–0–0	03	3–0–0	03	DLE
ILC705X	Institute Level Elective-1	3–0–0	03	3–0–0	03	ILE
AIL701	Deep Learning Lab	0–2–0	02	0–1–0	01	PC
AIL702	Natural Language Processing Lab	0–2–0	02	0–1–0	01	PC
AIDLL703X	Department Level Elective-3 Lab	0–2–0	02	0–1–0	01	DLE
AIPR75	Project Based Learning- Major Project Lab-A	0–6#–0	06*	0–3–0	03	PBL
INT-71	Internship-VI	--		---	---	INT
Total		**15-12-0**	**27**	**15-6-0**	**21**	

Major Project A and B:

- Students can form groups with minimum 2 (Two) and not more than 3 (Three)
- Faculty Load: In Semester VII – ½ hour per week per project group
  In Semester VIII – 1 hour per week per project group

EXAMINATION SCHEME

Course Code	Course Name	Marks										
		CA				ESE	Duration in Hrs	TW	O	P	P&O	Total
		T-1	T-2	Avg. of T1 & T2	IA							
AIC701	Deep Learning	30	30	30	10	60	2.30	--	--	--	--	100
AIC702	Natural Language Processing	30	30	30	10	60	2.30	--	--	--	--	100
AIDLC703X	Department Level Elective-3	30	30	30	10	60	2.30	--	--	--	--	100
AIDLC704X	Department Level Elective-4	30	30	30	10	60	2.30	--	--	--	--	100
ILC705X	Institute Level Elective-1	30	30	30	10	60	2.30	--	--	--	--	100
AIL701	Deep Learning Lab	--	--	--	--	--	--	25	--	--	25	50
AIL702	Natural Language Processing Lab	--	--	--	--	--	--	25	--	--	25	50
AIDLL703X	Department Level Elective-3 Lab	--	--	--	--	--	--	25	25	--	--	50
AIPR75	Project Based Learning- Major Project Lab-A	--	--	--	--	--	--	25	--	--	50	75
INT-71	Internship-VI	--	--	--	--	--	--	--	--	--	--	--
Total		**150**	**150**	**150**	**50**	**300**	--	**100**	**25**	**--**	**100**	**725**

Major Project A and B:

- Students can form groups with minimum 2 (Two) and not more than 3 (Three)
- Faculty Load: In Semester VII – ½ hour per week per project group
  In Semester VIII –1 hour per week per project group

Abbreviations: TH – Theory, P – Practical, TUT – Tutorial, PC – Professional Core Course, PE-DLC – Professional Elective - Department Level Elective Course, OE-ILC – Open Elective - Institute Level Elective Course, PBL – Project-Based Learning, CA – Continuous Assessment, T1 – Test 1, T2 – Test 2, IA – Internal Assessment, ESE – End Semester Exam, TW – Term Work, O – Oral Exam, P – Practical Exam, P&O – Practical & Oral Exam, Professional

Electives - Department Level Elective Courses & Labs (PE-DLC -3 & PE-DLC-4)

Department Level Elective-3			
Group A: Computer Networks and Programming	**Group B: Applied Artificial Intelligence**	**Group C: Embedded System, Analytics and System Security**	**Group D: Bioinformatics**
AIDLC7031	AIDLC7032	AIDLC7033	AIDLC7034
Speech Processing	Internet of Everything	Cryptography and Network Security	Biostatistics

Department Level Elective-4			
Group A: Computer Networks and Programming	**Group B: Applied Artificial Intelligence**	**Group C: Embedded System, Analytics and System Security**	**Group D: Bioinformatics**
AIDLC7041	AIDLC7042	AIDLC7043	AIDLC7044
Business Intelligence	AI in Healthcare	Digital Forensics	Genetic Engineering and Genomics
Open Electives-Institute Level Courses (OE-ILC-1)			
ILC7051	**ILC7052**	**ILC7053**	**ILC7054**
Product Life Cycle Management	Reliability Engineering	Management Information System	Design of Experiments
ILC7055	**ILC7056**	**ILC7057**	**ILC7058**
Operations Research	Cyber Security and Laws	Disaster Management and Mitigation Measures	Energy Audit and Management
ILC7059			
Development Engineering			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIC701	Deep Learning	03	-	-	03

Prerequisite:	Basic mathematics and Statistical concepts, Linear algebra, Machine Learning.
Course Objectives: (COBs):	1. To learn the fundamentals of Neural Network and Deep Networks. 2. To gain an in-depth understanding of training Deep Neural Networks. 3. To acquire knowledge of advanced concepts of Convolution Neural Networks, Auto encoders and Recurrent Neural Networks. 4. To know application and recent trends in Deep Learning.
Course Outcomes: (COs):	1. Gain basic knowledge of Neural Networks and Deep Networks. 2. Acquire in depth understanding of training Deep Neural Networks. 3. Design appropriate DNN model for unsupervised learning application-autoencoders. 4. Design appropriate DNN model for supervised learning application-CNN. 5. Design appropriate DNN model for supervised learning application-RNN. 6. Gain familiarity with recent trends and applications of Deep Learning.

Module No. & Name	Subtopics	COs Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction: Deep Network fundamentals	1.1 Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes	CO1	02	04
	1.2 Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning		02	
2. Training, Optimization and Regularization of Deep Neural Network	2.1 Training Feedforward DNN Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function	CO2	03	09
	2.2 Optimization Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp		03	
	2.3 Regularization Overview of Overfitting, Types of biases, Bias Variance Tradeoff Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output		03	
3.Autoencoders: Unsupervised	3.1 Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders,	CO3	03	07

Learning	Regularization in Autoencoders			
	3.2 Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders.		03	
	3.3 Application of Autoencoders: Image Compression		01	
4.Convolutional Neural Networks (CNN): Supervised Learning	4.1 Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function.	CO4	04	07
	4.2 Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture.		03	
5. Recurrent Neural Networks (RNN): Supervised Learning	5.1 Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT.	CO5	05	08
	5.2 Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit		03	
6. Recent Trends and Applications	6.1 Generative Adversarial Network: GAN Architecture.	CO6	02	04
	6.2 Applications: Image Generation, Deep Fake		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	--	01	01
			Total hours	42

Books:	
Text Books:	1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. “Deep Learning”, MIT Press Ltd, 2016. 2. Li Deng and Dong Yu, “Deep Learning Methods and Applications”, Now publishers Inc (30 June 2014). 3. Buduma, N. and Locascio, N., “Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc.". 4. JM Zurada “Introduction to Artificial Neural Systems”, Jaico Publishing House 5. M. J. Kochenderfer, Tim A. Wheeler. “Algorithms for Optimization”, MIt Press.
Reference Books:	1. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill. 2. François Chollet. “Deep learning with Python “(Vol. 361). 2018 New York: Manning. 3. Douwe Osinga. “Deep Learning Cookbook”, O’REILLY, SPD Publishers, Delhi. 4. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc 5. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.
Useful Links:	https://nptel.ac. https://deeplearning.cs.cmu.edu/S21/index.html
	http://www.cse.iitm.ac.in/~miteshk/CS6910.html
	https://nptel.ac.in/courses/106/106/106106184/
	https://www.deeplearningbook.org/
	http://introtodeeplearning.com/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz /

	assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIC702	Natural Language Processing	03	--	--	03

Prerequisite:	1. Data structures & Algorithms 2. Project Probability Theory
Course Objectives (COBs):	1. To understand natural language processing and apply basic algorithms in this field. 2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics. 3. To design and implement various language Models and applications of NLP techniques in real life applications
Course Outcomes (COs):	1. Explain about the basics of natural language processing. 2. Explore capabilities and limitations of current natural language technologies 3. Build model linguistic phenomena with formal grammars. 4. Apply algorithms for NLP based pragmatics problems 5. Analyze mathematical and linguistic foundations underlying approaches to the various areas in NLP. 6. Apply NLP techniques to design real world NLP applications.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Natural Language Processing	1.1 Introduction to data and its significance in NLP. History of NLP, levels of NLP. Natural language vs. programming language	CO1	01	03
	1.2 Knowledge in language processing, 03 Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP		02	
2. Word Level Analysis	2.1 Morphology analysis survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, finite automata	CO2	04	08
	2.2 Finite state transducers (FST), Morphological parsing with FST, Lexicon free FST Porter stemmer. N Grams Ngram language model, N-gram for spelling correction		04	
3. Syntax analysis	3.1 Part-Of-Speech tagging (POS) Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues Multiple tags & words, Unknown words. Introduction to CFG, Types of Passing	CO3	05	08
	3.2 Sequence labelling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).		03	
4. Semantic Analysis	4.1 Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their sense	CO4	06	08
	4.2 Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD), Dictionary based approach, Information extracting and		02	

	Extracting relationships/relations, Latent semantic analysis			
5. Pragmatics	Discourse reference resolution, reference phenomenon , syntactic & semantic constraints on co reference	CO5	06	06
6. Applications of NLP	Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition, Language skill: formally a dialog system or dialog engine, Topic Modeling	CO6	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization	--	01	01
			Total hours	42

Books:	
Text Books	1. Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008. 2. 2. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999 3. Steven Bird, Ewan Klein, "Natural Language Processing with Python", O'Reilly, ISBN-13 978-0596516499, 2009
Reference Books	1. Siddiqui and Tiwary U.S., "Natural Language Processing and Information Retrieval", Oxford University Press (2008). 2. Daniel M Bikel and Inned Zitouni, "Multilingual Natural Language Processing Applications", Pearson, 2013. 3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin Editor) The Handbook of Computational Linguistics and Natural Language Processing. 4. Nie1 J le Roux, Sugnet Lubbe, A step by step Tutorial: An introduction into R application and programming.
Useful Links:	1. https://wordnetweb.princeton.edu/perl/webwn
	2. https://onlinecourses.nptel.ac.in/noc21_cs102/preview
	3. Kaggle Databases
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7031	Speech Processing	03	--	--	03

Prerequisite:	1. Applications of Mathematics in Engineering-I,II
Course Objectives (COBs):	1. To teach Fundamentals of Digital Speech Processing. 2. To introduce Digital Models for The Speech Signal. 3. To teach Speech Analysis in time and frequency domain. 4. To introduce Homomorphic Speech processing, Pattern Recognition 5. To explore Methods and Application of audio Signal Processing.
Course Outcomes (COs):	1. Demonstrate Fundamentals of Digital Speech Processing. 2. Describe Digital Models for the Speech Signal. 3. Describe Speech Analysis in time and frequency domain. 4. Explain Homomorphic Speech Processing. 5. Demonstrate Pattern Recognition Methods. 6. Demonstrate Application of Audio Recognition.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Fundamentals of Digital Speech Processing	1.1 Discrete Time Signal and Systems,	CO1	04	06
	1.2 Transform Representation of Signals and Systems- The z-Transform, Discrete time Fourier Transform and The Discrete Fourier Transform, Fast Fourier Transform			
	1.3 Fundamentals of Digital Filters FIR Systems, IIR System		02	
	1.4 Sampling– The sampling Theorem, Decimation and Interpolation of Sampled Waveforms			
2. Digital Models for the Speech Signal	2.1 The Process of Speech Production– The Mechanism of Speech Production, Acoustic Phonetics	CO2	04	08
	2.2 The Acoustic Theory of Speech Production– Sound Propagation, Example: Uniform Lossless Tube, Effect of Losses in the Vocal Tract, Effects of Radiation at the Lips		02	
	2.3 Digital Models for Speech Signals Vocal Tract, Radiation, Excitation, The Complete Model		02	
3. Time Domain and Frequency Domain Analysis of Speech	3.1 Time energy, average magnitude, and zero-crossing rate, speech vs silence discriminations	CO3	05	10
	3.2 Short-time autocorrelation, pitch period estimation using short-time autocorrelation, median smoothing			
	3.3 Time dependent Fourier representation for voiced and unvoiced speech signals, linear filtering interpretation, spectrographic displays		03	
	3.4 Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using		02	

	log spectrum			
4.Homomorphic Speech Processing	4.1 Cepstral analysis of speech, Mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP)	CO4	03	05
	4.2 Pitch period estimation in cepstral domain, evaluation of formants using cepstrum		02	
5. Automatic Speech Recognition	5.1 Introduction to Statistical Speech Recognition, HMMs for Acoustic Modelling, HMMs and WFSTs, WFSTs for ASR	CO5	04	08
	5.2 Neural Network based acoustic modelling (Hybrid/Tandem/TDNN models),Intro to RNN-based models and Language modelling, RNN-based language models		02	
	5.3 Speech Synthesis, Convolutional Neural Networks in Speech		02	
6. Audio Processing Applications	6.1 Applications: Music Applications, Text to Speech, Speech/Music Discrimination	CO6	02	02
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	----	01	01
			Total hours	42

Books:	
Text Books	1. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education, Delhi, 2004. 2. Shaila D. Apte, "Speech and Audio Processing", Wiley India, New Delhi, 2012. 3. Ben Gold and Nelson Morgan, ―Speech and Audio Signal Processing‖, Wiley India (P) Ltd, New Delhi, 2006. 4. Thomas F. Quatieri,"Discrete-Time Speech Signal Processing: Principles and Practice‖, Prentice Hall, 2001
Reference Books	1. Douglas O'Shaughnessy, "Speech Communications: Human & Machine", Universities Press, Hyderabad, Second Edition, 2001. 2. Eduardo R. Caianiello, "Speech Processing, Recognition and Artificial Neural Networks", Proceedings of 3rd International School on Neural Nets. 3. Jouni Pohjalainen, Espoo, "Methods of Audio Content Classification, Thesis submitted November 2007. 4. J. L. Flanagan, "Speech Analysis Synthesis and Perception", Second edition, Springer Verlag (1972). 5. M. Muller, D. P. W. Ellis, A. Klapuri and G. Richard, "Signal Processing for Music Analysis," IEEE Journal of Selected Topics in Signal Processing, vol. 5, no. 6, pp. 1088-1110, Oct. 2011, doi: 10.1109/JSTSP.2011.2112333. 6. Anssi Klapuri, Manuel Davy, "Signal Processing Methods for Music Transcription", 2006, ISBN: 978-0-387-30667-4.
Useful Links:	1. https://onlinecourses.nptel.ac.in/noc22_ee117/preview
	2. https://www.youtube.com/watch?v=M4GRBJJMecY
	3. https://www.cse.iitb.ac.in/~pjyothi/cs753/index.html
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2 : 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes.

	• Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7032	Internet of Everything	03	--	--	03

Prerequisite:	1. Internet of Things 2. Computer Networks
Course Objectives (COBs):	**The objectives of this course are to:** 1. Understand the concepts of Industry 4.0 and basics of Industrial IoT. 2. Apply sensing, actuation, communication and networking in Industrial IoT. 3. Understand the need of security, analytics for Industrial IoT. 4. Demonstrate the Industrial IoT-for various application domains.
Course Outcomes (COs):	**On successful completion of the course the students will be able to:** 1. Understand the concepts of Industry 4.0 and Industrial IoT. 2. Implement sensing, actuation, communication and networking for Industrial IoT. 3. Implement analytics for Industrial IoT. 4. Understand the need of security for Industrial IoT. 5. Demonstrate Industrial IoT for manufacturing and oil & gas industry. 6. Demonstrate Industrial IoT for transportation and smart & connected cities.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. In Industry 4.0 and Industrial IoT	1.1 Industry 4.0: Basics – Globalization, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Impacts of Industry 4.0	CO1	04	08
	1.2 Industrial IoT: Basics- IIoT and Industry 4.0, IIC, Industrial Internet systems, Industrial Processes		04	
2. Sensing & actuation, Communication and Networking	2.1 IIoT- Industrial Sensing, Snsors and actuators Next generation sensors	CO3	03	08
	2.2 IIoT- Processing		02	
	2.3 IIoT- Communication and Networking.		03	
3. Analytics	3.1 Introduction to data analytics for IoT,	CO4	06	06
	3.2 Edge streaming analytics, Network Analytics, Data Visualization Techniques			
4. Security	4.1 Need of IIoT Security, Basic Security Goals, IT and OT Security Requirement, IIoT Security Risk Management, IIoT Attack Surface, Security Framework for IIoT, Standards Related to IIoT Security.	CO5	05	05
5. Application Domains-I	5.1 Manufacturing: Connected Manufacturing, Architecture for Connected Factory, Industrial Automation Control Protocols, Connected Factory Security, Edge Computing in connected factory	CO5	06	06
	5.2 Oil and Gas: Introduction, Key Challenges, IoT architecture for Oil and Gas, Improving operational efficiency.			

6.Application Domains-II	6.1 Smart and Connected Cities: An IoT strategy for smart cities, Smart City IoT architecture, Smart City Security Architecture, Smart City- Use cases. 6.2 Transportation: Introduction, Transportation Challenges, An IoT architecture for transportation, IoT use cases for transportation.	CO5	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1.Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", ISBN 9780367897581,Published December 15, 2020 by CRC Press 2. David Hanes, et.al., "IoT Fundamentals- Networking Tehnologies, Protocols, and Use cases for the Internet of Things"			
Reference Books	1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", (Apress) 2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat "Industrial Internet of Things: Cyber manufacturing Systems", (Springer)			
Useful Links:	https://onlinecourses.nptel.ac.in/noc20_cs69			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7033	Cryptography and Network Security	03	--	--	03

Prerequisite:	Computer Networks
Course Objectives (COBs):	**Students will try to learn:** 1. To introduce classical encryption techniques and concepts of modular arithmetic and number theory. 2. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms. 3. To explore the design issues and working principles of various authentication protocols, PKI standards. 4. To explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email. 5. To use existing cryptographic utilities to build programs for secure communication. 6. To use the concepts of cryptographic utilities and authentication mechanisms to design secure applications.
Course Outcomes(COs):	**Students will be able to:** 1. Define system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory. 2. Explain, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication. 3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes. 4. Apply different digital signature algorithms to achieve authentication and create secure applications. 5. Apply network security basics, analyse different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP. 6. Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Number Theory and Basic Cryptography	1.1 Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's theorem	CO1	03	07
	1.2 Classical Encryption techniques, Symmetric cipher model, mono alphabetic and polyalphabetic substitution techniques: Vigenere cipher, play fair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers		04	
2. Block Ciphers &	2.1 Data Encryption Standard-Block cipher	CO2	04	08

Public Key Cryptography	principles-block cipher modes of operation, Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm			
	Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm		03	
	2.3 Key management Diffie Hellman Key exchange		01	
3. Cryptographic Hashes, Message Digests and Digital Certificate	3.1 Authentication requirement, Authentication function , Types of Authentication	CO3	02	08
	3.2 MAC: Hash function, Security of hash function and MAC-MD5-SHA-HMAC-CMAC		04	
	3.3 Digital Certificate: X.509, PKI		02	
4. Digital signature schemes and Authentication Protocol	4.1 Digital signature and authentication protocols : Needham Schroeder Authentication protocol	CO4	02	05
	4.2 Digital Signature Schemes – RSA, EI Gamal and Schnorr, DSS.		03	
5. Network Security	5.1Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP SYN flood, DNS Spoofing	CO5	02	07
	5.2 Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood		02	
	5.3 Distributed Denial of Service, Defenses against Denial of Service Attacks		01	
	5.4 Firewalls, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots.		02	
6. Network Security Applications	6.1 Authentication Applications, Kerberos, Internet Security Protocols: SSL, TLS	CO6	02	04
	6.2 IPSEC: AH, ESP, Secure Email: PGP and S/MIME, Key Management.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. Mark Stamp's Information Security Principles and Practice, Deven Shah,Wiley. 2. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013. 3. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill. 4. Bernard Menezes, "Cryptography & Network Security", Cengage Learning.
Reference Books	1. Bruce Schneier, Applied Cryptography, Protocols Algorithms and Source Code in C, Wiley. 2. Atul Kahate, Cryptography and Network Security, Tata Mc Graw Hill. 3. Dr. V. K. Pachghare, Cryptography and Information Security.
Useful Links:	1. Cryptography And Network Security - Course (nptel.ac.in)
	2. Cryptography I | Coursera
	3. Free Cryptography Tutorial - Introduction to Information Security | Udemy
Continuous Assessment	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2 : 30 Marks (where each Test shall be of 30 Marks),

(CA):	• Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7034	Biostatistics	03	--	--	03

Prerequisite:	1. Applications of Mathematics in Engineering-I and II
Course Objectives (COBs):	1. To cover basic concepts and theory related to statistics and its applications in healthcare. 2. To focus on various statistical abilities for healthcare such as analysis of variance, hypothesis testing, estimation, etc.
Course Outcomes (COs):	1. Explain concepts of Biostatistics, Descriptive statistics and basic probability concepts. 2. Apply Probability Distributions, Sampling Distribution and measure of location to solve healthcare problems. 3. Estimate t distribution, chi-square distribution, and F distribution. 4. Describe a null and alternative hypothesis and carry out a structured hypothesis test. 5. Analyse variance using regression and correlation. 6. Apply mathematical properties of chi-square distribution and use the chi-square distribution for goodness-of-fit tests.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Biostatistics	1.1 Sources and types of Data, collection of medical data, Presentation and Illustration of quantitative and qualitative data	CO1	02	04
	1.1 Basic concepts, Measurement and measurement scales, Sampling and Statistical Inference		01	
	1.2 Descriptive statistics: Measures of central tendency, Measures of dispersion		01	
2. Probability Distributions, Sampling Distribution and Measure of location	2.1 Introduction to Probability Distributions and its medical applications, Binomial distributions, Poisson distributions, Normal distributions	CO2	02	07
	2.2 Sampling distributions – sample mean, difference between two sample means, sample proportions, difference between two sample proportions		02	
	2.3 Measure of location-Percentiles, Types of variability, Measures of variability		03	
3. Estimation	3.1 Confidence intervals for a population mean, The 't' distribution, Confidence intervals for difference between two population means, population proportion, difference between two population proportions	CO3	04	07
	3.2 Variance of normally distributed population, ratio of variances of two normally distributed populations, Determination of sample size for estimating means and proportions		03	

4. Hypothesis Testing	4.1 Hypothesis testing for – A single population means, proportion and variance, difference between two population means, proportion and variance, Parametric and Nonparametric testing	CO4	03	06
	4.2 Type – I and II error and power of test		03	
5. Analysis of variance	5.1 Completely randomized design, Randomized complete block design, Repeated measures design, Factorial experiment	CO5	03	08
	5.2 Simple Linear Regression and Correlation: The regression model, Sample regression equation, correlation model, correlation coefficient		02	
	5.3 Multiple Regression and Correlation Multiple Linear regression model, Obtaining and Evaluating multiple Regression Equation, Multiple correlation model		03	
6. Chi square Distribution, analysis of frequency and introduction to AI vital statistics	6.1 Mathematical properties of the chi-square distribution and its application in healthcare , Test of Goodness of fit, independence and Homogeneity	CO6	03	07
	6.2 Definition of vital statistics, scope and objective, methods, case study of Civil Registration System in India		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. Wayne W. Daniel, "Biostatistics-A foundation for analysis in health sciences", Seventh edition, Wiley India 2. Bratati Banerjee, "Mahajan's Methods in Biostatistics for Medical Students and Research Workers", The Health Sciences Publisher New Delhi, 9th Edition. 3. Sunder Rao and J. Richard, "An Introduction to Biostatistics", Third Edition, Prentice Hall of India. 4. Usman Zafar Paracha, "Basic Biostatistics with Basic Steps in Python" Kindle Edition, Amazon Asia-Pacific Holdings Private Limited. 5. J. Ravichandran, "Probability and statistics for engineers", Wiley /India.
Reference Books	1. Biostatistics – How it works by Steve selvin, Pearson education 2. B.L.Agarwal, "Basic statistics", New Age International Publisher 3. Probability and Statistics by Schaum's series. 4. S. C. Gupta and V. K. Kapoor, "Fundamentals of mathematical statistics", Second edition, Sultan Chand Publisher
Useful Links:	1. https://nptel.ac.in/courses/102106051 2. https://www.udemy.com/course/statistics-for-ai-ml-developers/ 3. https://www.coursera.org/specializations/data-science-statistics-machine-learning
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2 : 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz /

	assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours 30 Minutes

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7041	Business Intelligence	03	--	--	03

Prerequisite:	1. Basic knowledge of database concepts and SQL. 2. Understanding of data warehousing. 3. Familiarity with programming. 4. Basic knowledge of statistics. 5. Familiarity with Excel. 6. Knowledge of business operations.
Course Objectives (COBs):	1. Understanding of database design, data modeling, and Structured Query Language (SQL) is essential to grasp the concepts of Business Intelligence. 2. Knowledge of data warehousing concepts such as data extraction, transformation, and loading (ETL) is required to understand how data is processed in Business Intelligence systems. 3. Knowledge of at least one programming language is essential to understand the logic behind building Business Intelligence applications and creating reports. 4. Understanding of basic statistics concepts such as mean, median, mode, standard deviation, correlation, and regression is helpful in analyzing and interpreting data in Business Intelligence. 5. A basic understanding of Microsoft Excel and its features, such as pivot tables, charts, and formulas, is helpful in creating and analyzing data in Business Intelligence. 6. An understanding of business operations and processes is necessary to understand the requirements and goals of Business Intelligence solutions and how they can improve business performance.
Course Outcomes (COs):	After successful completion of course student will be able to: 1. Explain the scope of BI solutions and their architecture. 2. Develop BI solutions including reports, ad hoc queries, dashboards, and scorecards. 3. Plan and manage BI projects, collect user requirements, and validate BI requirements. 4. Create different types of reports and perform data grouping, filtering, and sorting. 5. Deploy, administer, and secure BI solutions, including system sizing, authentication, and authorization. 6. Explain the importance of data quality and be able to perform data cleansing and profiling.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Business Intelligence	1.1 Understanding the scope of today's BI solutions and how they fit into existing infrastructure Assessing new options such as SaaS and cloud-based technology.	CO1	02	08
	1.2 Describing BI, its components and architecture, and previewing the future of BI.		02	

	1.3 Crafting a better experience for all business users, End User Assumptions Setting up Data for BI		02	
	1.4 The Functional Area of BI Tools		02	
2. Elements of Business Intelligence Solutions	2.1 Reports and ad hoc queries Analyzing OLAP data	CO2	03	07
	2.2 Developing Dashboards and Scorecards Metadata Models		02	
	2.3 Automating tasks and events Real-time monitoring capabilities		02	
3: Planning and Building the BI Project	3.1 Planning the BI project Identifying Project Resources Defining Project Tasks	CO3	02	06
	3.2 Risk Management and Mitigation Cost-justifying BI solutions and measuring success Collecting User Requirements Prioritizing and Validating BI Requirements.		02	
	3.3 Best Practices for BI Design Post-Implementation Evaluations.		02	
4. Reporting Authoring	Types of Reports: List, Crosstabs, Statistics, Chart, Map, Financial, etc.	CO4	02	06
	Adding Calculations to Reports Adding Summary Lines to Reports Drill up, Drill down, Drill-through capabilities Running or scheduling reports		02	
	Exporting Reports to different output forms such as PDF, Excel, CSV, and XML.		02	
5. BI Deployment, Administration, and Security	Centralized Versus Decentralized Architecture BI Architecture Alternatives.	CO5	02	06
	Expanding BI Authentication Authorization Access Permissions, Groups, and Roles Single-sign-on Server Administration.		02	
	Manage Status and Monitoring Audit, Mail Server, and Portal Integration.		02	
6. Advanced Topics in Business Intelligence	Real-time Analytics Social Media Analytics.	CO6	02	06
	Artificial Intelligence and Business Intelligence Integration.		02	
	Ethics and Governance in Business Intelligence.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1. Rick Sherman, "Business Intelligence Guidebook: From Data Integration to Analytics" 2. Ramesh Sharda, Dursun Delen, "Business Intelligence: A Managerial Perspective on Analytics" 3. Wilfried Grossmann, Stefanie Rinderle-Ma, "Fundamentals of Business Intelligence"			

Reference Books	1.Swain Scheps and Alan R. Simon, "Business Intelligence for Dummies" 2. Paulraj Ponniah, "Data Warehousing Fundamentals for IT Professionals"
Useful Links:	https://en.wikipedia.org/wiki/Business_intelligence.
	https://www.webopedia.com/TERM/B/Business_Intelligence.html.
	https://www.cio.com/article/40296/Business_Intelligence_Definition_and_Solutions.
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7042	AI in Healthcare	03	--	--	03

Prerequisite:	1. Artificial Intelligence. 2. Internet of Things
Course Objectives (COBs):	1. To understand the need and significance of AI for Healthcare. 2. To study advanced AI algorithms for Healthcare. 3. To learn Computational Intelligence techniques. 4. To understand evaluation metrics and ethics in intelligence for Healthcare systems.
Course Outcomes (COs):	**After the successful completion of this course, learner will be able to:** 1. Explain the role of AI for handling Healthcare data. 2. Apply AI algorithms for Healthcare Problems. 3. Apply various Computational Intelligence techniques for Healthcare Application. 4. Evaluate metrics of healthcare systems. 5. Explain various NLP Techniques in healthcare 6. Design real time Healthcare Applications

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction	1.1 Overview of AI and ML,A Multifaceted Discipline, Applications of AI in Healthcare - Prediction, Diagnosis, personalized treatment and behaviour modification, drug discovery, follow-up care etc,	CO1	03	06
	1.2 Realizing potential of AI and ML in healthcare, Healthcare Data - Use Cases.		03	
2. AI, ML, Deep Learning and Data Mining Methods for Healthcare	2.1 Knowledge discovery and Data Mining, ML, Multi classifier Decision Fusion, Ensemble Learning, Meta-Learning and other Abstract Methods.	CO2	02	07
	2.2 Computational Intelligence Techniques, Unsupervised learning, dimensionality reduction algorithms		02	
	2.3 Deep Learning CNN,DBN		03	
3. Evaluating learning for Intelligence	3.1 Model development and workflow, evaluation metrics, Parameters and Hyper parameters,	CO3	03	07
	3.2 Hyper parameter tuning algorithms, multivariate testing, Ethics of Intelligence.		04	
4. Natural Language Processing in Healthcare	4.1 NLP tasks in Medicine, Low-level NLP components, High level NLP components, NLP Methods.	CO4	03	06
	4.2 Clinical NLP resources and Tools, NLP Applications in Healthcare. Model Interpretability using Explainable AI for NLP applications.	CO4	03	
5. Intelligent personal Health Record	5.1 Introduction, Guided Search for Disease Information, Recommending SCA's.	CO5	03	06
	5.2 Recommending HHP's, Continuous User Monitoring.		03	

6. Future of Healthcare using AI	6.1 Evidence based medicine, Personalized Medicine, Connected Medicine, Digital Health and Therapeutics, Conversational AI, Virtual and Augmented Reality,	CO6	04	07
	6.2 Block chain for verifying supply chain, patient record access, Robot - Assisted Surgery, Smart Hospitals, and Case Studies on use of AI and ML for Disease Risk Diagnosis from patient data, Augmented reality applications for Junior doctors.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. Bose, T.K and S.K. Mitra. (1990). Fruits, Tropical and Subtropical. Naya Prakash, 206 Bidthan saran, Calcutta. 2. Nature and Properties of Soils, The Hardcover – Import, 1 March 2016 Publishing House Pvt Ltd, New Delhi. 3. Das, P.C. (2012). Vegetable Crops of India. Kalayani Publishers, New Delhi. 4.Bosoi, E.S. (2018). Theory, Construction and Calculation of Agricultural Machines (Vol. 1 and 2). Oxonion Press Pvt. Ltd., New Delhi. 5. Donnel Hunt. Farm Machinery and management. Iowa State University Press, Ames, USA.
Reference Books	1. De, G.C. (1989). Fundamentals of Agronomy. Oxford & IBH Publishing Co Pvt Ltd, New Delhi. 2. Russel. Soil Condition and Plant Growth. ELBS, Longmans, U.K. 3.Review of agricultural IoT technology Jinyuan Xu a , Baoxing Gu a , Guangzhao Tian a,b**,**
Useful Links:	1. https://www.sciencedirect.com/journal/artificial-intelligence-in-agriculture 2. https://onlinecourses.nptel.ac.in/noc22_bt57/preview:-Biotechnology
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7043	Digital Forensics	03	--	--	03

Prerequisite:	Computer Network, Cryptography and System Security
Course Objectives (COBs):	1.To discuss the need and process of digital forensics and Incident Response Methodology. 2. To explore the procedures for identification, preservation, and acquisition of digital evidence. 3.To explore techniques and tools used in digital forensics for Operating system and malware investigation. 4.To explore techniques and tools used for Mobile forensics and browser, email forensics.
Course Outcomes (COs):	1. Describe the phases of Digital Forensics and methodology to handle the computer security incident. 2. Describe the process of collection, analysis and recovery of the digital evidence. 3. Explore various tools to analyze malwares and acquired images of RAM/hard drive. 4. Acquire adequate perspectives of digital forensic investigation in mobile devices 5. Analyze the source and content authentication of emails and browsers. 6. Write unambiguous investigation reports which offer valid conclusions.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Digital Forensics	1.1 Digital Forensics Defination, Digital Forensics Goals, Digital Forensics Categories - Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics	CO1	03	06
	1.2 Introduction to Incident - Computer Security Incident, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident		03	
2. Digital Evidence, Forensics Duplication and Digital Evidence Acquisition	2.1 Digital evidence, Types of Digital Evidence, Challenges in acquiring Digital evidence, Admissibility of evidence, Challenges in evidence handling, Chain of Custody	CO2	03	09
	2.2 Digital Forensics Examination Process - Seizure, Acquisition, Analysis, Reporting. Necessity of forensic duplication, Forensic image formats, Forensic duplication techniques,.		03	
	2.3 Acquiring Digital Evidence - Forensic Image File Format, Acquiring Volatile Memory (Live Acquisition), Acquiring Nonvolatile Memory (Static Acquisition), Hard Drive Imaging Risks and Challenges, Network Acquisition		03	
3. Forensics Investigation	3.1 Analyzing Hard Drive Forensic Images, Analyzing RAM Forensic Image, Investigating Routers	CO3	02	04
	3.2 Malware Analysis - Malware, Viruses, Worms,		02	

	Essential skills and tools for Malware Analysis, List of Malware Analysis Tools and Techniques			
4.Windows and Unix Forensics Investigation	4.1 Investigating Windows Systems - File Recovery, Windows Recycle Bin Forensics, Data Carving, Windows Registry Analysis, USB Device Forensics, File Format Identification, Windows Features Forensics Analysis, Windows 10 Forensics, Cortana Forensics	CO4	04	08
	4.2 Investigating Unix Systems - Reviewing Pertinent Logs, Performing Keyword Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships		04	
5.Mobile Forensics	5.1 Android Forensics, Mobile Device Forensic Investigation - Storage location, Acquisition methods, Data Analysis	CO5	02	08
	5.2 GPS forensics - GPS Evidentiary data, GPS Exchange Format (GPX), GPX Files, Extraction of Waypoints and Track Points, Display the Tracks on a Map.		02	
	5.3 SIM Cards Forensics - The Subscriber Identification Module (SIM), SIM Architecture, Security, Evidence Extraction.		02	
6.Browser, Email Forensic & Forensic Investigation Reporting	6.1 Web Browser Forensics, Google chrome, Other web browser investigation Email forensics - Sender Policy Framework (SPF), Domain Key Identified Mail (DKIM), Domain based Message Authentication Reporting and Confirmation (DMARC)	CO6	02	04
	6.2 Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1 Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGrawHill, 2006. 2 Digital Forensics Basics A Practical Guide Using Windows OS — Nihad A. Hassan, APress Publication, 2019. 3 Xiaodong Lin, "Introductory Computer Forensics: A Hands-on Practical Approach", Springer Nature, 2018.
Reference Books	1. M S Khan et al, Applied Molecular Biotechnology- next generation to Genetic Engineering, CRC Press, 2016. 2. Jane K Setlow, Genetic Engineering-Principles and methods, Volume 27, 2006, Springer. 3. Green M.R and Sambrook J. "Molecular Cloning", a Laboratory Manual, Cold Spring Harbor Laboratory Press, New York, USA. Fourth Edition (2012).
Suggested MOOC Course Links	Course on "Ethical Hacking" https://nptel.ac.in/courses/106/105/106105217/
	Course on "Digital Forensics" https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
	Course on Cyber Incident Response https://www.coursera.org/learn/incident-response
	Course on "Penetration Testing, Incident Responses and Forensics" https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics

Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIDLC7044	Genetic Engineering and Genomics	03	--	--	03

Prerequisite:	1. Molecular biology 2. Cellular biology
Course Objectives (COBs):	1. To gain an understanding of genetic engineering. 2. To gain an understanding of basic molecular biology concepts and techniques. 3. To know of gene expression and the process of development in eukaryotes. 4. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
Course Outcomes (COs):	After successful completion of course, students will be able to - 1. Explain the concepts of molecular biology. 2. Explain sequencing principles of DNA, RNA in human being, plants. 3. Describe DNA modification techniques. 4. Acquire knowledge on host cells and vectors. 5. Find proficiency in conducting experiments involving genetic manipulation. 6. Explain genome sequencing and genome mapping for gene prediction.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introducing molecular biology	1.1: Introduction-Genetic Engineering, flow of genetic information, The structure of DNA, RNA	CO1	02	07
	1.2: Gene organization, anatomy of gene, structure of gene in prokaryotes and eukaryotes		02	
	1.3: Gene expression from gene to proteins, regulation, transcription and translation, genes and genomes, size, complexity, organization.		03	
2. Working with nucleic acid	2.1: Handling and quantification of nucleic acid, isolation of DNA, RNA	CO2	02	07
	2.2: labeling nucleic acid, nucleic acid hybridization, gel electrophoresis		02	
	2.3: DNA sequencing principles, preparation of DNA fragments, sequencing types		03	
3. DNA modification	3.1: Restriction enzymes-cutting DNA, Type II restriction, restriction mapping	CO3	03	05
	3.2: DNA modifying enzymes, DNA ligase, joining DNA molecules.		02	
4. Host Cells and Vectors	4.1: host cell types, basic cloning plasmid,	CO4	02	06
	4.2: Bacteriophage vectors, hybrid/plasmid phase vectors		02	
	4.3: Artificial chromosomes, transformation and transfection of DNA into Cells, packaging phage DNA		02	
5. Cloning strategies	5.1: Cloning from mRNA, Cloning from genomic DNA	CO5	03	06
	5.2: Advanced cloning strategies, synthesis and cloning of cDNA		03	
6. Genomics	6.1: Introduction, Genome mapping, genome	CO6	03	08

	sequencing, Gene prediction and counting			
	6.2: Genome similarity, SNPs and comparative genomics,		03	
	6.3: Pharmacogenomics, functional genomics and microarrays, molecular phylogeny		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1. Desmond S T Nicholl, An Introduction to Genetic Engineering, Third Edition, Cambridge University Press, 2008 2. A. J. Nair PhD, Introduction to Biotechnology and Genetic Engineering, Infinity Science Press, 2007.			
Reference Books	1. M S Khan et al, Applied Molecular Biotechnology- next generation to Genetic Engineering, CRC Press, 2016 2. Jane K Setlow, Genetic Engineering-Principles and methods, Volume 27, 2006, Springer 3. Green M.R and Sambrook J. "Molecular Cloning", a Laboratory Manual, Cold Spring Harbor Laboratory Press, New York, USA. Fourth Edition (2012).			
Useful Links:	1. https://oyc.yale.edu/biomedical-engineering/beng-100/lecture-3			
	2. https://www.youtube.com/watch?v=Yh9w_fyvpUk			
	3. https://www.ebi.ac.uk/training/online/courses/functional-genomics-i-introduction-and-design/what-is-genomics/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (**ESE**):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7051	Product Life Cycle Management	03	--	--	03

Course Objectives (COBs):	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. 5. To familiarize the students with the need, benefits and components of PLM. 6. To acquaint students with Product Data Management & PLM strategies. 7. To give insights into new product development program and guidelines for designing and developing a product. 8. To familiarize the students with Virtual Product Development.
Course Outcomes (COs):	1. Apply the different phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation. (PO3) 2. Analysis various approaches and techniques for designing and developing products. (PO5) 3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc. (PO8) 4. Applying virtual product development tools for components, machining and manufacturing plant. (PO7) 5. Create an Integration of Environmental Aspects in Product Design (PO7) 6.Analysis the Life Cycle Assessment and Life Cycle Cost Analysis (PO11,12)

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Product Lifecycle Management (PLM)	1.1 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.	CO1	06	10
	1.2 PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.		04	
2. Product Design	2.1 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.	CO2	05	09
	2.2 Characteristic Features of Concurrent Engineering,		04	

	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			
3. Product Data Management (PDM)	3.1 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	CO3	05	05
4.Virtual Product Development Tools	4.1 For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques.	CO4	03	05
	4.2 Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies		02	
5. Integration of Environmental Aspects in Product Design	5.1 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	CO5	05	05
6. Life Cycle Assessment and Life Cycle Cost Analysis	6.1 Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment.	CO6	03	05
	6.2 Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. Saaksvuori, Antti, Immonen, Anselmi, "Product Lifecycle Management" ISBN 978-3-540-26906-9. 2. Product Lifecycle Management: 21st Century Paradigm for Product Realisation Decision engineering, ISSN 1619-5736,2005.
Reference Books	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, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314 4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking",TataMcGrawHill,2006,ISBN:0070636265.
Useful Links:	1. https://www.intechopen.com/books/product-lifecycle-management-terminology-and-applications/introductory-chapter-product-lifecycle-management-terminology
	2. https://www.spectechular.walkme.com/top-3-product-lifecycle-management-books/
	3. https://dasme.co/wp-content/uploads/2016/07/plm.pdf
	4.https://books.google.co.in/books/about/Product_Lifecycle_Management.html?id=PiVri4OyU7AC&redir_esc=y

Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2 : 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7052	Reliability Engineering	03	--	--	03

Course Objectives (COBs):	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.
Course Outcomes (COs):	1. 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. Apply the knowledge to improve reliability of complex system 5. Analysis the Maintainability and Availability of system 6. Identity a Failure Mode Effect and Criticality Analysis.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Probability theory	1.1 Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem	CO1	02	08
	1.2 Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.		03	
	1.3 Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.		03	
2. Reliability Concepts, Failure Data Analysis, Reliability Hazard Models	2.1 Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.	CO2	02	08
	2.2 Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.		03	
	2.3 Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.		03	
3. System Reliability	3.1 System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	CO3	05	05
4. Reliability Improvement	4.1 Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.	CO4	04	08
	4.2 System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.		04	
5.Maintainability and	5.1 System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault	CO5	03	05

Availability	Isolation and self-diagnostics. 5.2 Parts standardization and Interchange ability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.		 02	
6. Failure Mode, Effects and Criticality Analysis	6.1 Failure mode effects analysis, severity/criticality analysis, FMECA examples. 6.2 Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	CO6	03 02	05
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1. Lewis, "Introduction to Reliability Engineering", 2nd Edition Wiley India 2. Birolini A, "Reliability Engineering Theory and Practice" 8ed (Hb 2017), Springer. 3. Donald W. Benbow, Hugh W. Broome, "The Certified Reliability Engineer Handbook" New Age International (P) Ltd., Publishers			
Reference Books	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.			
Useful Links:	1. https://victorops.com/blog/the-comprehensive-site-reliability-engineering-sre-pdf			
	2. https://nptel.ac.in/courses/105/108/105108128/			
	3.https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_5_Lecture_3_final.pdf			
	4. https://documents.in/document/curso-nptel-reliability-engineering.html			
	5. https://www.coursera.org/learn/site-reliability-engineering-slos			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7053	Management Information System	03	--	--	03

Course Objectives (COBs):	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.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1.Describe how information system transforms business. 2.Identify the impact information systems have on an organization. 3.Describe IT infrastructures and its components and its current trends. 4.Explain the principal tools and technologies for accessing information from databases. 5.Apply to improve business performance and decision making. 6.Identify the types of systems used for enterprise wide knowledge management.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction to Information System	1.1 Computer Based Information Systems, Impact of IT on organizations.	CO1	02	04
	1.2 Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.		02	
2. Data and Knowledge Management	2.1 Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management.	CO2, CO3	04	07
	2.2 Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results.		03	
3.Ethical Issues and Privacy	3.1 Ethical issues and Privacy: Information Security.	CO3	03	07
	3.2 Threat to IS and Security Controls.		04	
4.Social Computing (SC)	4.1 Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing.	CO4	03	07
	4.2 Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.		04	
5.Computer Networks	5.1 Computer Networks Wired and Wireless technology.	CO5	03	06
	5.2 Pervasive computing, Cloud computing model.		03	
6.Project leadership and Ethics and Closing the projects	6.1 Information System within Organization: Transaction Processing Systems, Functional Area Information System.	CO6	04	08
	6.2 ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models. Managing without authority; Areas of further study.		04	
II. Course	Recap of Modules, Outcomes, Applications, and	---	01	01

Conclusion	Summarization.			
			Total hours	42
Books:				
Text Books	1. K. Rainer, Brad Prince, Management Information Systems, Wiley. 2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm10th Ed., Prentice Hall.			
Reference Books	1. S. Jawadekar's Management Information Systems: published by McGraw-Hill Education. 2. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall.			
Useful Links:	1.https://www.nptel.ac.in/			
	2.https://www.coursera.org/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7054	Design of Experiments	03	--	--	03

Course Objectives (COBs):	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
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action. 2. Analyze the different fitting regression models. 3. Apply the different two level factorial designs. 4. Distinguish the different fractional factorial methods. 5. Apply the methods taught to real life situations. 6. Plan, analyze, and interpret the results of experiments.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction	1.1 Strategy of Experimentation, Typical Applications of Experimental Design.	CO1	01	02
	1.2 Guidelines for Designing Experiments, Response Surface Methodology.		01	
2. Fitting Regression Models	2.1 Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression.	CO2	04	08
	2.2 Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.		04	
3. Two-Level Factorial Designs and Analysis	3.1 The 2^2 Design, The 2^3 Design, The General2k Design.	CO3	04	08
	3.2 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.		04	
4. Two-Level Fractional Factorial Designs and Analysis	4.1 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.	CO4	04	08
	4.2 Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.		04	
5. Conducting Tests	5.1 Introduction to Response Surface Methodology, The Method of Steepest Ascent.	CO5	04	08
	5.2 Analysis of a Second-Order Response Surface, Experimental Designs for Fitting Response Surfaces.		04	
6. Taguchi Approach	6.1 Crossed Array Designs and Signal-to-Noise Ratios.	CO6	03	05
	6.2 Analysis Methods, Robust design examples.		02	
II. Course	Recap of Modules, Outcomes, Applications, and	---	01	01

Conclusion	Summarization.			
			Total hours	42
Books:				
Text Books	1. R. Mayers, D. Montgomery and C. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, John Wiley & Sons, New York. 2. D. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, New York. 3. W. Dimond, Peactical Experiment Designs for Engineers and Scientists, John Wiley and Sons.			
Reference Books	1. G. Box, J Hunter and W. Hunter, Statics for Experimenters: Design, Innovation and Discovery, Wiley. 2. A. Dean, and D. Voss, Design and Analysis of Experiments, Springer. 3. P. Ross, Taguchi Technique for Quality Engineering, McGraw Hill. 4. M. Phadake, Quality Engineering using Robust Design, Prentice Hall.			
Useful Links:	1. https://nptel.ac.in/courses/110/105/110105087/			
	2.https://www.udemy.com/course/design-of-experiments-i/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7055	Operation Research	03	--	--	03

Course Objectives (COBs):	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
Course Outcomes (COs):	1. Define and formulate linear programming problems and solve them by applying appropriate techniques. 2 Determining the optimum solution for transportation and Assignment models. 3 Choose the appropriate queuing model for a given practical application and propose the best strategy and value of the given game model. 4. Use CPM and PERT techniques, to plan, schedule and control project activities. Determining the optimum sequence to process jobs. 5. Judge classical & probabilistic inventory models and simulate different real life probabilistic situation using Monte Carlo simulation technique. 6. Selecting the best strategy from various alternatives by applying various tools and methodology for decision-making.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	-	01	01
1.Linear Programming	1.1 Linear Programming: Problem formulation, Graphical Method and simplex method.	CO1	04	10
	1.2 Artificial Variable Simplex Techniques: Big-M Method and Two-Phase Method.		03	
	1.3 Advanced Topics in Linear Programming: Duality in Linear Programming and the Dual Simplex Method.		03	
2.Transportation models and Assignment models	2.1 Transportation Model: North-west corner method, Row Minima method, Column Minima method, Least – cost method, Vogel's Approximation method, Optimality by MODI method and Unbalanced Transportation Problem.	CO2	03	06
	2.2 Assignment Model: The Hungarian method for solution of Assignment problems, Unbalanced assignment problem and maximization problem.		03	
3.Queuing Model and Game Theory	3.1 Queuing Models: Introduction, Single-channel, Finite population model with Poisson Arrivals and Exponential Service Times (Limited Source Model).	CO3	03	06
	3.2 Game Theory, 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.		03	
4.Network analysis in	4.1 Project Management: Phases of project management, Network construction, Critical Path	CO4	04	07

project planning and Sequencing models	Method (CPM) and Process Evaluation & Review Techniques (PERT). (Exclude Cost analysis, crashing, resource scheduling and updating)			
	4.2 Sequencing Models: Processing n jobs through one machine, two machines and three machines, Processing n jobs through m machines.		03	
5.Inventory Control and Simulation	5.1 Inventory Models: Introduction, Inventory models with Deterministic demand (with and without shortages) and Inventory models with price breaks.	CO5	04	07
	5.2 Simulation: Definition, Types of Simulation Models, Monte Carlo Technique, Practical Problems, Applications in Queuing and Inventory problems.		03	
6.Decision Theory	Steps in Decision theory approach, Decision – Making Environments, Decision making under conditions of certainty and uncertainty, Decision making under conditions of Risk and Decision Trees.	CO6	04	04
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	–	01	01
			Total hours	42

Books:	
Reference Books	1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002. 2. avindran, 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. S. D. Sharma, Kedar Nath, Ram Nath “Operations Research” 5. Kanti Swarup, P. K. Gupta and Man Mohan, “Operations Research” Sultan Chand & Sons
Useful Links:	1. https://onlinecourses.nptel.ac.in/noc19_ma29/preview
	2. https://www.coursera.org/courses?query=operations%20research
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7056	Cyber Security and Laws	03	--	--	03

Course Objectives (COBs):	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.
Course Outcomes (COs):	Learner will be able to… 1. Explain the concept of cybercrime and its effect on outside world. 2. Classify and Examine the Cyber Offences and security implication. 3. Illustrate and identify the modus operandi followed in cyber-crimes. 4. Explain the aspects in Indian Cyber Laws. 5. Explain the penalties in cyber law. 6. Apply Information Security Standards compliance during software design and development.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. 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.	CO1	04	04
2. Cyber offenses & Cybercrime	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, 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	CO2	09	09
3. Tools and Methods Used in Cyberline	Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	CO3	06	06
4. 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	CO4	08	08

	Law			
5. Indian IT Act.	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	CO5	06	06
6. Information Security Standard compliances	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	CO6	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi 2. Suresh T. Vishwanathan; The Indian Cyber Law, Bharat Law House New Delhi 3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi. 4. Advocate Prashant Mali, "Cyber Law & Cyber Crimes", Snow White Publications, Mumbai
Reference Books	1.Nina Godbole, Information Systems Security, Wiley India, New Delhi 2.Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing. 3.William Stallings, Cryptography and Network Security, Pearson Publication 4.Websites for more information is available on: The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in 5.Website for more information, A Compliance Primer for IT professional
Useful Links:	1. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
	2. Website for more information , A Compliance Primer for IT professional https://www.sans.org/reading-room/ whitepapers/ compliance/ compliance-primer-professionals- 33538
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7057	Disaster Management and Litigation Measures	03	--	--	03

Course Objectives (COBs):	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 or 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.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain 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. Explain the Simple Dos and Don'ts in Such Extreme Events and act accordingly. 5. Examine Financing Relief Measures. 6. Explain Preventive and Mitigation Measures.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction	1.1 Definition of Disaster, Hazard, Global and Indian Scenario, General Perspective, Importance of Study in Human Life.	CO1	02	04
	1.2 Direct and Indirect Effects of Disasters, Long Term Effects of Disasters.		02	
2.Natural Disaster and Manmade disasters	2.1 Natural Disaster: Meaning and Nature of Natural Disaster, Flood, Flash Flood, Drought, Cloud Burst.	CO2	01	07
	2.2 Earthquake, Landslides, Avalanches, Volcanic Eruptions, Mudflow, Cyclone, Storm, Storm Surge.		01	
	2.3 Climate Change, Global Warming, Sea Level Rise, Ozone Depletion.		02	
	2.4 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of Growing Population and Subsequent Industrialization.		02	
	2.5 Urbanization and Changing Lifestyle of Human Beings in Frequent Occurrences of Manmade Disasters.		01	
3.Disaster Management, Policy and Administration	3.1 Disaster Management: Meaning, Concept, Importance.	CO3	02	06
	3.2 Objective of Disaster Management Policy, Disaster Risks in India, Paradigm Shift in Disaster Management.		02	
	3.3 Policy and Administration Importance and Principles of Disaster Management Policies, Command and Co-Ordination of in Disaster Management.		01	

4.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.	CO4	02	06
	4.2 Methods and Measures to Avoid Disasters, Management of Casualties, Set Up of Emergency Facilities, Importance of Effective Communication Amongst Different Agencies in Such Situations.	CO4	02	
	4.3 Use of Internet and Software for Effective Disaster Management. Applications of GIS, Remote Sensing and GPS.	CO3,4	02	
5.Financing Relief Measures	5.1 Ways to Raise Finance for Relief Expenditure, Role of Government Agencies and NGO's in this Process.	CO5	02	08
	5.2 Legal Aspects Related to Finance Raising as well as Overall Management of Disasters.		02	
	5.3 Various NGO's and the Works they have Carried Out in the Past on the Occurrence of Various Disasters, Ways to Approach these Teams.		02	
	5.4 International Relief Aid Agencies and Their Role in Extreme Events.		02	
6. Preventive and Mitigation Measures	6.1 Pre-Disaster, During Disaster and Post-Disaster Measures in Some Events in General.	CO6	02	08
	6.2 Structural Mapping: Risk Mapping, Assessment and Analysis, Sea Walls and Embankments, Bio Shield, Shelters, Early Warning and Communication.		02	
	6.3 Non-Structural Mitigation: Community Based Disaster Preparedness, Risk Transfer and Risk Financing, Capacity Development and Training, Awareness And Education, Contingency Plans.		02	
	6.4 Do's And Don'ts in Case of Disasters and Effective Implementation of Relief Aids.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	1. H Gupta Disaster Management, Universities Press Publications. 2. O Dagur, Disaster Management: An Appraisal of Institutional Mechanisms in India, Centre for Land Warfare Studies. 3. C Damon and Butterworth, Introduction to International Disaster Management, Elseveir Publications.
Reference Books	1. K. Yonng, Concepts and Techniques of GIS –C.P.Lo, Prentice Hall (India) Publications. 2. R Singh, Natural Hazards and Disaster Management, Vulnerability and Mitigation, Rawat Publications.
Useful Links:	1. www.msme.gov.in/
	2. www.dcmesme.gov.in/
	3. www.msmetraining.gov.in/
Continuous Assessment	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks),

(CA):	• Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7058	Energy Audit and Management	03	--	--	03

Course Objectives (COBs):	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.
Course Outcomes (COs):	After the successful completion of this course, the learner will be able to: 1. Illustrate present state of energy security and its importance. 2. Describe the basic principles and methodologies adopted in energy audit of an utility. 3. Apply the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. 4. Evaluate the energy performance evaluation of some common thermal installations and identify the energy saving opportunities 5. Analyze the data collected during performance evaluation and recommend energy saving measures. 6. Reviewing the concepts of Energy Conservation in buildings.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.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	CO1	04	04
2. 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)	CO2	08	08
3. Energy Management and Energy Conservation in Electrical System	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment 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,	CO3	10	10

	soft starters, variable speed drives.			
4. 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.	CO4	10	10
5. 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.	CO5	04	04
6. Energy conservation in Buildings	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	CO6	03	03
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42

Books:	
Text Books	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
Reference Books	1. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press 2. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
Useful Links:	1.www.energymanagertraining.com
	2.www.bee-india.nic.in
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC7059	Development Engineering	03	--	--	03

Course Objectives (COBs):	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 designs for robustness and optimization.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Plan data collection to turn data into information and to make decisions that lead to appropriate action. 2. Analyze the different fitting regression models. 3. Apply different two-level factorial designs. 4. Differentiate the different fractional factorial methods. 5. Apply the methods taught to real life situations. 6. Explain methods to plan, analyze, and interpret the results of experiments.

Module No. & Name	Sub Topics	CO Mapped	Hrs./ Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction	1.1 Strategy of Experimentation, Typical Applications of Experimental Design.	CO1	01	03
	1.2 Guidelines for Designing Experiments, Response Surface Methodology.		02	
2. Fitting Regression Models	2.1 Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regressions.	CO2	04	08
	2.2 Confidence Intervals in Multiple Regression, Prediction of new Response Observation, Regression Model Diagnostics, Testing for Lack of Fit.		04	
3.Two Levels Factorial Designs	3.1 The 2^2Design, The 2^3 Design, The General 2^k Design	CO3	03	08
	3.2 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.		05	
4.Two Levels Fractional Factorial Methods	4.1 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.	CO4	04	08
	4.2 Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.		04	
5. Response Surface Methods and Designs	5.1Introduction to Response Surface Methodology, The Method of Steepest Ascent.	CO5	04	08
	5.2Analysis of a Second-Order Response Surface, Experimental Designs for Fitting Response Surfaces.		04	
6.Taguchi Approach	6.1Crossed Array Designs and Signal-to-Noise Ratios.	CO6	02	04
	6.2Analysis Methods, Robust Design examples.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01

Total hours	42
Books:	
Text Books	1. R. Mayers, D. Montgomery and C. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, John Wiley & Sons, New York. 2. D. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, New York. 3. W. Dimond, Peactical Experiment Designs for Engineers and Scientists, John Wiley and Sons.
Reference Books	1. G. Box, J Hunter and W. Hunter, Statics for Experimenters: Design, Innovation and Discovery, Wiley. 2. A. Dean, and D. Voss, Design and Analysis of Experiments (Springer text in Statistics), Springer. 3. P. Ross, Taguchi Technique for Quality Engineering, McGraw Hill. 4. M. Phadake, Quality Engineering using Robust Design, Prentice Hall.
Useful Links:	guide.berkeley.edu/graduate/degree-programs/*development-engineering*
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks, and includes • Average of Test 1 and Test 2: 30 Marks (where each Test shall be of 30 Marks), • Internal Assessment: 10 Marks. • Duration of each Test shall be 1 Hour and 30 Minutes. • Internal Assessment shall be based on presentation / during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be 02 Hours and 30 Minutes.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIL701	Deep Learning Lab	-	01	-	01

Lab Prerequisite:	1. Python Programming, 2. Engineering Mathematics
Lab Objectives(LOBs):	1. To implement basic neural network models for simulating logic gates. 2. To implement various training algorithms for feedforward neural networks. 3.To design deep learning models for supervised, unsupervised and sequence learning.
Lab Outcomes (LOs):	1. Implement basic neural network models to learn logic functions using virtual lab. 2. Design and train feedforward neural networks using various learning algorithms. 3. Build and train deep learning models such as Auto encoders. 4. Build and train deep learning models such as CNNs. 5. Build and train deep learning models such as RNN. 6. Build and train deep learning models such as LSTM.

Lab No.	Experiment Title	LO mapped	Hrs./ Lab
0	**Lab Prerequisite**	--	02
1	**Based on Module 1 (Any two) using Virtual Lab** 1. Implement Mc-Culloch Pitts model for binary logic functions. 2. Implement Perceptron algorithm to simulate any logic gate. 3. Implement Multilayer Perceptron algorithm to simulate XOR gate. 4.To explore python libraries for deep learning e.g. Theano, TensorFlow etc.	LO1	02
2	**Module 2 (Any Two)** 1.Apply any of the following learning algorithms to learn the parameters of the supervised single layer feedforward neural network. a.Stochastic Gradient Descent b.Mini Batch Gradient Descent c.Momentum GD d.Nestorev GD e.Adagrad GD f.Adam Learning GD 2. Implement a back propagation algorithm to train a DNN with at least 2 hidden layers. 3. Design and implement a fully connected deep neural network with at least 2 hidden layers for a classification application. Use appropriate Learning Algorithm, output function and loss function.	LO2	02
3	**Module 3 (Any One)** 1. Design the architecture and implement the auto encoder model for Image Compression. 2. Design the architecture and implement the auto encoder model for Image denoising.	LO3	02
4	**Module 4 (Any One)**	LO4	02

	1. Design and implement a CNN model for digit recognition application. 2. Design and implement a CNN model for image classification.		
5	**Module 5 (Any Two)** 1. Design and implement LSTM for Sentiment Analysis. 2. Design and implement GRU for classification on text data. 3. Design and implement RNN for classification of temporal data.	LO5 LO6	02
Virtual Lab Links:	1. http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php		
	2. http://noiselab.ucsd.edu/ECE228_2018/Reports/Report16.pdf		
Term work (TW):	• Term work should consist of a minimum of 8 experiments • The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. • Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. • The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. • The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. • Total 25 Marks (Experiments: 20-marks, Assignments/Case study/demo/presentation: 05-marks) Note: Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.		
Oral/Practical/P&O:	• P&O examination will be based on experiment list and performance of experiment. • For Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).		

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIL702	Natural Language Processing Laboratory	--	01	--	01

Lab Prerequisite:	1. Python 2. R Language
Lab Objectives (LOBs):	1. To implement basic algorithms of NLP. 2. To apply N Gram to the Text. 3. To implement Semantics of the Text using NLP algorithms 4. To apply different NLP techniques to the Indian Languages
Lab Outcomes (LOs):	1. Apply the basic algorithms using Python. 2. Implement the grammar rules of NLP to the text and test the results. 3. Implement the error free Language reading by applying suitable algorithms. 4. Implement the NLP techniques to real life applications. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Lab Prerequisite	--	02
1	Pre-processing of Text (Tokenization,), filtration, Script Validation, Stop word removal, Stemming	LO1, LO5, LO6	02
2	Morphological Analysis	LO2, LO5, LO6	02
3	N-Gram Model	LO2, LO5, LO6	02
4	POS Tagging	LO2, LO5, LO6	02
5	Chunking	LO3, LO5, LO6	02
6	Named Entity Recognition	LO4, LO5, LO6	02
7	Case Studies (Proposed case studies) a) Sentiment Analysis / Opinion Mining Gauge attitude / sentiments / evaluations / emotions of a speaker or chat b) CV parsing Shortlisting Candidate Automated Interview. c) Clause classification in legal contracts Contract Making d) Automate response to RFP Tender Filing e) Concept extraction from legal / lease documents Risk Analysis f) Text summarization Evaluation, Automated Paper Correction. g) Meeting analyzer / Meeting notes summary generation MOM. h) Automatic email response, Office Efficiency.	LO4, LO5, LO6	02
Useful Lab Links:	1. https://cse24-iiith.virtual-labs.ac.in/#		
Term work:	1. Term work should consist of a minimum of 6 experiments and a Case Study		

	2. Journal must include contents on practical performance and a report on case study of the course. 3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 20-marks, Assignments/Case study/demo/presentation: 05-marks). 4. A practical/Oral exam of 25 marks will be conducted at the end of the semester.
Oral/Practical/ P&O:	• Practical examination will be based on experiment list and performance of experiment. • For Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL7031	Speech Processing Laboratory	--	01	--	01

Lab Prerequisite:	1. Applications of Mathematics in Engineering-I and II 2. Python
Lab Objectives (LOBs):	1. To study types of signal and Speech signal processing. 2. To perform analysis of Speech Signal. 3. To study classification methods for pattern recognition.
Lab Outcomes (LOs):	After successful completion of lab student will be able to 1. Implement synthesis of vowels by source filter model. 2. Plot STFT for speech segment analysis and through Praat for the estimation of signal parameters. 3. Compute of Linear Predictive coefficients and plot the LPC spectrum. 4. Perform Cepstral analysis of speech segments. 5. Perform Classification using pattern recognition. 6. Write accurate documentation for experiment performed.

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Lab Prerequisite	--	02
1	Digital speech analysis using PRAAT.	LO1	02
2	Sampling Frequency and Bit Resolution for Speech Signal Processing	LO1	02
3	Identification of Voice/Unvoiced/Silence regions of Speech	LO1	02
4	Recognition of different language phonemes.	LO2	02
5	Speech synthesis based on source filter model	LO2	02
6	Plotting of STFT and estimation of signal parameters	LO2	02
7	Cepstral Analysis of Speech	LO4	02
8	Linear Prediction Analysis	LO3	02
9	Spoken English Digit/Character classification using Pattern Recognition Methods	LO5	02
10	Spoken English Vowel classification using Pattern Recognition Methods	LO5	02
11	Case study	LO5	02

Useful Lab Links:	1.https://vlab.amrita.edu/index.php?sub=59&brch=164 2.https://ssp-iiith.vlabs.ac.in/List%20of%20experiments.html
Term work (TW):	1. Term work should consist of a minimum of 8 experiments. 2. Journal must include at least 2 assignments on content of theory and practical of the course "Speech Processing Lab". 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments:-20 marks, Assignments:-05 marks).
Oral/Practical /P&O:	Oral examination will be based on experiment list and performance of experiment.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL7032	Internet of Everything Lab	--	01	--	01

Lab Prerequisite:	1. Internet of Things 2. Basic knowledge of computer and internet 3. Computer Communication Networks
Lab Objectives (LOBs):	**The objectives of this course are to:** 1. Understand the concepts of Industry 4.0 and basics of Industrial IoT. 2. Apply sensing, actuation, communication and networking in Industrial IoT. 3. Implement analytics for Industrial IoT applications. 4. Demonstrate the Industrial IoT-for various application domains.
Lab Outcomes (LOs):	**On successful completion of the course the students will be able to:** 1. Identify the use of Sensing & actuation, Communication and Networking in Industrial IoT Application. 2. Apply Sensing & actuation, Communication and Networking in Industrial IoT Application. 3. Implementation of analytics in Industrial IoT Application. 4. Demonstrate various Industrial IoT case studies. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the Laboratory.

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Lab Prerequisite	--	02
1	Identify the use of Sensing & actuation in Industrial IoT Application.	LO1, LO5, LO6	02
2	Identify the use of Communication and Networking in Industrial IoT Application.		02
3	Apply Communication and Networking in Industrial IoT Application	LO2, LO5, LO6	02
4	Implementation of analytics in Industrial IoT Application-I	LO3, LO5, LO6	02
5	Implementation of analytics in Industrial IoT Application-II		02
6	Implementation of Big Data Analytics Tools and Technology.		02
7	Implementation of Big Data Analytics Tools and Technology.		02
8	Implementation of Streaming Analytics.		02
9	Case Study - Industrial IoT Application Domain-I	LO4, LO5, LO6	04
10	Case Study - Industrial IoT Application Domain-II		04

Useful Lab Links:	https://onlinecourses.nptel.ac.in/noc20_cs69
Term work(TW):	1. Term work should consist of a minimum of 8 experiments. 2. Journal must include at least 2 assignments on content of theory and practical of the course "Internet of Everything Lab".

	3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments:-20 marks, Assignments:-05 marks)
Oral/Practical/P&O:	Oral examination will be based on experiment list and performance of experiment.

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL7033	Cryptography and Network Security Laboratory	--	01	--	01

Lab Prerequisite:	1. Computer Networks 2. Operating System 3. Basics of Java and Python
Lab Objectives (LOBs):	Students will try: 1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers 2. To be able to analyze and implement public key algorithms like RSA and El Gamal 3. To analyze and evaluate performance of hashing algorithms 4. To explore the different network reconnaissance tools to gather information about networks 5. To explore and use tools like sniffers, port scanners and other related tools for analyzing packets in a network. 6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.
Lab Outcomes (LOs):	Students will learn to: 1. Apply the knowledge of symmetric cryptography to implement simple ciphers 2. Analyze and implement public key algorithms like RSA and El Gamal 3. Analyze and evaluate performance of hashing algorithms 4. Explore the different network reconnaissance tools to gather information about networks 5. Use tools like sniffers, port scanners and other related tools for analyzing packets in a network 6. Apply and set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Lab Prerequisite	--	02
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers	LO1	02
2	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal	LO2	02
3	Implementation of Diffie Hellman Key exchange algorithm	LO2	02
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs	LO3	02
5	Exploring wireless security tools like Kismet, NetStumbler etc.	LO3	02
6	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.	LO4	02
7	Study of packet sniffer tools wireshark, :- 1. Observer performance in promiscuous as well as non-promiscuous mode. 2. Show the packets can be traced based on different filters.	LO5	02
8	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan,	LO5	02

	etc.		
9	Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark.	LO4	02
10	Simulate DOS attack using Hping and other tools	LO5	02
11	Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities.	LO5	02
12	Set up IPSEC under LINUX.	LO6	02
13	Set up Snort and study the logs.	LO6	02
14	Explore the GPG tool of linux to implement email security	LO6	02
Useful Lab Links:	Virtual Labs (iitb.ac.in)		
Term work(TW):	1. Term work should consist of a minimum of 8 experiments 2. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. 3. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. 4. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. 5. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. 6. Total 25 Marks (Experiments-20 marks, Assignments:-05 marks) **Note:** Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.		
Oral/Practical /P&O:	Oral/Practical /P&O examination will be based on experiment list and performance of experiment.		

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL7034	Biostatistics Laboratory	--	01	--	01

Lab Prerequisite:	1. Applications of Mathematics in Engineering-I, II. 2. Python/R programming. 3. MS Excel.
Lab Objectives (LOBs):	1. To cover basic concepts and theory related to statistics. 2. To focus on various statistical abilities such as analysis of variance, hypothesis testing, estimation, etc.
Lab Outcomes (LOs):	1. Demonstrate the concept of Measurement and Sampling. 2. Interpret Probability Distributions and Sampling Distribution 3. Demonstrate the importance and basic principles of estimation and uses of the distribution, chi-square distribution, and F distribution. 4. Compare a null and alternative hypothesis and carry out a structured hypothesis test. 5. Compare Simple and Multiple Linear Regression and Correlation models. 6. Show mathematical properties of chi-square distribution and use the chi-square distribution for goodness-of-fit tests.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
0	Lab Prerequisite	--	02
1	Measurement and Sampling: To select a simple random sample from *.sav and enter your data into an R file.	LO1	02
2	Frequency Distributions: To explore the AGE data in your sample with a stem-and-leaf plot and frequency table.	LO1	02
3	Summary Statistics: To calculate and interpret summary statistics for the data in your sample.	LO1	02
4	Probability: To calculate and interpret binomial probabilities and Normal probabilities.	LO2	02
5	Introduction to Estimation: To learn about the sampling distribution of means and confidence intervals for μ.	LO3	02
6	Introduction to Hypothesis Testing: To learn about significance testing and to conduct one-sample tests for means.	LO4	02
7	Paired Samples: To learn how to analyze paired samples for a quantitative outcome.	LO5	02
8	Independent Samples: To compare two independent means.	LO5	02
9	Inference About a Proportion: To make inferences about a population proportion (prevalence, in this instance).	LO6	02
10	Cross-Tabulated Counts and Independent Proportions: To cross-tabulate binary data from independent groups and compare independent proportions.	LO6	02

Mini Project (if any)

Virtual Lab Links:	1. https://www.youtube.com/watch?v=fDRa82lxzaU
	2. https://www.youtube.com/watch?v=tutoTRTI7Qc
Term work(TW):	1. Term work should consist of a minimum of 6 experiments and 2 Case studies.

	2. Journal must include at least 2 assignments on content of theory and practical of the course "Biostatistics". 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments:-20 marks, Assignments:-05 marks)
Oral/Practical/P&O:	Oral examination will be based on experiment list and performance of experiment.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIPR75	Major Project Lab-A	--	03	--	03

Prerequisites	1. PBL Mini Project Lab-1 2. PBL Mini Project Lab-2 3. PBL Minor Project Lab-1 4. PBL Minor Project Lab-2
Course Objectives (COBs):	The Project work enables the students, 1. To develop the required skills and knowledge about research. 2. To analyze a specific problem or issue by using the latest technologies with a multidisciplinary approach. 3. To demonstrate proficiency in the design of a research project, application with appropriate research methods. 4. To present and adopt various research ideas with appropriate solution.
Course Outcomes (COs):	Learner will be able to, 1. Identify formulate, review research literature, and analyses complex engineering problems 2. Design solutions, components, or processes for complex engineering problems 3. Select appropriate modern engineering tools and analyse data to meet the problem statement. 4. Use standard norms of engineering practices and engage in lifelong learning. 5. Excel in writing reports with effective presentation. 6. Interact efficiently as an individual with the team members for timely and professional management of project.

Guidelines:

1. Project Topic:

To proceed with the project work it is very important to select the right topic. Projects can be undertaken on any domain of electronics and recent technology programmers.

- Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum four and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Students must consult an internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decisions regarding selection of projects.
- Online log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Students have to submit a weekly progress report to the internal guide whereas the internal guide has to keep track of the progress of the project and also has to maintain attendance reports. This progress report can be used for awarding the term work marks. In case of industry projects, visit by an internal guide will be preferred.
- Students should publish a review paper based on the literature survey of project title and present it in Conferences/Journals.

Project Report Format:

At the end of semester, a project report should preferably contain at least following details,

1. Abstract
2. CO-PO mapping
3. Introduction
4. Literature Survey
    a. Comparative Survey of Existing system
    b. Limitation of the Existing system or research gap
5. Proposed System:
    a. Problem Statement and Objective
    b. Methodology (your approach to solve the problem)
    c. Analysis/Framework/ Algorithm
    d. Details of Hardware & Software
    e. Design details
    f. Budget details
    g. Implementation Plan for next semester
6. Conclusion and future scope
7. References
8. Review paper published copy with certificate of publication.
9. Term Work:
   Distribution of marks for term work shall be as follows:
    a. Weekly Attendance on Project Day
    b. Contribution in the Project work
    c. Project Report (Spiral Bound) with review paper published in conference/Journal
    d. Term End Presentation (Internal)
10. The final certification and acceptance of TW of 25 Marks ensures the satisfactory performance on the above aspects.

P&O: P&O examination of 50 marks will be based on Presentations of Major Project-A

SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Technology
(Formerly known as K J Somaiya Institute of Engineering and Information Technology)
An Autonomous Institute permanently affiliated to University of Mumbai

Honours Degree Program Manual

(Prepared based on the Guidelines for AICTE and University of Mumbai)

For

1. **Computer Engineering**
2. **Information Technology**
3. **Electronics & Telecommunication Engineering**
4. **Artificial Intelligence & Data Science**

(with effect from AY 2022-2023)

SOMAIYA
VIDYAVIHAR

K J Somaiya Institute of Technology
(Formerly known as K J Somaiya Institute of Engineering and Information Technology)
An Autonomous Institute permanently affiliated to University of Mumbai

ACADEMIC YEAR 2022-23

Honours Degree Programs in Engineering and Technology Manual

Introduction:

As per the AICTE's Approval Process Handbook-2020-21: Chapter VII- clause 7.3.2 (Page 99-101) and APH 2021-22, all branches of Engineering and Technology shall offer Elective Courses in the EMERGING AREAS viz., Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Robotics, Quantum Computing, Data Sciences, Cyber Security, 3D Printing and Design, Augmented Reality/ Virtual Reality (AR/VR), as specified in Annexure 1 of the Approval Process Handbook.

a) Under Graduate Degree Courses in EMERGING AREAS shall be allowed as specialization from the same Department. The minimum additional Credits for such Courses shall be in the range of 18-20 and the same shall be mentioned in the degree, as specialization in that particular area. For example, doing extra credits for Robotics in Mechanical Engineering shall earn B.E./ B.Tech. (Hons.) Mechanical Engineering with specialization in Robotics

b) Minor specialization in EMERGING AREAS in Under Graduate Degree Courses may be allowed where a student of another Department shall take the minimum additional Credits in the range of 18-20 and get a degree with minor from another Department.

It is also made very clear by AICTE that areas in which Honours Degree may be offered are numerous. It is up to the Universities with the help of their Academic Board/Council to decide whether Honours. Degree is to be offered or not in any particular area, which is not mentioned above. The criteria for "Honours. Degree will cumulatively require additional 18 to 20 credits in the specified area in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 169 credits of KJSIT)"

1. Honours Degree under KJSIT:

Honours degree program is introduced in order to facilitate the students to choose additionally the specialized courses in the emerging areas of their choice and build their competence in such domains. Based on AICTE guidelines, KJSIT has proposed to offer following Honours degree program corresponding to each engineering program as shown in Table 1.

Table 1: Honours Degree Programs

Sr. No.	Honours degree programs
1	Artificial Intelligence and Machine Learning
2	Blockchain
3	Cyber Security
4	Augmented and Virtual Reality
5	Data Science
6	Internet of Things (IoT)

2. Honours Degree Eligibility Criteria for Students:

In view of the above-mentioned guidelines issued by AICTE in APH 2020-21 and APH 2021-22 for offering Honours degree in the various engineering programs, the following recommendations are proposed on the eligibility criteria for students opting for same;

Eligibility criteria for opting the Honours Degree program:

a. Students with no backlog in semester I, II, and III
b. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above
c. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above

Each eligible student can opt for maximum one Honour's Programs at any time.

i) Students registered for Honours Degree Program need to complete (clear/pass) Honours Degree along with regular B Tech degree to get benefit of Award of Honours along with B Tech Degree. Students with clear pass out in regular B Tech program and having ATKT in Honours program; will only be awarded with regular B Tech degree.

ii) However, it is optional (not the compulsion) for eligible students to take additional honours degree program.

iii) Student shall complete Honors degree program in the stipulated four semesters only.

3. Examination and Evaluation of Honours Degree Courses:

Hons degrees courses will be offered in Third and Final Year of engineering as specialisation in emerging areas. Modalities for Examination and Evaluation will be,

a. The continuous assessment (CA= Average of 2 tests+ Internal Assessment (IA)) and End Sem. Examination (ESE) evaluation shall follow the same pattern as adopted for corresponding semester stated by the University/ Autonomous Institute.
b. End semester Assessment will be done as per the laid down practices by following all applicable ordinances and regulations of University of Mumbai/Rules stated in Manual of KJSIT.
c. Hons. degree courses can be treated as Audit type of courses, wherein passing marks set will be 40. If any student scored equal or more than passing marks in particular course can be declared as pass.
d. Grading of courses offered under Honours degree shall be avoided and also not included in overall CUMMULATIVE GRADE POINT AVERAGE, to bring parity with all students admitted for the basic program.
e. Hons. degree shall be conferred in addition to basic degree only after successfully completion of all courses.
f. Institute can make provision for entering pass or fail in course offered under Honours degree.

4. Award of Honours Degree Program:

The students successfully completing the Honours Degree shall be awarded with the degree designated as: "B. Tech. (Engineering) (Hons. - Specialization)"

Example 1: Students s successfully completing B Tech in Computer Engineering with specialization (Honours) in Cyber Security shall get a degree as **"**B **Tech (Computer Engineering) (Hons. - Cyber Security)"**

Example 2: Students successfully completing B Tech in Electronics and Telecommunication Engineering with specialization in Internet of Things (IoT) shall get a degree as

"**B Tech (Electronics and Telecommunication Engineering) (Hons.- Internet of Things)**"

5. Honours Degree Program Scheme and Structure:

Honours degree program be offered from academic year 2022-23 onwards along with KJSITs Autonomous Scheme II syllabus.

Honours credit courses will be offered from Semester V onwards to Semester VIII as shown in Table 2.

Table 2: Honours degree Program credit and Examination Scheme

Honours in ----- (With effect from 2022-23)											
Year & Sem	**Course Code and Course Title**	**Teaching Scheme (Hours / Week)**			**Examination Scheme and Marks**						**Credits**
		Theory	**Seminar /Tutorial**	**Pract.**	**Average of Test 1 & Test 2**	**Internal Assessment**	**End Sem. Exam**	**Term Work**	**Oral/ Pract**	**Total**	**Credits**
TY Sem. V	HXXC501: TH Subject 1	04	--	--	30	10	60	--	--	100	04
									Total Marks & Credits =	100	04
TY Sem. VI	HXXC601: TH Subject 2	04	--	--	30	10	60	--	--	100	04
									Total Marks & Credits =	100	04
LY Sem. VII	HXXC701: TH Subject 3	04	--	--	30	10	60	--	--	100	04
	HXXL701: Lab-1	--	--	04	--		--	50	50	100	02
									Total Marks & Credits =	200	06
LY Sem. VIII	HXXC801: TH Subject 4	04	-	--	30	10	60	--	--	100	04
									Total Marks & Credits =	**100**	**04**
Total Marks for Semesters V,VI, VII &VIII =100+100+200+100 = 500											
Total Credits for Semesters V,VI, VII &VIII = 04+04+06+04 = 18											

6.Honours Degree Programs offered for KJSIT:

Mapping with existing Engineering/Technology Programs of KJSIT- Honour's degree programs are conducted as per AICTE guidelines. Each eligible student can opt for maximum one Honour's Degree Programs at any time as shown in Table 3.

Table 3: Honours Programs offered for KJSITs Branches

Sr. No.	Honours Degree Programs	Programs who can offer this Honours Degree Program
1	Artificial Intelligence and Machine Learning	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology
2	Blockchain	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology 4. Artificial Intelligence and Data Science
3	Cyber Security	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology 4. Artificial Intelligence and Data Science
4	Augmented and Virtual Reality	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology 4. Artificial Intelligence and Data Science
5	Data Science	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology
6	IoT	1. Computer Engineering 2. Electronics and Telecommunication Engineering 3. Information Technology 4. Artificial Intelligence and Data Science

Additional 4 Theory & One Lab courses to be cleared and evaluated under each Honours program for total 18 credits and 500 marks, are as given under table 4 to 9 respectively.

Table 4: Honours Degree Program in Artificial Intelligence and Machine Learning

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination	Credits	Marks
Artificial Intelligence and Machine Learning	Sem V	HXXC501: Mathematics for AI & ML	4	100
	Sem VI	HXXC601: Game Theory using AI & ML	4	100
	Sem VII	HXXC701: AI&ML in Healthcare	4	100
	Sem VII	HXXL701: AI&ML in Healthcare lab	2	100
	Sem VIII	HXXC801: Text, Web and Social Media Analytics	4	100
Total		**4 Theory +1 Lab**	**18**	**500**

Table 5: Honours Degree Program in Block chain

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination		Credits	Marks
BlockChain	Sem V	HXXC501:	Bit coin and Crypto currency	4	100
	Sem VI	HXXC601:	Block chain Platform	4	100
	Sem VII	HXXC701:	Block chain Development	4	100
	Sem VII	HXXL701:	Block chain Setup Lab	2	100
	Sem VIII	HXXC801:	DeFi (Decentralized Finance)	4	100
Total		**4 Theory +1 Lab**		**18**	**500**

Table 6: Honours Degree Program in Cyber Security

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination	Credits	Marks
Cyber Security	Sem V	HXXC501: Ethical Hacking	4	100
	Sem VI	HXXC601: Digital Forensic	4	100
	Sem VII	HXXC701: Security Information Management	4	100
	Sem VII	HXXL701: Vulnerability Assessment Penetration Testing (VAPT) Lab	2	100
	Sem VIII	HXXC801: Application Security	4	100
Total		**4 Theory +1 Lab**	**18**	**500**

Table 7: Honours Degree Program in Data Science

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination	Credits	Marks
Data Science	Sem V	HXXC501: Mathematics for Data Science	4	100
	Sem VI	HXXC601: Statistical Learning for Data Science	4	100
	Sem VII	HXXC701: Data Science for Health and Social Care	4	100
	Sem VII	HXXL701: Data Science for Health and Social Care Lab	2	100
	Sem VIII	HXXC801: Text, Web and Social Media Analytics	4	100
Total		**4 Theory +1 Lab**	**18**	**500**

Table 8: Honours Degree Program in Augmented and Virtual Reality

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination		Credits	Marks
Augmented and Virtual Reality	Sem V	HXXC501:	Virtual Reality	4	100
	Sem VI	HXXC601:	AR and Mix Reality	4	100
	Sem VII	HXXC701:	ARVR Application-I	4	100
	Sem VII	HXXL701:	ARVR Lab	2	100
	Sem VIII	HXXC801:	Game Development with VR	4	100
Total		**4 Theory +1 Lab**		**18**	**500**

Table 9: Honours Degree Program in Internet of Things

Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination		Credits	Marks
Internet of Things	Sem V	HXXC501:	IoT Sensor Technologies	4	100
	Sem VI	HXXC601:	IoT System Design	4	100
	Sem VII	HXXC701:	Dynamic Paradigm in IoT	4	100
	Sem VII	HXXL701:	Interfacing & Programming with IoT Lab	2	100
	Sem VIII	HXXC801:	Industrial IoT	4	100
Total		**4 Theory +1 Lab**		**18**	**500**

Dr. Suresh Ukarande
Principal

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HBCC501	Bit coin and Crypto currency	04+0+0

Prerequisite:	**Introduction to Cryptography:** Hash functions, Public key cryptography, Digital Signature (ECDSA).
Course Objectives:	The course aims: 1. To get acquainted with the concept of Block and Blockchain. 2. To learn the concepts of consensus and mining in Blockchain. 3. To get familiar with the bitcoin currency and its history. 4. To understand and apply the concepts of keys, wallets and transactions in the Bitcoin Network. 5. To acquire the knowledge of Bitcoin network, nodes and their roles. To analyze the applications& case studies of Blockchain.
Course Outcomes:	

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy Level
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concept of Block chain.	L1,L2
2	Associate knowledge of consensus and mining in Block chain.	L1,L2
3	Summarize the bit coin crypto currency at an abstract level.	L1,L2
4	Apply the concepts of keys, wallets and transactions in the Bit coin network.	L3
5	Interpret the knowledge of Bit coin network, nodes and their roles.	L1,L2
6	Illustrate the applications of Block chain and analyze case studies.	L3

Module No. & Name	Sub Topics	CO Mapped	Hrs./Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	**Introduction to Cryptography:** Hash functions, Public key cryptography, Digital Signature (ECDSA).	--	2	2
1. Introduction to Block chain	1.1 Structure of a Block, Block Header, Block Identifiers: Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Block chain, Merkle Trees and Simplified Payment Verification (SPV). **Self-learning Topics:** Block chain Demo.	CO1	6	6
2. Consensus and Mining	2.1 Decentralized Consensus, Byzantine General's Problem, Independent Verification of Transactions, Mining Nodes, Aggregating Transactions into Blocks, Constructing the Block header, Mining the Block, Successfully Mining the Block, Validating a New Block, Assembling and Selecting Chains of Blocks, Block chain Forks	CO2	12	12

	Self-learning Topics: Study different consensus algorithms			
3. Introduction to Bit coin	3.1 What is Bit coin and the history of Bit coin, Getting the first bit coin, finding the current price of bit coin and sending and receiving bit coin, Bit coin Transactions. **Self-learning Topics:** Study the website coinmarketcap.com/	CO3	4	4
4. Concepts of Bit coin	**4.1 Keys and addresses, Wallets and Transactions:** Public Key Cryptography and Crypto currency, Private and Public Keys, Bit coin Addresses, Base58 and Base58Check Encoding, Nondeterministic (Random) Wallets, Deterministic (Seeded) Wallets, HD Wallets (BIP-32/BIP-44), Wallet Best Practices, Using a Bit coin Wallets, Transaction Outputs and Inputs, Transaction Fees, Transaction Scripts and Script Language, Turing Incompleteness, Stateless Verification, Script Construction (Lock + Unlock), Pay-to-Public-Key-Hash (P2PKH), Bitcoin Addresses, Balances, and Other Abstractions **Self-learning Topics:** Visit and use https://bitcoin.org/en/	CO4	13	13
5. Bit coin Networks	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, Bloom Filters, SPV Nodes and Privacy, Encrypted and Authenticated Connections, Transaction Pools **Self-learning Topics:** Study technical papers based on bitcoin security	CO5	**7**	**7**
6. Blockchain Applications & case studies	Domain-Specific Applications: FinTech, Internet of Things, Industrial and Manufacturing, Energy, Supply chain & Logistics, Records & Identities, Healthcare Case studies related to cryptocurrencies Concept of Altcoin **Self-learning Topics:** Read Technical papers on blockchain applications	CO6	8	8
			Total hours	**48**
Books:				
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. "Blockchain Applications: A Hands-On Approach", by ArshdeepBahga, Vijay Madisetti, Paperback – 31 January 2017. 3. "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", July 19, 2016, by Arvind Narayanan, Joseph Bonneau, Edwa rdFelten, Andrew Miller, Steven Goldfeder, Princeton University Press.			
Reference Books				
	1. **"**Mastering Blockchain", by Imran Bashir, Third Edition,Packt Publishing **2. "**Mastering Ethereum: Building Smart Contracts and Dapps Paperback" byAndreas Antonopoulos, Gavin Wood, Publisher(s): O'Reilly Media			

<table>
<tr><td></td><td>3. “Blockchain revolution: how the technology behind bitcoin is changing money, business and the world $ don tapscott and alex tapscot, portfolio penguin, 856157449.</td></tr>
<tr><td colspan="2">Online References:</td></tr>
<tr><td colspan="2">https://andersbrownworth.com/blockchain/
https://andersbrownworth.com/blockchain/public-private-keys/
https://www.coursera.org/learn/cryptocurrency
https://coinmarketcap.com/</td></tr>
<tr><td>Assessment:</td><td>Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –
<table><tr><td>1.</td><td>Class Test 1</td><td>30 marks</td></tr><tr><td>2.</td><td>Class Test 2</td><td>30 marks</td></tr><tr><td>3.</td><td>Internal Assessment</td><td>10 marks</td></tr></table>Continuous Assessment (Avg. of T1 and T2: 30-Marks): Test-1 and Test-2 consists of two class tests of 30 marks each. Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test-1). Duration of each test shall be one hour.
Internal Assessment(IA):
Marks will be allotted as per designed rubrics.</td></tr>
<tr><td colspan="2">End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.</td></tr>
</table>

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HBCC601	Block chain Platform	(04+0+0)

Prerequisite:	Introduction to Block chain and Bit coin.
Course Objectives:	The course aims: 1. Understand the blockchain platform and its terminologies. 2. Understand smart contracts, wallets, and consensus protocols. 3. Design and develop decentralized applications using Ethereum, and Hyperledger. 4. Creating blockchain networks using Hyperledger Fabric deployment. 5. Understand the considerations for creating blockchain applications. 6. Analyze various Blockchain Platforms.
Course Outcomes:	

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy Level
On successful completion, of course, learner/student will be able to:		
1	Explain the Blockchain platform and its types.	L1,L2
2	Create Public Blockchain using Ethereum.	L3,L4,L5, L6
3	Develop Smart Contracts using REMIX IDE.	L3,L4,L5
4	Apply the concept of private blockchain using Hyperledger.	L3
5	Analyze different types of blockchain platforms.	L3,L4
6	Deploy Enterprise Applications on Blockchain.	L3,L4,L5

Module No. & Name	Sub Topics	CO Mapped	Hrs./Subtopic	Total Hrs. /Module
I. Prerequisite	Introduction to Block chain and Bit coin.	--	2	2
1. Introduction to Block chain Platforms	1.1 Why Blockchain Platform: Platform types, Public, Private, technology requirements for implementation. Introduction to Ethereum, Hyperledger and Smart Contracts. Case study of blockchain Application. **Self-learning Topics:** Study different applications of block chain.	CO1	6	6
2. Public Block chain	2.1 Introduction, Characteristics of Public Blockchain, Advantages. Examples of Public Blockchain-Bitcoin: Terminologies and Transaction, Ethereum: Smart contract, Comparison of Bitcoin and Ethereum, Other public Blockchain platforms. **Self-learning Topics:** Study any one case study on public block chain.	CO2, CO3	8	8
3. Ethereum Blockchain	3.1 Introduction, Ethereum and Its Components: Mining, Gas, Ethereum, Ether, Ethereum Virtual Machine, Transaction, Accounts. Architecture of ethereum, Smart Contract: Remix IDE, Developing smart contract for ethereum blockchain, e-	CO2, CO3, CO6	12	12

	voting applications using smart contract, Dapp Architecture. Types of test-networks used in ethereum, Transferring Ethers Using MetaMask, Mist Wallet, Ethereum Frameworks, Case study of Ganache for ethereum blockchain. Deploying e-voting applications on Ganache framework. Ethereum 2., Concept of Beacon chain, POS (Proof of Stake), Shading of Chain. **Self-learning Topics:** Study case study on any ethereum blockchain.			
4. Private Blockchain	4.1 Introduction, Key Characteristics, Need of Private Blockchain. Consensus Algorithm for private Blockchain (Ex. RAFT and PAXOS), Smart Contract in Private Blockchain, Case Study of E-commerce Website, Design Limitations. **Self-learning Topics:** Case study on private block chain.	CO4	8	8
5. Hyperledger Blockchain	5.1 Introduction to Hyperledger, tools and frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies, Distributed Ledgers. Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes etc.,Transaction Flow, Advantages of Hyperledger Fabric Blockchain, working of Hyperledger Fabric, Creating Hyperlegder network, Case Study of Supply chain management using Hyperledger **Self-learning Topics:** Case study on Hyperledger blockchain.	CO5, CO6	12	12
6. Other Blockchain platforms	6.1 Corda, Ripple, Quorum and other emerging blockchain platforms, Case Study on any of the blockchain platforms. Developing Blockchain application on Cloud(AWS/Azure) **Self-learning Topics:** Compare different blockchain platforms.	CO5	4	4
			Total hours	**48**
Books:				
Text Books	1. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and MeenaKarthikeyen, Universities press. **2.** Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.			
Reference Books	1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD 2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress. **3.** Blockchain with Hyperledger Fabric,LucDesrosiers, Nitin Gaur, Salman A. Baset, VenkatramanRamakrishna,Packt Publishing.			
Online References:				

<table>
<tr><td colspan="2">1. Blockchain by Example, BellajBadr, Richard Horrocks, Xun (Brian) Wu, November 2018, Implement decentralized blockchain applications to build scalable Dapps.
2. Blockchain for Business, https://www.ibm.com/downloads/cas/3EGWKGX7.
3. https://www.hyperledger.org/use/fabric</td></tr>
<tr><td>Assessment:</td><td>Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –<table><tr><td>1.</td><td>Class Test 1</td><td>30 marks</td></tr><tr><td>2.</td><td>Class Test 2</td><td>30 marks</td></tr><tr><td>3.</td><td>Internal Assessment</td><td>10 marks</td></tr></table>Continuous Assessment (Avg. of T1 and T2: 30-Marks): Test-1 and Test-2 consists of two class tests of 30 marks each. Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test-1). Duration of each test shall be one hour.
Internal Assessment(IA):
Marks will be allotted as per designed rubrics.</td></tr>
<tr><td colspan="2">End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.</td></tr>
</table>

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HBCC701	Block chain Development	(04+0+0)

Prerequisite:	Blockchain cryptocurrency, Blockchain platform
Course Objectives:	The course aims: 1. To understand Ethereum Ecosystem. 2. To understand aspects of different programming languages. 3. To explain how to use the solidity programming language to develop a smart contract for blockchain. 4. To demonstrate deployment of smart contracts using frameworks. 5. To understand principles of Hyperledger fabric. 6. To understand challenges to apply blockchain in emerging areas.
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 use Ethereum Components.	L1,L2
2.	To Analyse different blockchain programming languages.	L3
3.	To implement smat contract in Ethereum using solidity.	L4,L5
4.	To analyse different developement frameworks.	L4
5.	To implement private blockchin network with Hyperledger fabric.	L4,L5
6.	To illustrate blockchain integration with emerging technologies and security issues.	L1,L2

Module No. & Name	Sub Topics	CO Mapped	Hrs./Subtopic	Total Hrs. /Module
I. Prerequisite	Blockchain cryptocurrency, Blockchain platform	--	2	2
1. Ethereum Ecosystem	1.1 Ethereum components: miner and mining node,Ethereum virtual machine,Ether,Gas,Transactions, accounts,swarm and whisper,Ethash, end to end transaction in Ethereum, architecture of Ethereum **Self-learning Topics**: Emerging blockchain platforms	CO1	4	4
2. Blockchain Programming	2.1 Types of Blockchain Programming, Solidity, GoLang,Vyper, Java, Simplicity, Rholang, Game Theory and Cryptonomics, Comparative study of different blockchain programming languages Decentralized file system-IPFS. **Self-learning Topics:** Emerging blockchain programming languages	CO2	8	8
3. Smart Contract	3.1 Solidity programming, Smart Contract programming using solidity, mapper function, ERC20 and ERC721 Tokens,comparison between ERC20 & ERC721, ICO, STOMetamask (Ethereum	CO3	10	10

	Wallet), setting up development environment, use cases of smart contract, smart Contracts: Opportunities, Risks **Self-learning Topics:** Cryptocurrencies and their security issues, Consensus mechanisms, Digital Signatures			
4. Blockchain Deployment	4.1 Ethereum client, Ethereum Network, Introduction to Go Ethereum(Geth), Geth Installation and Geth CLI, Setting up a Private Ethereum Blockchain. Introduction to Truffle, Smart Contract deployment on a Private Blockchain. Introduction to Ganache Introduction to Dapp,Dapp architecture, Daaps Scalability,testing Connecting to the Blockchain and Smart Contract, Web3js, Deployment **Self-learning Topics:** Smart Contract deployment using Ganache.	CO4	10	10
5. Hyperledger Application Development	5.1 Installing Hyperledger Fabric, Hyperledger Fabric Network, Building Your First Network, Hyperledger Fabric Demo, Hyperledger Fabric Network Configuration, Certificate Authorities, Chaincode Development and Invocation, Deployment and testing of chaincode on development network, Hyperledger Fabric Transactions. **Self-learning Topics:** Hyperledger sawtooth, Hyperledger caliper.	CO5	12	12
6. Blockchain integration and Research challenges	6.1 Integrating Blockchain with cloud, IoT, AI, ERP, End to end blockchain integration, Risks and Limitations of Blockchain: Privacy & Security. Criminal Use of Payment Blockchains, The "Dark" Side of Blockchain. Research challenges in blockchain, **Self-learning Topics**:Use Cases: Blockchain for Health Insurance, Blockchain in Supply chain management, Blockchain & PropTech, Blockchain in Banking.	CO6	6	6
			Total hours	**48**
Books:				
Text Books:	1. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly. **2.** Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press			
Reference Books:				
	1. Blockchin enabled Applications, Vikram Dhillon, Devid Metcalf, Max Hooper, Apress **2.** Building Blockchain Projects, Narayan Prusty, Packt			
Online References:				
https://ethereum.org/en/ https://www.trufflesuite.com/tutorials https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.html https://www.blockchain.com/				

<table>
<tr><td colspan="2">https://docs.soliditylang.org/en/v0.7.4/</td></tr>
<tr><td>Assessment:</td><td>Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –
<table><tr><td>1.</td><td>Test 1</td><td>30 marks</td></tr><tr><td>2.</td><td>Test 2</td><td>30 marks</td></tr><tr><td>3.</td><td>Internal Assessment</td><td>10 marks</td></tr></table>Continuous Assessment (Avg. of T1 and Test 2 is 30Marks): Test-1 and Test-2 consists of two class tests of 30 marks each. Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test-1). Duration of each test shall be one hour.
Internal Assessment(IA):
Marks will be allotted as per designed rubrics.</td></tr>
<tr><td colspan="2">End Semester Theory Examination will be of 60-Marks with 2 hours 30 mins duration.</td></tr>
</table>

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HBCSBL601	Private Blockchain Setup Lab(SBL)	(0+04+0)

Prerequisite:	Expertise in Programming, Basic knowledge of Computer Security, Networking.
Lab Objectives:	The Lab aims: 1. To build and test Private Ethereum Blockchain. 2. To learn the concept of the genesis block and Account in the Blockchain. 3. To get familiar with the mining blocks to create a ether. 4. To understand and apply the concepts of keys, wallets. 5. To acquire the knowledge of gateway and desktop application. 6. To analyze the applications & case studies of Blockchain.
Lab Outcomes: (LOs):	On successful completion, of lab, learner/student will be able to: 1. To understand how blockchain systems (mainly Etherum) work . 2. To create the genesis blocks using Puppeth, a CLI tool and account using Smart Contract. 3. To create mining blocks, check the account and PoW. 4. To use cryptocurrency exchanges and wallets safely. 5. To create Gateway to Blockchain Apps. 6. To use Blockchain on Mobile App and on Cloud.

Hardware & Software Requirements:	**Hardware Requirements**	**Software Requirements**	**Other Requirements**
	PC With Following Configuration 1. PC i3/i5/i7 Processor or above. 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. NodeJs 2. Ethereum 3.Geth 4. Solidity	1. Internet Connection.

Lab.No.	Module	Experiment Title	LO mapped	Hrs./Lab
1	**Build and Test**	Install Ethereum network to create a private EthereumBlockchain Self- learning topic: Hyperledger	LO1	4
2	**Build and Test**	Installation of geth	LO1	5
3	**Create the Genesis block**	Create the genesis block using Puppeth, a CLI tool	LO2	5
4	**Create Account in the blockchain**	Smart contract	LO2	6
5	**Mining Blocks to create Ether**	Mine blocks, check account balance, PoWvsPoA	LO3	6
6	**Gateway to Blockchain Apps**	Metamask	LO4	5
7	**Web and Desktop Application**	Solidity programming on remix	LO4	6
8	**Application Development**	Crypto Exchange and Wallet	LO5	4
9	**Application Development**	Blockchain Mobile App or Web Application using Dapp	LO6	6

10	**Application Development**	Hosting of a private blockchain on cloud(AWS/Azure)	LO6	5
			Total hours	**52**

Books:

Text Books	1. Mastering Ethereum: Building Smart Contracts and Dapps, Andreas Antonopoulos, Gavin Wood, O'Reilly Publication 2. Mastering Blockchain, Second Edition: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, Imran Bashir 3. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, RiteshModi, Packt publication 4. Mastering Blockchain, Imran Bashir, Second Edition,Packt Publication.
Reference Books	
	1. Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN, 2nd Edition by Andreas M. Antonopoulos, June 2017, and Publisher: O'Reilly Media, Inc. ISBN: 9781491954386. 2. Blockchain Applications: A Hands-On Approach, by ArshdeepBahga, Vijay Madisetti, Paperback – 31 January 2017. Mastering Blockchain, Imran Bashir, Packt Publication.

Online References:

1. https://geth.ethereum.org/downloads/
2. https://medium.com/@agrawalmanas09/how-to-setup-private-ethereum-blockchain-on-windows-10-machine-ab497e03d6b8
3. https://geth.ethereum.org/docs/dapp/
4. https://www.edureka.co/blog/ethereum-private-network-tutorial
5. https://docs.soliditylang.org/en/develop/index.html
6. https://metamask.io
7. https://medium.com/publicaio/a-complete-guide-to-using-metamask-updated-version-cd0d6f8c338f
8. https://docs.aws.amazon.com/blockchain-templates/latest/developerguide/blockchain-templates-create-stack.html

Term Work:

The Term work shall consist of at least 10 to 12 practical based on the above syllabus. The term work Journal must include at least 2 assignments. The assignments should be based on real world applications which cover concepts from all above syllabus**.**

Term Work Marks: 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

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

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HBCC801	DeFi (Decentralized Finance)	(04+0+0)

Course Objectives:	The course aims: 1. The basic concepts of Centralized and Decentralized Finance and compare them. 2. The DeFi System and its key categories. 3. The DeFi components,primitives,incentives,metrics and major business models where they are used. 4. The DeFi Architecture and EcoSystem. 5. The DeFi protocols. 6. The real time use cases of DeFi.
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	Explain the basic concepts of Centralized and Decentralized Finance and compare them.	L1, L2
	2	Describe the the DeFi System and its key categories.	L1
	3	Discuss the DeFi components, primitives, incentives, metrics and major business models where they are used.	L1, L2
	4	Explain the DeFi Architecture and EcoSystem.	L1, L2
	5	Illustrate the DeFi protocols.	L1
	6	Discuss the real time use cases of DeFi.	L1,L2

Module No. & Name	**Sub Topics**	**CO Mapped**	**Hrs./Subtopic**	**Total Hrs. /Module**
I. Prerequisite	Blockchain & Cryptocurrency,Blockchain Platform, Blockchain Development	-	02	02
1. Introduction: Centralized and decentralized finance	Difference between Centralized and Decentralized Finance, Traditional Financial Institution- Banks: 1. Payment and Clearance systems, 2. Accessibility, 3. Centralization and Transparency, Decentralized Finance Vs Traditional Finance **Self-learning Topics:** The Potential Impact of Decentralized Finance	CO1	06	06
2. What is decentralized finance (defi)?	The DeFi Ecosystem, Problems that DeFi Solves How Decentralized is DeFi? Defi key Categories:- Stablecoins, Stable coin and pegging,Lending and Borrowing,Exchanges,Derivations, Fund Management, Lottery,Payments,Insurance **Self-learning Topics:** How Decentralized Finance Could Make Investing More Accessible.	CO2	06	06

3. DeFi Primitives and Business Models	3.1 DeFi Components: Blockchain Cryptocurrency The Smart Contract Platform Oracles Stablecoins Decentralized Applications 3.2 DeFi Primitives: Transactions Fungible Token: Equity Tokens, Utility Tokens and Governance TokensNFT: NFT Standard, Multi-token standard Custody Supply Adjustment: Burn-Reduce Supply, Mint-Increase Supply, Bonding Curve-Pricing Supply Incentives: Staking Rewards, Slashing, Direct Rewards and Keepers, Fees Swap: Order Book Matching, Automated Market Makers Collaterlized Loans Flash Loans (Uncollaterlized Loans) 3.3 DeFi Key Metrics: Total Value Locked, Daily Active Users, Market Cap 3.4 DeFi Major Business Models: Decentralized Currencies, Decentralized Payment Services, Decentralized fundraising, Decentralized Contracting **Self-learning Topics:** Study any real time Business model.	CO3	10	10
4. DeFi Architecture and EcoSystem	4.1DeFi Architecture: Consumer Layer: Blockchains, Cross-Blockchain networks, Oracles, Digital Asset Layer: Cryptocurrencies, Infrastructure Layer: Wallets and Asset Management, DEXes and Liquidity, Lending and Borrowing, Prediction Markets, Synthetic Assets, Insurance 4.2 DeFi EcoSystem and Protocols: On-chain Asset Exchange, Loanable Fund Markets on-chain assets, Stablecoins, Portfolio Management, Derivatives, Privacy-preserving mixers 4.3 DeFi Risk and Challenges: Technical Risks, Usability Risks, Centralization Risks, Liquidity Risks, Regulation Risk **Self-learning Topics:** Study of the Problems which are holding DeFi adoption back	CO4	10	10
5. DeFi Deep Dive	5.1.aker DAO:Maker Protocol: Dai Stablecoins, Maker Vaults, Maker Protocol Auctions Maker Actors: Keepers, Price Oracles, Emergency Oracles, DAO Teams,Dai Savings Rate Dai Use case Benefits and Examples 5.2.UniSwap:UniSwap Protocol Overview: How UniSwap Works, EcoSystem Participants, Smart Contracts UniSwap Core Concepts: Swaps, Pools, Flash Swaps, Oracles 5.3. Compound:Compound Protocol: Supplying Assets, Borrowing Assets, Interest Rate Model Compound Implementation and Architecture: cToken Contracts, Interest Rate Mechanics,	CO5	10	10

	Borrowing, Liquidation, Price Feeds, Comptroller, Governance 5.4. wBTC:Need for wBTC: Tokenization and common Issues wBTC Implementation and Technology: Users, Custodian Wallet Setup, Minting, Burning wBTC Governance, wBTC vs Atomic Swaps, Fees, Legal Binding, Trust Model and Transparency **Self-learning Topics:** MakerDAO Governance,UniSwap GovernanceProtocol Math,Compound Protocol Math			
6. Use Cases	6.1Decentralized Exchanges 6.2Decentralized Stablecoins 6.3Decentralized Money Markets 6.4Decentralized Synthetix 6.5Decentralized Insurance 6.6Decentralized Autonomous Organization (DAO), **Self-learning Topics:** Stock Exchange Operations, Derivatives,Tether, Ampleforth, How to get stablecoins,Synthetix Network, Token,The Ongoing Impact of The DAO's Rise and Fall, DAO Projects	CO6	08	08
		Total hours	**52**	
Books:				
Text Books	1. How to DeFi,Darren Lau, Daryl Lau, Teh Sze Jin,Kristian Kho, Erina Azmi, TM Lee,Bobby Ong-1st Edition, March 2020 2. DeFi and the Future of Finance-Campbell R. Harvey 3. DeFi Adoption 2020 A Definitive Guide to Entering the Industry.			
Reference Books/White Papers:				
	1. Blockchain disruption and decentralized finance: The rise of decentralized business models-Yan Chen,Cristiano Bellavitis 2. SoK: Decentralized Finance (DeFi)-Sam M. Werner, Daniel Perez, Lewis Gudgeon,Ariah Klages-Mundt,Dominik Harz*‡, William J. Knottenbelt,Imperial College London, † Cornell University, Interlay 4. Decentralized Finance (DeFi) –A new Fintech Revolution? 5. https://makerdao.com/da/whitepaper/ 6. https://uniswap.org/ 7. https://compound.finance/documents/Compound.Whitepaper.pdf 8. https://wbtc.network/assets/wrapped-tokens-whitepaper.pdf 9. https://defiprime.com/exchanges 10. https://defirate.com/stablecoins/ 11. https://academy.ivanontech.com/blog/decentralized-money-markets-and-makerdao 12. https://www.gemini.com/cryptopedia/nexus-mutual-blockchain-insurance-nxm-crypto			

<table>
<tr><td></td><td>13. https://consensys.net/blockchain-use-cases/decentralized-finance/
14. https://tokenlon.zendesk.com/hc/en-us/articles/360041114431-DeFi-Explained-Synthetic-Assets,
15. https://www.blockchain-council.org/synthetix/synthetix-snx-the-biggest-ecosystem-in-decentralized-finance/</td></tr>
<tr><td colspan="2">Online References:</td></tr>
<tr><td colspan="2">1. https://www.udemy.com/
2. https://www.coursera.org/</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Assessment:</td><td>Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –
<table>
<tr><td>1.</td><td>Class Test 1</td><td>30 marks</td></tr>
<tr><td>2.</td><td>Class Test 2</td><td>30 marks</td></tr>
<tr><td>3.</td><td>Internal Assessment</td><td>10 marks</td></tr>
</table>
Continuous Assessment (Avg, of T1 and T2: 30-Marks): Test-1 and Test-2 consists of two class tests of 30 marks each. Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test-1). Duration of each test shall be one hour.
Internal Assessment(IA):
Marks will be allotted as per designed rubrics.</td></tr>
<tr><td colspan="2">End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.</td></tr>
</table>

Course Code	Course Name	Credits Assigned (TH+P+TUT)
HCSC501	Ethical Hacking	04+0+0

Prerequisite:	Computer Networks, Databases, system security
Course Objectives:	The course aims: 1. To describe Ethical hacking and fundamentals of computer Network. 2. To understand about Network security threats, vulnerabilities assessment and social engineering. 3. To discuss cryptography and its applications. 4. To implement the methodologies and techniques of Sniffing techniques, tools, and ethical issues. 5. To implement the methodologies and techniques of hardware security. 6. To demonstrate systems using various case studies.
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	Articulate the fundamentals of Computer Networks, IP Routing and core concepts of ethical hacking in real world scenarios.	L1,L2
2	Apply the knowledge of information gathering to perform penetration testing and social engineering attacks.	L3
3	Demonstrate the core concepts of Cryptography, Cryptographic checksums and evaluate the various biometric authentication mechanisms.	L1,L2
4	Apply the knowledge of network reconnaissance to perform Network and web application-based attacks.	L3
5	Apply the concepts of hardware elements and endpoint security to provide security to physical devices.	L3
6	Simulate various attack scenarios and evaluate the results.	L4,L5

Module No. & Name	Sub Topics	CO Mapped	Hrs./Sub topic	Total Hrs. /Module
I. Prerequisite	Computer Networks, Databases, system security	--	2	2
1. Introduction to Ethical Hacking	1.1 Fundamentals of Computer Networks/IP protocol stack, IP addressing and routing, Routing protocol, Protocol vulnerabilities, Steps of ethical hacking, Demonstration of Routing Protocols using Cisco Packet Tracer Self-learning Topics:TCP/IP model, OSI model	CO1	10	10
2. Introduction to	2.1 Private-key encryption, public key-encryption,	CO3	08	08

Cryptography	key Exchange Protocols, Cryptographic Hash Functions & applications, steganography, biometric authentication, lightweight cryptographic algorithms.Demonstration of various cryptographic tools and hashing algorithms **Self-learning Topics**: Quantum cryptography, Elliptic curve cryptography			
3.Introduction to network security	3.1 Information gathering, reconnaissance, scanning, vulnerability assessment, Open VAS, Nessus, System hacking: Password cracking, penetration testing, Social engineering attacks, Malware threats, hacking wireless networks (WEP, WPA, WPA-2), Proxy network, VPN security, Study of various tools for Network Security such as Wireshark, John the Ripper, Metasploit, etc. **Self-learning Topics**: Ransomware(Wannacry), Botnets, Rootkits, Mobile device security	CO2	12	12
4.Introduction to web security and Attacks	4.1 OWASP, Web Security Considerations, User Authentication, Cookies, SSL, HTTPS, Privacy on Web, Account Harvesting, Web Bugs, Sniffing, ARP poisoning, Denial of service attacks, Hacking Web Applications, Clickjacking, Cross-Site scripting and Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, SSO, Vulnerability assessments, SQL injection, Web Service Security, OAuth 2.0, Demonstration of hacking tools on Kali Linux such as SQLMap, HTTrack, hping, burp suite,Wireshark etc. **Self-learning Topics**: Format string attacks	CO4	10	10
5.Elements of Hardware Security	5.1 Side channel attacks, physical unclonable functions, Firewalls,Backdoors and trapdoors, Demonstration of Side Channel Attacks on RSA, IDS and Honeypots. **Self-learning Topics**: IoT security	CO5	6	6
6.Case Studies	6.1 Various attacks scenarios and their remedies. Demonstration of attacks using DVWA. **Self-learning Topics**: Session hijacking and man-in-middle attacks	CO6	4	4
			Total hours	**52**
Books:				
Text Books	1. Computer Security Principles and Practice --William Stallings, Seventh Edition, Pearson Education, 2017. 2. Security in Computing -- Charles P. Pfleeger, Fifth Edition, Pearson Education, 2015. 3. Network Security and Cryptography -- Bernard Menezes, Cengage Learning, 2014. 4. Network Security Bible -- Eric Cole, Second Edition, Wiley, 2011 5. Mark Stamp's Information Security: Principles and Practice --Deven Shah, Wiley, 2009.			
Reference Books	1.UNIX Network Programming –Richard Steven,Addison Wesley, 2003 2. Cryptography and Network Security -- Atul Kahate, 3rd edition, Tata Mc Graw			