



SOMAIYA
VIDYAVIHAR

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

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 VIII)
Including
Honours Degree Program

With effect from A.Y. 2023-24

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 VIII - B.TECH. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

Semester- VIII-Credit Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credit Assigned		Course Category
		(TH-P-TUT)	Total	(TH-P-TUT)	Total	
AIC801	Reinforcement Learning	3-0-0	03	3-0-0	03	PC
AIDLC802X	Department Level Elective-5	3-0-0	03	3-0-0	03	DLE
AIDLC803X	Department Level Elective-6	3-0-0	03	3-0-0	03	DLE
ILC804X	Institute Level Elective-2	3-0-0	03	3-0-0	03	ILE
AIL801	Reinforcement Learning Lab	0-2-0	02	0-1-0	01	PC
AIDLL802X	Department Level Elective-5 Lab	0-2-0	02	0-1-0	01	DLE
AIL805	Robotic Process Automation Lab	0-2-0	02	0-1-0	01	PC
AIPR86	Project Based Learning-Major Project Lab-B	0-12#-0	12*	0-6-0	06	PBL
INT81	Internship-VII	--	--	--	--	INT
Total		12-18-0	30	12-9-0	21	

#PBL-PR-B (Conference /Journal Publication Filing Patent, Creation of Product & Licensing, Start up, SIH, Participation etc)

*Load of learner, not the faculty

Semester- VIII-Examination Scheme

Course Code	Course Name	Examination Scheme										
		Marks										
		CA				ESE	Duration in Hrs	TW	O	P	P&O	Total
T-1	T-2	Avg. of T1 and T2	IA									
AIC801	Reinforcement Learning	30	30	30	10	60	2.30	--	--	--	--	100
AIDLC802X	Department Level Elective-5	30	30	30	10	60	2.30	--	--	--	--	100
AIDLC803X	Department Level Elective-6	30	30	30	10	60	2.30	--	--	--	--	100
ILC804X	Institute Level Elective-2	30	30	30	10	60	2.30	--	--	--	--	100
AIL801	Reinforcement Learning Lab	--	--	--	--	--	--	25	--	--	25	50
AIDLL802X	Department Level Elective-5 Lab	--	--	--	--	--	--	25	25	--	--	50
AIL805	Robotic Process Automation Lab	--	--	--	--	--	--	25	--	--	25	50
AIPR86	Project Based Learning-Major Project Lab-B	--	--	--	--	--	--	50	--	--	100	150
INT81	Internship-VII	--	--	--	--	--	--	--	--	--	--	--
Total		120	120	120	40	240	--	125	25	--	150	700

Major Project A and B: Students can form groups with minimum 2 and not more than 3

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 – V & PE-DLC – VI)

Department Level Elective-5			
Group A: Computer Networks and Programming	Group B: Applied Artificial Intelligence	Group C: Embedded System, Analytics and System Security	Group D: Bioinformatics
AIDLC8021	AIDLC8022	AIDLC8023	AIDLC8024
High Performance Computing	Design thinking and Innovation	Social Media Analytics	ML in Bioinformatics
Department Level Elective-6			
Group A: Computer Networks and Programming	Group B: Applied Artificial Intelligence	Group C: Embedded System, Analytics and System Security	Group D: Bioinformatics

AIDLC8031	AIDLC8032	AIDLC8033	AIDLC8034
Quantum Computing	Intelligent Vehicle Technology	Threat Analysis and Modelling	Biometric System Modelling and Simulation
Institute Level Elective-2			
ILC8041	ILC8042	ILC8043	ILC8044
Project Management	Finance Management	Entrepreneurship Development and Management	Human Resource Management
ILC8045	ILC8046	ILC8047	ILC8048
Professional Ethics and CSR	Research Methodology	IPR and Patenting	Digital Business Management
ILC8049			
Environmental Management			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
A1C801	Reinforcement Learning	03	--	--	03
Prerequisites	1. Machine Learning 2. Analysis of Algorithm				
Course Objectives (COBs):	1. To Learn how to define RL tasks and the core principals behind the RL. 2. To understand and work with tabular methods to solve classical control problems. 3. To understand and work with approximate solutions (deep Q network-based algorithms). 4. To learn the policy gradient methods from vanilla to more complex cases. 5. To explore recent advance in RL. 6. To recognize current advanced techniques and applications in RL.				
Course Outcomes (COs):	1. Describe Reinforcement Learning and its basics. 2. Explain tabular methods to solve classical control problems. 3. Explain approximate solutions like deep Q network-based algorithms. 4. Describe the policy gradient methods. 5. Describe recent advances in Reinforcement Learning. 6. Apply suitable RL techniques for real time 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 Reinforcement Learning	1.1 Introduction and basics of reinforcement learning (RL), Examples, Elements of RL, Limitations and Scope, History of Reinforcement Learning	CO1	03	03	
2. Tabular Solution Methods	2.1 Multi-arm Bandits, Finite Markov Decision Processes, Dynamic Programming, and Monte Carlo Methods	CO2	03	10	
	2.2 Temporal-Difference Learning, Q-Learning and n-Step algorithm		03		
	2.3 Case Study: Automatically Scaling Application Containers to Reduce Cost Extensions to Q-Learning: Standard, Double, Delay Q learning.		04		
3.Deep Q-Networks	3.1 Deep Learning Architectures-- Fundamentals, Common Neural Network Architectures, Deep Learning Frameworks, Deep Reinforcement Learning	CO3	05	09	
	3.2 Deep Q Learning -- Experience Relay, Q-Network clones, NN Architecture, Implementing DQN, Case Study: Reducing Energy Usage in Buildings		04		
4. Policy Gradient Methods	4.1 Benefits of Learning a Policy Directly Calculate the Gradient of a Policy Policy Gradient Theorem Policy Functions -- Linear Policies, Arbitrary Policies	CO4	04	08	
	4.2 Practical Reinforcement Learning The RL Project Life Cycle-- Definition RL Engineering and Refinement-- Process, Environment Engineering, State Engineering or State		04		

	Representation Learning, Policy Engineering			
5. Recent Advances	5.1 Meta-learning, Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Ethics in RL	CO5	04	04
6. Applications and Case Studies	6.1 TD Gammon Samuel's Checkers Player The Acrobot Elevator Dispatching Dynamic Channel allocation Job-Shop Scheduling	CO6	05	05
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. Dr. Phil Winder, "Reinforcement Learning: Industrial applications with intelligent Agents", O'REILLY Publication. 2. Richard S. Sutton and Andrew G. Barto , "Reinforcement Learning: An Introduction" , Second edition. 3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012). 			
Reference Books	<ol style="list-style-type: none"> 1. Enes Bilgin, Mastering Reinforcement Learning with Python: Build next-generation, self-learning models using reinforcement learning techniques and best practices, Paperback 2. Maxim Lapan , Deep Reinforcement Learning Hands-On: Apply modern RL methods to practical problems of chatbots, robotics, discrete optimization, web automation, and more, 2nd Edition Paperback 3. G. Ciaburro, Keras Reinforcement Learning Projects, Packet Publishing 4. S. Ravichandiran, Hands-on Reinforcement Learning with Python, Packet Publishing 			
Useful Links:				
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIDLC8021	High Performance Computing	03	--	--	03
Prerequisites	Digital Logic and Computer Architecture				
Course Objectives (COBs):	1. To learn concepts of parallel programming as it pertains to high-performance computing. 2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigms.				
Course Outcomes (COs):	1. Recognize parallel processing approaches. 2. Describe different Pipeline and hazard techniques. 3. Describe different parallel processing platforms involved in achieving High Performance Computing. 4. Demonstrate efficient and high-performance parallel programming. 5. Interpret Parallel Programming performance measures. 6. Learn parallel programming using message passing paradigm using open- source APIs and MPI.				
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 Introduction to Parallel Computing: Introduction to Parallelism(What, Why, Applications) Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function)	CO1	02	05	
	1.2 Classification Models: Architectural Schemes (Flynn's, Shore's, Feng's, Handler's)		01		
	1.3 Memory Access: Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory		01		
	1.4 Parallel Architectures: Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture		01		
2.Pipeline Processing	2.1 Introduction, Pipeline Performance, Arithmetic Pipelines,	CO2	02	06	
	2.2 Pipeline instruction processing, Pipeline stage design,		02		
	2.3 Hazards, Dynamic instruction scheduling		02		
3.Parallel Programming Platforms	3.1 Parallel Programming Platforms: Implicit Parallelism:	CO3	01	07	
	3.2 Trends in Microprocessor & Architectures, Limitations of Memory System Performance,		02		
	3.3 Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines		04		
4.1 Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques	4.2 Characteristics of Tasks and Interactions, Mapping	CO4	02	08	
			03		

4.Parallel Algorithm Design	Techniques for Load Balancing			
	4.3 Methods for Containing Interaction Overheads, Parallel Algorithm Models		03	
5.Performance Measures	5.1 Performance Measures: Speedup, execution time, efficiency, cost, scalability	CO5	01	05
	5.2 Effect of granularity on performance, Scalability of Parallel Systems		02	
	5.3 Amdahl's Law, Gustavson's Law, Performance Bottlenecks		02	
6.HPC Programming	6.1 Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming	CO6	02	08
	6.2 The Building Blocks: Send and Receive Operations		02	
	6.3 MPI: The Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Introduction to OpenMP		04	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	<ol style="list-style-type: none"> 1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, —Introduction to Parallel Computingl, Pearson Education, Second Edition, 2007 2. M. R. Bhujade, —Parallel Computing, 2nd edition, New Age International Publishers, 2009. 3. Georg Hager, Gerhard Wellein, —Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011. 			
Reference Books	<ol style="list-style-type: none"> 1. Michael J. Quinn, —Parallel Programming in C with MPI and OpenMPI, McGraw-Hill International Editions, Computer Science Series, 2008. 2. Kai Hwang, Zhiwei Xu, —Scalable Parallel Computing: Technology, Architecture, Programmingl, McGraw Hill, 1998. 3. Laurence T. Yang, MinyiGuo, —High- Performance Computing: Paradigm and Infrastructure Wiley, 2006 4. Kai Hwang, Naresh Jotwani, —Advanced Computer Architecture: Parallelism, Scalability, Programmabilityl, McGraw Hill, Second Edition, 2010 			
Useful Links:	<ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/106/108/106108055/ 2. https://www.coursera.org/courses?query=high%20performance%20computing 3. https://www.edx.org/learn/discrete-mathematics 4. https://www.coursera.org/specializations/discrete-mathematics 5. https://nptel.ac.in/courses/106/106/106106094/ 6. https://swayam.gov.in/nd1_noc19_cs67/preview 			
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none">• 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
AIDLC8022	Design Thinking and Innovation	03	--	--	03
Prerequisites	Basics of TBL, PBL Basics of communication skill				
Course Objectives (COBs):	<ol style="list-style-type: none"> 1.To develop creative mind-set while designing, innovating, developing, and testing solutions for new products, services and processes. 2.To understand the role of creative idea to construct innovation in the digital era and drive disruptive innovation. 3.To create a design thinking culture to drive innovation in an organizational setup. 4.To envisage innovative solutions individually and in teams for maximizing business impact 5.To develop the ability to create and test prototypes those are customer-centric and innovative. 				
Course Outcomes (COs):	After successful completion of course student will be able to: <ol style="list-style-type: none"> 1. Explain basic rules of design thinking. 2. Define the user needs for HCD design. 3. Create a design thinking culture for idea immersion. 4. Develop a story to explain idea to product and give visual experience. 5. Envisage innovative solutions individually and in teams for maximizing business impact. 6. Develop the ability to create and test prototypes that are customer-centric and innovative. 				
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 design thinking and innovation	1.1 Introduction, need for design thinking , what is design key concept of design thinking, advantages disadvantages and applications, What is Creativity?, Thinking Differently, Basic Rules of Design Thinking, A Simplified Process of Design	CO1	02	06	
			02		
			02		
2. Context, environment and design	2.1 Types of research, Ethnographic Research, Participatory Research, Evaluative Research, Effective Research for HCD Design in the World. User Context Visible and Invisible Users, Hybrid Model of Research, Identifying user needs, Re-defining the Problem, The User Value Proposition, Needs vs. Wants.	CO2	03	08	
			03		
			02		
3. Ideation and Immersion	3.1 Creative Ideation and Pattern Recognition, Developing Creative Habits, Creative Thinking Techniques, SCAMPER Brainstorming Tools, The Importance of True Immersion, Immersive Learning, Immersive Experience in the Design Process, Mindful Design Automobile Design Process	CO3	03	06	
			03		
4. Storytelling	4.1 Stories vs. Narrations Storyteller Across Time and	CO4	02	06	

and visualization	Cultures, Experimental Storytelling, Storytelling in Research, Rural storytelling, The Importance of Visuals and Visualization, Visualizing Human Experiences Storyboarding or Image Boarding		02	
			02	
5. Integrating design technology and business	5.1 Introduction to Project Management Methodologies Scrum, Kanban, and Scrumban, Customer Segmentation and Innovation, Design and Systems Thinking, Design and Systems Thinking Working Harmoniously Business Design Contributions of a Business Designer	CO5	02	06
			02	
			02	
6. Innovations project life cycle	6.1 Innovations project life cycle and innovation management Tools Lean Management Principles, Logical and Creative Thinking Product Implementation Lifecycle, Types of Innovation, Roadblocks to Idea Generation and Implementation, Strategies for Whole Brain Thinking, Design Management	CO6	02	07
			02	
			03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value" Published by Allworth Press. 2. HarperCollins, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Kindle Edition published by e-books; 1st edition 3. David Kelley and Tom Kelley, "Creative Confidence: Unleashing the Creative Potential within Us", published by William Collins. 			
Reference Books	<ol style="list-style-type: none"> 1. Christian Müller-Roterberg, "A practical guide to design thinking, Moritz Gekeler publisher Friedrich-Ebert-Stiftung (FES) Handbook of Design Thinking", Publisher: Kindle Direct Publishing ISBN: 978-1790435371 2. Idris Mootee, "Design by startigic Innovation", Published by John Wiley & Sons, Inc., Hoboken, New Jersey. 3. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers" published by Columbia University Press. 4. Jeanne Liedtka , Karen Hold , Jessica Eldridge, "Experiencing Design: The Innovator's Journey", Published by Columbia Business School Publishing. 			
Useful Links:	<ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/110106124 2. https://onlinecourses.nptel.ac.in/noc22_mg32/preview 			
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIDLC8023	Social Media Analytics	03	--	--	03
Prerequisites	Graph Theory, Data Mining, Python/R programming				
Course Objectives (COBs):	The course aims: <ol style="list-style-type: none"> 1. Familiarize the learners with the concept of social media. 2. Familiarize the learners with the concept of social media analytics and understand its significance. 3. Enable the learners to develop skills required for analyzing the effectiveness of social media. 4. Familiarize the learners with different tools of social media analytics. 5. Familiarize the learner with different visualization techniques for Social media analytics. 6. Examine the ethical and legal implications of leveraging social media data. 				
Course Outcomes (COs):	After successfully completion of the course the student will be able to <ol style="list-style-type: none"> 1. Explain the concept of Social media 2. Explain the concept of social media Analytics and its significance. 3. Analyze the effectiveness of social media 4. Apply different Social media analytics tools effectively and efficiently. 5. Apply different effective Visualization techniques to represent social media analytics. 6. Acquire the fundamental perspectives and hands-on skills needed to work with social media data. 				
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. Social Media Analytics: An Overview	1.1 Core Characteristics of Social Media, Types of Social Media, and Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations.	CO1	03	06	
	1.2 Purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools.		03		
2. Social Network Structure, Measures & Visualization	2.1 Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust.	CO2	02	06	
	2.2 Network Visualization - Graph Layout, Visualizing Network features, Scale Issues.		02		
	2.3 Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools.		04		

3. Social Media Text, Action & Hyperlink Analytics	3.1 Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools	CO3	04	08
	3.2 Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools		02	
	3.3 Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools.		02	
4.Social Media Location & Search Engine Analytics	4.1 Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools.	CO4	03	06
	4.2 Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools.		03	
5. Social Information Filtering	5.1 Social Information Filtering - Social Sharing and filtering , Automated Recommendation systems, Traditional Vs social Recommendation Systems	CO5	03	06
	5.2 Understanding Social Media and Business Alignment, Social Media KPI, Formulating a Social Media Strategy, Managing Social Media Risks		03	
6. Social Media Analytics Applications and Privacy	6.1 Social media in public sector - Analyzing public sector social media, analyzing individual users, case study.	CO6	02	07
	6.2 Business use of Social Media - Measuring success, Interaction and monitoring, case study.		03	
	6.3 Privacy - Privacy policies, data ownership and maintaining privacy online.		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours			42	
Books:				
Text Books	<ol style="list-style-type: none"> Gohar F. Khan, Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, (ISBN-10: 1507823207). Jennifer Golbeck, Analyzing the Social Web 1st Edition Matthew A Russell, Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, O'Reilly. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011. 			
Reference Books	<ol style="list-style-type: none"> Matthew Ganis, Avinash Kohirkar, Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, IBM Press Alex Gonçalves, Social Media Analytics Strategy_ Using Data to Optimize Business Performance, A Press Business Team Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulos, Social Media Data Mining and Analytics, (2019), Wiley, ISBN 978-1-118-82485-6. Siddhartha Chatterjee, Michal Krystyanczuk, Python Social Media Analytics: Analyze and visualize data from Twitter, YouTube, GitHub, and more Kindle Edition. Raghav Bali, Dipanjan Sarkar, Tushar Sharma.Learning, Social Media Analytics with 			

	<p>R</p> <p>6. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann, 2013.</p> <p>7. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, Github, and More, 2nd Edition, O'Reilly Media, 2013.</p> <p>8. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011.</p>
Useful Links:	https://cse.iitkgp.ac.in/~pawang/courses/SC16.html
	https://onlinecourses.nptel.ac.in/noc20_cs78/preview
	https://nptel.ac.in/courses/106106146
	https://7layersanalytics.com/
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIDL8024	ML in Bioinformatics	03	--	--	03
Prerequisites	1. Molecular Biology, 2. Machine Learning				
Course Objectives (COBs):	1. To learn cellular molecular biology 2. Learn how to implement machine learning for biological problems 3. Learn algorithms used in machine learning. 4. Apply machine learning to practical projects.				
Course Outcomes (COs):	After successful completion of course, students will be able - 1. Explain basic cell architecture and structure of DNA 2. Apply probabilistic framework in bioinformatics 3. Apply nearest neighbor clustering in bioinformatics 4. Apply suitable machine learning algorithm 5. Evaluate prediction performance using neural network 6. Explain future techniques applicable in bioinformatics				
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 bioinformatics	1.1: The structure, content and scale of DNA, basic cell architecture, genes and proteins, genomes- diversity, size and structure, information content of biological sequences.	CO1	03	08	
	1.2: Introduction to search and its algorithm, complexity of search, use of graph in bioinformatics		02		
2. ML foundation-I	2.1: Introduction to probability, Baye's Theorem, Bayesian network.	CO2	02	08	
	2.2: Bayesian Modelling, Bayesian inference and induction, The Cox Jaynes Axioms, graphical model structure		03		
	2.3: Probabilistic modelling and inference examples, the simplest sequence models, statistical mechanics		03		
3. ML foundation-II	3.1: Introduction, Nearest neighbour method, Nearest neighbour approach for secondary structure protein folding prediction	CO3	03	08	
	3.2: Clustering- Advanced clustering techniques, Application guidelines		02		
	3.3: Decision Tree- Methods, Gain criterion, Over fitting and pruning, Application guidelines, Bioinformatics applications		03		
4. ML algorithms	4.1: Introduction, dynamic programming, gradient descent algorithm	CO4	03	08	
	4.2: EM/GEM algorithms		02		
	4.3: Markov Chain, Monte-Carlo Methods, Simulated Annealing, Evolutionary and Genetic Algorithms, Learning Algorithms: Miscellaneous Aspects.		03		

5. Neural Network application	5.1: Sequence Encoding and Output Interpretation, Sequence Correlations and Neural Networks, Prediction of Protein Secondary Structure	CO5	02	05
	5.2: Prediction of Signal Peptides and Their Cleavage Sites, Applications for DNA and RNA Nucleotide Sequences , Prediction Performance Evaluation, Different Performance Measures		03	
6. Future Techniques	6.1: Genetic Programming- Method, Application guidelines, Bioinformatics applications	CO6	02	05
	6.2: Cellular Automata- Method, Application guidelines, Bioinformatics applications, hybrid method		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1. Edward Keedwell and Ajit Narayanan, Intelligent Bioinformatics: The Application of Artificial Intelligence Techniques to Bioinformatics Problems, Wiley (2005). 2. P Baldi and S Brunak, Bioinformatics: The Machine Learning Approach, (2001)			
Reference Books	1. Olson et al., 2018. Data-driven advice for applying machine learning to bioinformatics problems, 2. Husmeier D, Dybowski R, and Roberts S (2005), Probabilistic Modeling in Bioinformatics and Medical Informatics, Springer, 3. Kim JB, Porreca GJ, Song L, Greenway SC, Gorham JM, Church GM, Seidman CE, Seidman JG. Polony multiplex analysis of gene expression (PMAGE) in mouse hypertrophic cardiomyopathy. Science. 2007 Jun 8; 316(5830):1481-4. PubMed PMID: 17556586. 4. MacBeath G, Schreiber SL. Printing proteins as microarrays for high-throughput function determination. Science. 2000 Sep 8; 289(5485):1760-3. PubMed PMID: 10976071. 5. Shankar J, Wu TD, Clemons KV, Monteiro JP, Mirels LF, et al. (2011) Influence of 17b-Estradiol on Gene Expression of Paracoccidioides during Mycelia-to- Yeast Transition. PLoS ONE 6(12): e28402. doi: 10.1371/journal.pone.0028402, 6. Published in final edited form as: Nature. 2015 Oct 15; 526(7573): 343–350. doi: 10.1038/nature1581.			
Useful Links:	1. https://www.advancedsciencenews.com/machine-learning-for-bioinformatics-and- neuroimaging/ 2. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_neural_networks.htm 3. https://www.analyticsvidhya.com/blog/2017/09/understaing-support-vector-machine- example-code/ 4. Link to NPTEL course contents: https://nptel.ac.in/courses/106104019/			
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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
AIDLC8031	Quantum Computing	03	--	--	03
Prerequisites	----				
Course Objectives (COBs):	1. To introduce the fundamentals of quantum computing 2. The problem solving approach using finite dimensional mathematics				
Course Outcomes (COs):	After the completion of course, students will be able to 1. Explain the basic principles of quantum computing. 2. Explain basic concepts of linear algebra required for quantum computing 3. Explain 1-qubit and 2-qubit gate operations and gain the ability to build simple quantum circuits 4. Analyze algorithms and compare effectiveness versus classical algorithms 5. Analyze the effectiveness of simple error correction codes				
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 and Background	1.1 Overview, Circuit model of computation,	CO1	02	06	
	1.2 A linear Algebra Formulation of the circuit model,		01		
	1.3 Review of Quantum Physics, Quantum physics and computations		02		
2.The linear Algebra and Dirac Notation	2.1 Dirac Notation and Hilbert Spaces, Dual Vectors , operators,	CO2	03	08	
	2.2 The spectral Theorem, Functions of operators,		02		
	2.3 Tensor Products, The Schmidt decomposition theorem		03		
3.Qubits and Framework of quantum mechanics	3.1 State of quantum system, Time evolution of closed system, composite systems, Measurements	CO3	03	09	
	3.2 Mixed states and general quantum operations		02		
	3.3 The quantum circuit model, Quantum gates,		02		
	3.4 Universal states of quantum gates		02		
4. Introductory Quantum Algorithms	4.1 Probabilistic versus Quantum Algorithms, Phase Kick-Back	CO4	02	08	
	4.2 Deutsch Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Problem		04		
	4.3 Simon's Algorithm		02		
5. Algorithms Based on Amplitude Amplification	5.1 Grover's Quantum Search Algorithm, Amplitude amplification, The Geometry of Amplitude Amplification	CO4	02	06	
	5.2 Quantum Amplitude estimation and quantum counting Practical Implications of Grover's Algorithm and Amplitude Amplification		04		
6.Quantum Error Correction	6.1 Classical error correction, The classical 3 bit code	CO5	01	05	

	6.2 Quantum error correction, error models for quantum computing		02	
	6.3 Three and Nine qubit quantum codes, Fault Tolerant quantum computation		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Reference Books	<ol style="list-style-type: none"> 1. Phillip Kaye Raymond Laflamme Michele Mosca, "An Introduction to Quantum Computing", by Oxford University Press Inc., New York 2. Eleanor Rieffel and Wolfgang Polak, "Quantum Computing: A Gentle Introduction, by The MIT Press Cambridge, Massachusetts London, England. 3. David McMahon, Quantum computing explained, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008. 			
Useful Links:	Online math tutorial: http://patrickjmt.com/			
Continuous Assessment:	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIDL8032	Intelligent Vehicle Technology	03	--	--	03
Prerequisites	----				
Course Objectives (COBs):	1. To understand the basics of electric vehicle system, their design methodologies, architecture and fundamentals. 2. To analyze various electric motors drives suitable for electric vehicles. 3. To discuss hybrid electric vehicles and their management. 4. To discuss different propulsion systems used for electric vehicles and their management. 5. To design different configurations of electric vehicles and components, sizing of components, design optimization and energy management. 6. To discuss intelligent controls for electric vehicles.				
Course Outcomes (COs):	After successful completion of course student will be able to: 1. Describe electrical vehicle system. 2. Identify suitable motor for electric vehicles. 3. Discuss hybrid vehicle technologies. 4. Explain electric vehicle propulsion systems. 5. Design electric vehicles. 6. Explain intelligent controls for electric vehicles.				
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. Vehicle Mechanics Roadway Fundamentals	1.1 Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power,	CO1	02	06	
	1.2 Force-Velocity Characteristics, Maximum Gradability.		02		
	1.3 Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile,		02		
	1.4 Distance Traversed, Tractive Power, Energy Required, Nonconstant FTR, General Acceleration, Propulsion System Design.		02		
2. Electric Vehicles Configuration	2.1 Electric and Hybrid Electric Vehicles Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics. , Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving	CO2	04	08	
	2.2 Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.		04		
3. Hybrid Electric vehicles	3.1 Types of EVs, Hybrid Electric Drive-train, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Introduction to Energy Storage.	CO3	08	08	
4. Electric Propulsion	4.1 Electric Propulsion EV consideration, DC motor drives and speed control, Induction motor drives,	CO4	03	05	
			02		

	Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives			
5. Design of Electric and Hybrid Electric Vehicles	5.1 Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator,	CO5	03	05
	5.2 Design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, and energy storage design.		02	
6. Intelligent Electric Vehicle	6.1 Intelligent Hybrid Battery Management System for Electric Vehicle, Rule-Based Control, Optimization-Based Control, AI-Based Control, Traffic (Look Ahead Method) Based Control.	CO6	08	08
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design CRC Press 2005. 2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press 2003.			
Reference Books	1. Chitra A., Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, S. Himavathi Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles, ISBN: 978-1-119-68190-8 July 2020 2. Emadi, A., Miller, J., Ehsani, M., Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003. 3. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010. 4. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012. 5. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013. 6. Amir Khajepour, Saber Fallah, Avesta Goodarzi, Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic, Wiley 7. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics.			
Continuous Assessment (CA):	<ul style="list-style-type: none"> 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):	<ul style="list-style-type: none"> 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
AIDLC8033	Threat Analysis and Modeling	03	--	--	03
Prerequisites	1.Cryptography and network security				
Course Objectives (COBs):	1. To learn concepts of threat modeling 2. To explore and manage various threats				
Course Outcomes (COs):	1. Explain strategies for threat modeling 2. Find different threats 3. Explore attack trees and attack libraries. 4. Classify and address threats. 5. Apply various threat modeling tools for web, cloud and mobile. 6. Interpret threats to cryptosystems.				
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 Dive In and Threat Model, Learning to Threat Model.	CO1	03	06	
	1.2 Strategies for Threat Modeling, Brainstorming Your Threats, Structured Approaches to Threat Modeling, Models of Software		03		
2.Finding Threats	2.1 STRIDE, Spoofing Threats, Tampering Threats, Repudiation Threats, Information Disclosure Threats	CO2	04	05	
	2.2 Denials-of-Service Threats.		01		
3.Attack Trees	3.1 Attack Trees, Working with Attack Trees, Representing a Tree, Real Attack Trees.	CO3	02	04	
	3.2 Attack Libraries, Properties of Attack Libraries.		02		
4 Managing and Addressing Threats	4.1, Processing and Managing Threats	CO4	02	08	
	4.2 Starting the Threat Modeling Project, Digging Deeper into Mitigations, Tracking with Tables and Lists, Scenario-Specific Elements of Threat Modeling. Defensive Tactics and Technologies.		03		
	4.3 Tactics and Technologies for Mitigating Threats, Addressing Threats with Patterns, Mitigating Privacy Threats.		03		
5 Threat Modeling Tools	5.1 Generally Useful Tools, Open-Source Tools, Commercial Tools.	CO5	03	07	
	5.2 Web and Cloud Threats, Web Threats, Cloud Tenant Threats, Cloud Provider Threats, Mobile Threats.		04		
6. Threats to Cryptosystems	6.1 Cryptographic Primitives, Classic Threat Actors, Attacks against Cryptosystems	CO6	03	09	
	6.2 Building with Crypto, Things to Remember about		03		

	Crypto Experimental Approaches.			
	6.3 Looking in the Seams, Operational Threat Models, Threats to Threat Modeling Approaches, How to Experiment.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1 Adam Shostack, "Threat Modeling: Designing for Security Designing for Security" Wiley publication, Edition, 2008. 2. Frank Swiderski, Window Snyder "Threat Modeling (Microsoft Professional)" Microsoft Press, Edition, 2008.			
Reference Books	1 Adam Shostack, "Threat Modeling: Designing for Security Designing for Security" Wiley publication, Edition, 2008. 2. Frank Swiderski, Window Snyder "Threat Modeling (Microsoft Professional)" Microsoft Press, Edition, 2008.			
Useful Links:	Introduction to Threat Modeling - Threat Modeling Coursera			
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIDLC8034	Biometric System Modeling and Simulation	03	--	--	03
Prerequisites	1. Machine Learning				
Course Objectives (COBs):	1. To understand the technologies of fingerprint, iris, face and speech recognition 2. To understand the general principles of design of biometric systems and the underlying trade-offs. 3. To recognize personal privacy and security implications of biometrics based identification technology. 4. To identify issues in the realistic evaluation of biometrics based systems.				
Course Outcomes (COs):	1. Demonstrate knowledge engineering principles underlying biometric systems. 2. Design basic biometric system applications. 3. Apply biometric system for face recognition. 4. Explain biometric system used for Iris recognition. 5. Explain biometric system used for speaker recognition. 6. Explain personal authentication system.				
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. Human Body and Biometrics	Our Body: Overview, Physical Structures, Behavioural Characteristics, Ways of Behaving	CO 2, CO 3	04	04	
2. Fingerprint Identification Technology	Review of Fingerprint Systems, Definitions and Notations, Fingerprint Image Processing, Minutiae Determination, Fingerprint Matching.	CO 1	08	08	
3. Face Recognition	Introduction to Face Recognition System Detection and Location of Faces, Features Extraction and Face Recognition	CO 1	07	07	
4. Iris Biometrics	Introduction, Iris Recognition, Coordinate System, Texture Energy Feature	CO 1	04	04	
5. Speaker Recognition	Introduction, Principles of Speaker Recognition, GSMSV Method.	CO 4	07	07	
6. Personal Authentication	Examples of Current Applications, Potential Application Areas, How to Select a Biometrics System, Application Programming Interface Standards	CO 4	08	08	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	02	02	
Total hours				42	
Books:					
Text Books	1. David D. Zhang, Automated Biometrics: Technologies and Systems, Kluwer Academic Publishers, New Delhi, 2000. 2. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, Biometric Systems, Technology Design and Performance Evaluation, Springer, 2005. 3. Arun A. Ross, Karthik Nandakumar, A.K.Jain, Handbook of Multibiometrics, Springer, New Delhi, 2006.				
Reference	1. Paul Reid, Biometrics for Network Security, Pearson Education, 2004.				

Books	<ol style="list-style-type: none"> 2. Nalini K Ratha, Ruud Bolle, Automatic fingerprint Recognition System, Springer, 2003 3. L C Jain, I Hayashi, S B Lee, U Halici, Intelligent Biometric Techniques in Fingerprint and Face Recognition CRC Press, 1999. 4. John Chirillo, Scott Blaul, Implementing Biometric Security, John Wiley, 2003. 5. S.Y. Kung, S.H. Lin, M.W.Mak, Biometric Authentication: A Machine Learning Approach Prentice Hall, 2005
Useful Links:	<ol style="list-style-type: none"> 1. https://www.udemy.com/course/biometrics/ 2. https://www.coursera.org/lecture/usable-security/biometric-authentication-RXVog
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8041	Project Management	03	--	--	03
Course Objectives (COBs):	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.				
Course Outcomes (COs):	1. Apply selection criteria and select an appropriate project from different options. 2. Write work break down structure for a project and develop a schedule based on it. 3. Identify opportunities and threats to the project and decide an approach to deal with them strategically. 4. Use Earned value technique and determine & predict status of the project. 5. Capture lessons learned during project phases and document them for future reference 6. Inculcate leadership qualities and ethics.				
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. Project Management Foundation	1.1 Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process.	CO1	02	05	
	1.2 Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).		03		
2. Initiating Projects	2.1 How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models)	CO2	03	06	
	2.2 Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.		03		
3. Project Planning and Scheduling	3.1 Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering,	CO3	03	08	
	3.2 Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart.		03		

	3.3 Introduction to Project Management Information System (PMIS).		02	
4.Planning Projects	4.1 Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan.	CO4	02	06
	4.2 Risk Management in projects: Risk management planning, Risk identification and risk register.		02	
	4.3 Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks		02	
5. Executing Projects	5.1 Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings.	CO5	03	08
	5.2 Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit.		03	
	5.3 Project procurement management, contracting and outsourcing.		02	
6.Project Leadership and Ethics	6.1 Introduction to project leadership, ethics in projects. Multicultural and virtual projects.	CO6	03	06
	6.2 Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
			Total hours	42
Books:				
Text Books	1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7 th Edition. 2. A Guide to the Project Management Body of Knowledge (PMBOK [®] Guide), 5 th Ed, Project Management Institute PA, USA 3. Gido Clements, Project Management, Cengage Learning.			
Reference Books	1.Gopalan, Project Management, Wiley India 2.Dennis Lock, Project Management, Gower Publishing England, 9 th Edition			
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none">• End Semester Exam shall be conducted for Total 60 Marks.• Duration of End Semester Exam shall be 02 Hours and 30 Minutes.
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Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC8042	Finance Management	03	--	--	03
Course Objectives (COs):	1. Overview of Indian financial system, instruments and market 2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management 3. Knowledge about sources of finance, capital structure, dividend policy				
Course Outcomes (COs):	After successful completion of course student will be able to: 1. Describe Indian financial system 2. Apply basic concepts of returns and risks. 3. Explain basic concepts of Time value of money. 4. Explain sources of finance, capital structure, dividend policy 5. Explain basic concepts of corporate finance 6. Apply basic concepts of working capital 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. Overview of Indian Financial System:	1.1 Characteristics, Components and Functions of Financial System	CO1	02	06	
	1.2 Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments-Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.		02		
	1.3 Financial Markets: Meaning, characteristics and Classification of Financial Markets Capital Market, Money Market and Foreign Currency Market		02		
	1.4 Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges				
2. Concepts of Returns and Risks:	2.1 Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	CO2	04	08	
	2.2 Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.		04		
3. Overview of Corporate Finance	Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	CO3	08	08	

	Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.			
4. Capital Budgeting:	Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity’s Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	CO4	04	04
5. Sources of Finance	Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity’s Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure.	CO5	03	05
			02	
6. Dividend Policy	Meaning and Importance of Dividend Policy; Factors Affecting an Entity’s Dividend Decision; Overview of Dividend Policy Theories and Approaches Gordon’s Approach, Walter’s Approach, and Modigliani-Miller Approach	CO6	08	08
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1. Eugene F. Brigham and Joel F Houston; Fundamentals of Financial Management, 13th Edition (2015) Publisher: Cengage Publications, New Delhi. 2. Robert C. Higgins; Analysis for Financial Management, 10th Edition (2013) by Publishers: McGraw Hill Education, New Delhi.			

Reference Books	<p>1.M. Y. Khan; Indian Financial System, 9th Edition (2015) Publisher: McGraw Hill Education, New Delhi.</p> <p>2.I. M. Pandey; Financial Management, 11th Edition (2015) Publisher: S. Chand (G/L) & Company Limited, New Delhi.</p>
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8043	Entrepreneurship Development and Management	03	--	--	03
Course Objectives (COBs):	<ol style="list-style-type: none"> To acquaint with entrepreneurship and management of business. Understand Indian environment for entrepreneurship. Idea of EDP, MSME. Discuss the government plan for startup business. Analyze the business risk. Discuss the successful business stories. 				
Course Outcomes (COs):	<p>Upon completion of the course, the learners will be able to:</p> <ol style="list-style-type: none"> Explain the concept of Business Plan and the Role of Money and Capital Markets in Entrepreneurial Development. Analyze Key regulations and legal aspects of entrepreneurship in India. Explain Government Policies for Startup. Describe Different Government initiatives for Startup. Explain Issues and Problems Faced by Micro and Small Enterprises. Describe Growth Strategies for small businesses. 				
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. Overview Of Entrepreneurship:	1.1 Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development.	CO1	01	04	
	1.2 Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur.		01		
	1.3 Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship.		02		
2. Business Plans And Importance Of Capital To Entrepreneurship:	2.1 Introduction: Preliminary and Marketing Plans, Management and Personnel.	CO2	02	09	
	2.2 Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur.		03		
	2.3 Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business.		02		
	2.4 New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations.		02		
3. Women's Entrepreneurship Development	Women's Entrepreneurship Development, Social Entrepreneurship-Role and Need, EDP Cell, Role of Sustainability and Sustainable Development for SMEs, Case Studies, Exercises.	CO3	05	05	

4. Indian Environment for Entrepreneurship	4.1 Key Regulations and Legal Aspects, MSMED Act 2006 and its Implications, Schemes and Policies of the Ministry of MSME, Role and Responsibilities of various Government Organisations, Departments, Banks etc.	CO4	03	09
	4.2 Role of State Governments in Terms of Infrastructure Developments and Support etc.		04	
	4.3 Public Private Partnerships, National Skill Development Mission, Credit Guarantee Fund, PMEGP, Discussions, Group Exercises etc.		02	
5. Effective Management of Business	5.1 Issues and Problems Faced by Micro and Small Enterprises and Effective Management of M and S Enterprises.	CO5	04	08
	5.2 Risk Management, Credit Availability, Technology Innovation, Supply Chain Management, Linkage with Large Industries, Exercises, E-Marketing.		04	
6. Achieving Success In The Small Business:	6.1 Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	CO6	04	04
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. P Charantimath, Entrepreneurship Development- Small Business Enterprise, Pearson 2. R Hisrich and M Peters, Entrepreneurship, the McGraw Hill Company. 3. D Kuratko, Entrepreneurship- Principles and Practices, Thomson Publication 			
Reference Books	<ol style="list-style-type: none"> 1. Dr T Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi. 2. Law and Practice Relating to Micro, Small and Medium Enterprises, Taxmann Publication Ltd. 3. L Maddhurima, S Shikah, Entrepreneurship, Excel Books. 4. R Bansal, STAY Hungry STAY Foolish, CIIE, IIM Ahmedabad 			
Useful Links:	<ol style="list-style-type: none"> 1. www.msme.gov.in 2. www.dcmesme.gov.in 3. www.msmetraining.gov.in 			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Duration of End Semester Exam shall be 02 Hours and 30 Minutes. 			

**Examination
(ESE):**

- End Semester Exam shall be conducted for Total 60 Marks.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC8044	Human Resource Management	03	--	--	03
Course Objectives (COBs):	<p>1.To introduce the students with basic concepts, techniques and practices of the human resource management.</p> <p>2.To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.</p> <p>3.To familiarize the students about the latest developments, trends & different aspects of HRM.</p> <p>4.To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers.</p>				
Course Outcomes (COs):	<p>Upon completion of the course, the learners will be able to:</p> <p>1.Describe the concepts, aspects, techniques and practices of human resource management.</p> <p>2.Describe the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.</p> <p>3.Apply the knowledge about the latest developments and trends in HRM.</p> <p>4.Analyze the knowledge of Cross-cultural Leadership and Decision Making.</p> <p>5.Apply the knowledge of behavioral skills learnt and integrate it with in interpersonal and intergroup environment emerging as future stable engineers and managers.</p> <p>6.Apply the Labor Laws & Industrial Relations and various Act.</p>				
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 HR	1.1 Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.	CO1	02	05	
	1.2 Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.		03		
2. Organizational Behavior (OB)	2.1 Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues.	CO2	01	07	
	2.2 Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for		02		

	Increasing Self Awareness.			
	2.3 Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour.		02	
	2.4 Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor).		01	
	2.5 Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.		01	
	2.6 Case study		01	
3. Organizational Structure & Design	3.1 Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	CO3	02	06
	3.2 Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.		02	
	3.3 Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.		02	
4. Human resource Planning	4.1 Recruitment and Selection process, Job-enrichment, Empowerment-Job-Satisfaction, employee morale.	CO4	02	05
	4.2 Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning.		01	
	4.3 Training & Development: Identification of Training Needs, Training Methods		02	
5. Emerging Trends in HR	5.1 Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment.	CO5	03	06
	5.2 Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.		03	
6. HR & MIS	6.1 Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries.	CO6	03	10
	6.2 Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent –		03	

	Corporate Mission, Vision, Objectives and Goals.			
	6.3 Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act.		04	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1.S. Robbins, Organizational Behavior, Pearson Education Limited. 2.V.S.P. Rao, Human Resource Management, Excel publishing. 3.K. Aswathapa, Human resource management: Text & cases.			
Reference Books	1.C. B. Mamoria and S. V. Gankar, Dynamics of Industrial Relations in India, Himalaya Publishing. 2.P. Subba Rao, Essentials of Human Resource management and Industrial relations, Himalaya Publishing. 3.L. Mullins, Management & Organizational Behavior, Pearson Publications.			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8045	Professional Ethics and Corporate Social Responsibility	03	--	--	03
Course Objectives (COBs):	1.To understand professional ethics in business 2.To recognized corporate social responsibility				
Course Outcomes(COs):	1. Explain rights and duties of business 2. Explain and understand the ethics in market and towards environment 3. Solve the problems of consumers and job discrimination ethically 4. Show corporate and social responsibility 5. Distinguish different aspects of corporate social responsibility 6. Explain global aspects of corporate social responsibility				
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. Professional Ethics and Business	The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	CO1	04	04	
2. Professional Ethics in the Marketplace	Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy. Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	CO2	04	08	
3. Professional Ethics of Consumer Protection	Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	CO3	04	06	
4. Introduction to Corporate Social Responsibility	Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	CO4	05	05	
5. Corporate Social Responsibility	Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and ublic-Private Partnership (PPP) in India	CO5	08	08	
6. Corporate Social Responsibility in Globalizing India	Corporate Social Responsibility voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility	CO6	08	08	

	Companies Act, 2013.			
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	Ananda Das Gupta; Business Ethics: Texts and Cases from the Indian Perspective (2013) Publisher Springer.			
Reference Books	2. Andrew Crane, Dirk Matten, Laura Spence; Corporate Social Responsibility: Readings and Cases in a Global Context (2007) Publisher: Routledge. 3. Manuel G. Velasquez; Business Ethics: Concepts and Cases, 7th Edition (2011) Publisher: Pearson, New Delhi. 4. Bidyut Chakrabarty, Routledge, Corporate Social Responsibility in India (2015) New Delhi.			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8046	Research Methodology	03	--	--	03
Prerequisite:	-----				
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. Describe about the methodologies in research. 2. Prepare a preliminary research design for projects in their subject matter areas. 3. Accurately collect, analyze and report data. 4. Present complex data or situations clearly. 5. Review and analyze research findings. 6. Summarize the different aspects and steps in conducting research.				
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 and Basic Research Concepts	1.1 Research Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	CO1	02	09	
	1.2 Need of Research in Business and Social Sciences		02		
	1.3 Objectives of Research		01		
	1.4 Issues and Problems in Research		02		
	1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical		02		
2. Types of Research	2.1. Basic Research	CO1, CO2	01	07	
	2.2. Applied Research		01		
	2.3. Descriptive Research		01		
	2.4. Analytical Research		01		
	2.5. Empirical Research		01		
	2.6. Qualitative and Quantitative Approaches		02		
3. Research Design and Sample Design	3.1 Research Design: Meaning, Types and Significance	CO1	04	07	
	3.2 Sample Design Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors		03		
4. Research Methodology	4.1 Meaning of Research Methodology	CO6	01	08	
	4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem		07		

	b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis Hypothesis testing and Interpretation of Data Preparation of Research Report			
5. Formulating Research Problem	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	CO4, CO5	04	04
6. Outcome of Research	6.1 Preparation of the report on conclusion reached	CO3	02	04
	6.2 Validity Testing & Ethical Issues		01	
	6.3 Suggestions and Recommendation		01	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	1. C. Kothari, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited, 1985.			
Reference Books	1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors. 2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited. 3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step guide for Beginners, (2 nd ed), Singapore, Pearson Education			
Useful Links:	https://libguides.newcastle.edu.au/researchmethods			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8047	IPR and Patenting	03	--	--	03
Prerequisite:	---				
Course Objectives (COBs):	1.To understand intellectual property rights protection system 2.To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures 3.To get acquaintance with Patent search and patent filing procedure and applications.				
Course Outcomes (COs):	After successful completion of the course student will be able to 1. Explain Intellectual Property assets 2. Explain the enforcements in IPR 3. Investigate the issues in IPR. 4. Illustrate basics of patent. 5. Explain the patent rules 6. Apply the procedure of filing patent nationally and internationally				
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 Intellectual Property Rights (IPR)	1.1 Meaning of IPR, Different category of IPR instruments Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.	CO1	03	05	
	1.2 Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development		02		
2. Enforcement of Intellectual Property Rights	2.1 Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement.	CO2	03	07	
	2.2 Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.		04		
3. Emerging Issues in IPR	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional	CO3	05	05	

	knowledge etc.			
4. Basics of Patents	Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	CO4	07	07
5. Patent Rules	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	CO5	08	08
6. Procedure for Filing a Patent (National and International)	Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement. Patent databases: Important websites, Searching international databases	CO6	07	07
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India 2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws 3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International 4. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell 5. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO 			
Reference Books	<ol style="list-style-type: none"> 1. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, 2. TMHR Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books 3. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books 4. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications 5. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications 6. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights, 7. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company 			

	8. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency 9. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET 10. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press
Continuous Assessment (CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
ILC8048	Digital Business Management	03	--	--	03
Course Objectives(COBs):	1.To familiarize with digital business concept 2.To acquaint with E-commerce 3.To give insights into E-business and its strategies				
Course Outcomes(COs):	After the successful completion of this course, learner will be able to: 1. Identify drivers of digital business. 2. Reviewing the concepts of E-commerce. 3. Devise the services of Digital Business. 4. Illustrate various techniques of managing E-business. 5. Illustrate various approaches of E-business Strategy. 6. Prepare E-business Plan.				
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 Business	1.1 Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy.	CO1	06	09	
	1.2 Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines /services) Opportunities and Challenges in Digital Business.		03		
2. Overview of E-Commerce	E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behaviour, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	CO2	06	06	
3. Digital Business Support services	ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development:	CO3	06	06	

	Building Digital business applications and infrastructure			
4. Managing E-Business	Managing Knowledge, Management skills for e-business, Managing Risks in e-business Security Threats to e-business - Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	CO4	06	06
5. E-Business Strategy	E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	CO5	04	04
6. Materializing e-business	From Idea to Realization-Business plan preparation. Case Studies and presentations	CO6	08	08
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011. 2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002. 3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014. 4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006. 			
Reference Books	<ol style="list-style-type: none"> 1. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson 2. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer 3. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan 4. E-Governance-Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance 5. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5 6. Measuring Digital Economy-Anewperspective-DOI:10.1787/9789264221796 enECD Publishing 			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none">• End Semester Exam shall be conducted for Total 60 Marks.• Duration of End Semester Exam shall be 02 Hours and 30 Minutes.
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Course Code	Course Name	Credits			
		TH	P	TUT	Total
ILC8049	Environmental Management	03	--	-	03
Prerequisites	General Awareness of environment and factors affecting the environment.				
Course Objectives (COBs):	1. Understand and identify environmental issues relevant to India and global concerns 2. Learn concepts of ecology 3. Familiarise environment related legislations 4. Understand to protect and sustain our natural resources of land, water, air, and vegetation.				
Course Outcomes (COs):	1. Interpret the concept of environmental management. 2. Learn the ecosystem and interdependence, food chain etc. and interpret environment related legislations. 3. Identify the environmental issues important to India. 4. Explain the regulating policies of Government in environmental management. 5. Identify solutions to protect the environment from pollution. 6. Examine the quality environmental 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 and Definition of Environment	1.1 Significance of Environment Management for contemporary managers	CO1	02	10	
	1.2 Career opportunities		01		
	1.3 Environmental issues relevant to India		02		
	1.4 Sustainable Development		03		
	1.5 The Energy scenario		02		
2. Global Environmental concerns	2.1 Global Warming	CO3	01	06	
	2.2 Acid Rain		01		
	2.3 Ozone Depletion		01		
	2.4 Hazardous Wastes	CO3, CO5	0.5		
	2.5 Endangered life-species		0.5		
	2.6 Loss of Biodiversity		01		
	2.7 Industrial/Man-made disasters/Atomic/Biomedical hazards, etc		01		
3. Concepts of Ecology	3.1 Ecosystems and interdependence between living organisms	CO2	01	05	
	3.2 Habitats		0.5		
	3.3 limiting factors		0.5		
	3.4 Carrying capacity		01		
	3.5 Food chain		01		
	3.6 Ecology		01		
4. Scope of Environment Management	4.1 Scope of Environment Management	CO1, CO4	03	10	
	4.2 Role & functions of Government as a planning and regulating agency.		03		

	4.3 Environment Quality Management and Corporate Environmental Responsibility		04	
5. Quality Environmental Management	5.1 Total Quality Environmental Management	CO6	02	05
	5.2 ISO-14000		02	
	5.3 EMS certification		01	
6. General overview of major legislations	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	CO3, CO4	03	03
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Books:				
Text Books	<ol style="list-style-type: none"> 1. C J Barrow, Routledge; Environmental Management: Principles and Practice, Publishers London, 1999 2. Jon C. Lovett and David G. Ockwell; A Handbook of Environmental Management Edited by, Edward Elgar Publishing 3. V Ramachandra and Vijay Kulkarni, Environmental Management TERI Press 			
Reference Books	<ol style="list-style-type: none"> 1. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005 2. Mary K Theodore and Louise Theodore, Introduction to Environmental Management, CRC 3. Majid Hussain, Environment and Ecology, 3rd Ed. Access Publishing, 2015 4. S N Chary and Vinod Vyasulu; Environmental Management: An Indian Perspective, Macmillan India, 2000 			
Useful Links:	<ol style="list-style-type: none"> 1. https://libguides.library.qut.edu.au/EVB302_Environmental_pollution/links 2. https://www.epd.gov.hk/epd/epic/english/epichome.html 3. http://www.ecovacservices.com/Useful-Links-6-5511.html 			
Continuous Assessment(CA):	<ul style="list-style-type: none"> • 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):	<ul style="list-style-type: none"> • 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
AIL801	Reinforcement Learning Lab	--	01	--	01
Lab Prerequisite:	Machine Learning. Analysis of Algorithm. Python.				
Lab Objectives (LOBs):	1. To cover basic concepts and theory related to Reinforcement Learning. 2. To learn different RL algorithms.				
Lab Outcomes (LOs):	1. Demonstrate the used of tabular methods to solve classical control problems. 2. Implement approximate solutions like deep Q network-based algorithms. 3. Apply the policy gradient methods. 4. Apply dynamic programming in Reinforcement Learning. 5. Demonstrate how to implement Q learning method. 6. Apply suitable RL techniques for real time applications.				
Lab No.	Experiment Title	LO mapped	Hrs/Lab		
0	Lab Prerequisite	--	02		
1	Implementation of following algorithms:	LO1	02		
2	Bandit Problems: Epsilon Greedy Agent	LO1	02		
3	Markov Decision Processes: Episode Returns	LO1	02		
4	Markov Decision Processes: Returns and Discount Factors	LO2	02		
5	The Bellman Equation	LO3	02		
6	Iterative Policy Evaluation and Improvement	LO3	02		
7	Policy Evaluation and Iteration	LO4	02		
8	Dynamic Programming	LO5	02		
9	Q-Learning and Sampling Based Methods	LO1	02		
10	Monte Carlo Rollouts	LO6	02		
11	Case studies	LO1	02		
Useful Lab Links:	1. Fundamentals of Deep Reinforcement Learning edX 2. https://www.incompleteideas.net/book/RLbook2020.pdf				
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 “Reinforcement Learning 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
AIDLL8021	High Performance Computing Lab	--	01	--	01
Lab Prerequisite:	Operating Systems				
Lab Objectives (LOBs):	<ol style="list-style-type: none"> 1. To learn concepts of parallel programming as it pertains to high-performance computing. 2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigms. 				
Lab Outcomes (LOs):	<p>At the end of the lab, students will be able to:</p> <ol style="list-style-type: none"> 1. Interpret parallel processing approaches & different design issues in parallel programming 2. Identify different parallel processing platforms involved in achieving High Performance Computing. 3. Demonstrate efficient and high-performance parallel programming. 4. Execute parallel programming using message passing paradigm using open- source APIs. 5. Implement programs with Multicore processor and GPU systems (OpenMP and CUDA). 6. Apply ethical principles like timeliness and adhere to rules of laboratory. 				
Lab No.	Experiment Title	LO mapped	Hrs./Lab		
0.	Lab Prerequisite	--	02		
1	Execution of Simple Hello world program on MPI platform	LO2, LO5, LO6	01		
2	<ol style="list-style-type: none"> a. Program to send data and receive data to/from processors using MPI b. Program illustrating Broadcast of data using MPI 	LO5, LO6	02		
3	Implement a parallel program to demonstrate the cube of N number within a set range.	LO1, LO6	02		
4	Write a parallel program for area of a circle/triangle	LO1, LO6	02		
5	Implement a program to demonstrate balancing of workload on MPI platform	LO3, LO5, LO6	02		
6	Using directives of MPI / OpenMP and API implement parallel programming for calculator application (add, sub, multiplication, and division)	LO1, LO4, LO5, LO6	02		
7	<p>Mini Project</p> <p>Evaluate performance enhancement of HPC for any of the following: One-Dimensional Matrix-Vector Multiplication/ Single-Source Shortest-Path/ Sample Sort/Two-Dimensional Matrix-Vector Multiplication</p>	LO1, LO2, LO3, LO4, LO5, LO6	02		
Term work (TW):	<ol style="list-style-type: none"> 1. Term work should consist of a minimum of 6 experiments 2. Journal must include at least 2 assignments on content of theory “High Performance Computing” and practical of the course “High Performance Computing 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 and Assignments: 05-marks) 				

Oral/Practical/P &O:	Practical Examination will be based on above experiment list and performance of experiments for 25 Marks
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Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL8022	Design Thinking and Innovation Lab	--	01	--	01
Lab Prerequisite:	1. Application of TBL, PBL. 2. Basics of communication skill				
Lab Objectives (LOBs):	1. To study how to convert idea to product. 2. To implement prototype. 3. To study customer needs and with consideration to that design innovative product.				
Lab Outcomes (LOs):	After successful completion of lab student will be able to 1. Implement creative idea to become proto type. 2. Define problem according to customer needs. 3. Perform role playing to understand need and pain point. 4. Design prototype and test. 5. Perform using mind mapping and scamper for innovation and given challenges for improved design. 6. Design and Analyse some small. Innovative project				
Lab No.	Experiment Title	LO mapped	Hrs./Lab		
0.	Lab Prerequisite	--	02		
1.	Random Word Ideation-	LO1	02		
2.	Crazy 8s	LO1	02		
3.	Customer Journey Mapping	LO2	02		
4.	Role-playing	LO3	02		
5.	Rapid Prototyping	LO4	02		
6.	Reverse Brainstorming	LO5	02		
7.	Mind Mapping	LO5	02		
8.	SCAMPER	LO5	02		
9.	Case Study 1	LO6	02		
10.	Case Study 2	LO6	02		
Useful Lab Links:	1. https://www.designsociety.org/download-publication				
Term work:	1. Term work should consist of a minimum of 6 experiments. 2. Journal must include at least 2 assignments on content of theory and practical of the course "Design Thinking 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:	Practical Examination will be based on above experiment list and performance of experiments for 25 Marks.				

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL8023	Social Media Analytics Lab	--	01	--	01
Lab Prerequisite:	Types of Graphs, Data Mining, Data Analytics				
Lab Objectives (LOBs):	<ol style="list-style-type: none"> 1. To understand the fundamental concepts of social media networks. 2. To learn various social media analytics tools and evaluation matrices. 3. To collect and store social media data. 4. To analyze and visualize social media data 5. To design and develop social media analytics models. 6. To design and build a social media analytics application. 				
Lab Outcomes (LOs):	<p>The students will be able to</p> <ol style="list-style-type: none"> 1. Explain characteristics and types of social media networks. 2. Explain social media analytics tools for business 3. Collect, monitor, store and track social media data 4. Analyze and visualize social media data from multiple platforms 5. Design and develop content and structure based social media analytics models. 6. Design and implement social media analytics applications for business. 				
Lab No.	Experiment Title	LO mapped	Hrs./Lab		
0	Lab Prerequisite	--	02		
1	Study various - i) Social Media platforms (Facebook, twitter, YouTubeetc) ii) Social Media analytics tools (Facebook insights, google analytics net lyticetc) iii) Social Media Analytics techniques and engagement metrics (page level, post level, member level) iv) Applications of Social media analytics for business. e.g. Google Analytics https://marketingplatform.google.com/about/analytics/ https://netlytic.org/	LO1 LO2 LO4 LO6	02		
2	Data Collection-Select the social media platforms of your choice (Twitter, Facebook, LinkedIn, YouTube, Web blogs etc) ,connect to and capture social media data for business (scraping, crawling, parsing).	LO3	02		
3	Data Cleaning and Storage- Pre-process, filter and store social media data for business (Using Python, MongoDB, R etc).	LO3	02		
4	Exploratory Data Analysis and visualization of Social Media Data for business.	LO4	02		
5	Develop Content (text, emoticons, image, audio, video) based social media analytics model for business. (e.g. Content Based Analysis :Topic , Issue ,Trend, sentiment/opinion analysis, audio, video, image analytics)	LO5	02		
6	Develop Structure based social media analytics model for any business. (e.g. Structure Based Models -community detection, influence analysis)	LO5	02		
7	Develop a dashboard and reporting tool based on real time social media data.	LO6	02		
8	Design the creative content for promotion of your business on	LO6	02		

	social media platform.		
9	Analyze competitor activities using social media data.	LO3	02
10	Develop social media text analytics models for improving existing product/ service by analyzing customer's reviews/comments.	LO5	02
Term work (TW):	<ol style="list-style-type: none"> 1. Term work should consist of 8 experiments. 2. Journal must include at least 2 assignments. 3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments: 20-marks, and Assignments: 05-marks) 		
Oral/Practical/ P&O:	Practical Examination will be based on above experiment list and performance of experiments for 25 Marks		

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIDLL8024	ML in Bioinformatics Lab	--	01	--	01
Lab Prerequisite:	1. PYTHON / PEARL				
Lab Objectives (LBOs):	1. Develop an understanding of important concepts in machine learning in the context of biological problems. 2. Implementation ML model in the context to solve biological problems.				
Lab Outcomes (LOs):	After successful completion, students will be able to- 1. Implement of KNN using Perl/Python Assessment. 2. Implement of ANN using Perl/Python Assessment. 3. Apply Hidden Markov Model for CpG island prediction Assessment. 4. Apply HMMER package and Pfam database Assessment. 5. Apply Transformational Grammars in bioinformatics Assessment. 6. Apply SVM in bioinformatics Assessment.				
Lab No.	Experiment Title	LO mapped	Hrs./Lab		
0	Lab Prerequisite	--	02		
1	Calculation of sensitivity, specificity, accuracy for a given classifier 2	LO1	02		
2	Implementation of crisp KNN for a microarray file	LO1	02		
3	Implementation of fuzzy KNN for a microarray file	LO1	02		
4	Identification tree construction using See5 and Weka	LO5	02		
5	Implementation of perceptron on LOGIC GATES	LO2	02		
6	Calculation of AAC and DPC for SVM and ANN input files	LO2 LO6	02		
7	Calculation of pseudo amino acid composition	LO3	02		
8	Implementation of ANN using SNNS software	LO2, LO3	02		
9	Implementation of SVM using SVM-light, LIBSVM and Weka	LO2, LO6	02		
10	Implementation of HMM for prediction of CpG islands	LO2, LO5	02		
11	HMM using HMMER package Stochastic context free grammar	LO4	02		
Virtual Lab Links:	1. http://hmmer.org/ 2. https://www.cs.waikato.ac.nz/ml/weka/https://nptel.ac.in/courses/106104019/26 3. https://www.rulequest.com/download.html				
Term work(TW):	1. Term work should consist of 8 experiments. 2. Journal must include at least 2 assignments. 3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments: 20-marks, and 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:	Practical Examination will be based on above experiment list and performance of experiments for 25 Marks

Lab Code	Lab Name	Credits			
		TH	P	TUT	Total
AIL805	Robotic Process Automation Lab	--	01	--	01
Lab Prerequisite:	Knowledge of coding languages				
Lab Objectives (LBOs):	1. Understand important concepts in Robotic Process Automation. 2. Understanding of UI path studio. 3. Implement Real time automation applications.				
Lab Outcomes (LOs):	After successful completion, students will be able to- 1. Set up UI Path studio environment 2. Implement basic operations on different data types. 3. Apply Arithmetic operations, different fields from an excel file 4. Validate different formats for input and output validations. 5. Develop RPA bots for web scraping Applications. 6. Develop RPA bots for real time automation applications with different file formats				
Lab No.	Experiment Title	LO mapped	Hrs./Lab		
0	Lab Prerequisite: Explain Process Definition Document, Solution Design Document, Project Tracking.	--	02		
1	Download, Install and Activate Ui-Path Studio. Learn all the basics of RPA (Variables, arguments and Control flow etc.)	LO1	02		
2	Program to empty the trash folder in Gmail and empty the Recycle Bin	LO1	02		
3	Program to perform if-activity, switch- activity (Hint: Find the smallest and biggest numbers in an array)	LO2	02		
4	Program to perform while activity, do-while activity, for-each activity (Hint: How an integer variable will increase from 5 to 50 in increments of 5)	LO3	02		
5	Program to perform Flowchart and Sequence activity on Scalar and Collection variables.	LO4	02		
6	Program to build a static data table, dynamic data table using data scrapping.	LO4	02		
7	Program to create simple calculator using a separate workflow and arguments	LO3	02		
8	Program for clipboard management. (Hint: open Notepad, write some data into it, and then copy the data to the clipboard. Later extract the data from the clipboard)	LO2, LO3	02		
9	Program to perform the following operations on an Excel file: i) Read cell ii) Write cell iii) Read range iv) Write range v) Append range	LO2	02		
10	Program to implement Arithmetic operations in 2 Excel files	LO5	02		
11	Program to read an Excel file and creating a data table by using data from the Excel file	LO3	02		
12	Program for acting on controls using mouse and keyboard activities, screen scrapping using OCR, extract Email Address	LO5	02		

13	Develop a solution design document for following use cases, Develop a bot for any two of the following applications <ol style="list-style-type: none"> 1. Find Unicorn Name Generators. 2. Find Movie Rating. 3. Implement Amazon Data Scraping. 4. Email Automation. 5. Supplier Management System. 6. Transferring Data from one system to another. 7. Password Generator. 8. Forms Processing 9. Connecting Robot to Orchestrator 10. Extracting data from PDFs, scanned documents and other formats 11. Generating mass emails 12. Create and deliver invoices. 	LO6	02
Reference Books:	<ol style="list-style-type: none"> 1. Nandan Mullakara, Arun Kumar Asokan, <i>Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere</i>, First Edition, Packt Publishing Ltd., 2020. 2. Alok Mani Tripathi, <i>Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath</i>, First Edition, Packt Publishing Ltd., 2018. 		
Useful Links:	<ul style="list-style-type: none"> • https://www.udemy.com/topic/robotic-process-automation • https://nielit.gov.in/aurangabad/content/short-term-course-robotic-process-automation • https://www.coursera.org/specializations/roboticprocessautomation 		
Term work(TW):	<ol style="list-style-type: none"> 1. Term work should consist of 8 experiments. (Total 6 Experiments from Lab No. 1 to 12 and Two RPA bot implementation out of 12 mentioned applications) 2. Journal must include experiment writeup and solution design document for use cases. 3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments with two RPA bots: 20-marks, and Solution design documents for the two used cases: 05-marks) 		
Oral/Practical /P&O:	Practical Examination will be based on above experiment list and performance of experiments for 25 Marks		

Course Code	Course Name	Credits			
		TH	P	TUT	Total
AIPR86	Major Project Lab-B	--	06	--	06
PBL Pre-requisites:	Major Project Lab-A				
PBL Objectives:	<p>The Project work enables the students:</p> <ol style="list-style-type: none"> 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 implement and present research idea with appropriate solution. 				
PBL Outcomes:	<p>Learner will be able to:</p> <ol style="list-style-type: none"> 1. Review literature, Design solutions, components or processes for complex engineering problems on the basis of research knowledge. 2. Implement projects using modern tools which are useful to society. 3. Apply contextual knowledge to assess the public health /safety /societal /environmental issues for sustainable development. 4. Document the work in project report and log book by referring reputed material. 5. Apply ethical principles and commit to professional ethics, responsibilities norms of the engineering practice and engage in independent and life-long learning. 6. Present their work in clear and effective manner with professional values like team work, time management and make financial arrangements. 				
Guidelines:					
<ul style="list-style-type: none"> • To proceed with the project implementation work for the selected research idea. • Projects can be designed in any domain of electronics by using recent technologies with multi- disciplinary approach. • For developing project/problem, theoretical concepts should be implemented as a practical implementation. • Project work must be carried out by the group of students with proper plan of work. • Students should involve themselves 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 implementation of the topic. • 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/present a paper based on their research/ project output. The publication should be in any good quality international conferences/non paid journals. • Students should prepare thesis as per the guidelines by the institute. 					
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. Published papers and certificates

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 with the published paper copy and publication certificate
- d) Term End Presentation (Internal)

The final certification and acceptance of TW of 50 marks ensures the satisfactory performance on the above aspects.

Distribution of Term work marks for both semesters shall be as below:

Marks

Distribution of Term work marks for both semesters shall be as below:		Marks
1.	Marks awarded by guide based on log book	10
2.	Marks awarded by review committee for presentation	10
3.	Quality of Project report	10
4.	Implementation of project	10
5.	<ul style="list-style-type: none"> ● Effort taken by students and making 2 min video ● Paper publications ● Idea/project completions and poster making 	10

Practical & Oral:

Practical & Oral examination of Major Project Lab-B of 100 Marks should be conducted by Internal and External examiners. Students have to give a presentation and demonstration on Major Project Lab-B.



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: currency	Bit coin and Crypto	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: Finance)	DeFi (Decentralized	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

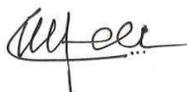
Honours Degree Program	Sem	Additional Subjects to be learnt and passed through the examination		Credits	Marks
Data Science	Sem V	HXXC501: Mathematics for Data Science		4	100
	Sem VI	HXXC601: Statistical Learning for Data Science		4	100
	Sem VII	HXXC701: Data Science for Health and Social Care		4	100
	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:	<p>The course aims:</p> <ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 Madiseti, Paperback – 31 January 2017. 3. “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, July 19, 2016, by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press. 			
Reference Books				
	<ol style="list-style-type: none"> 1. “Mastering Blockchain”, by Imran Bashir, Third Edition, Packt Publishing 2. “Mastering Ethereum: Building Smart Contracts and Dapps Paperback” by Andreas Antonopoulos, Gavin Wood, Publisher(s): O’Reilly Media 			

	3. “Blockchain revolution: how the technology behind bitcoin is changing money, business and the world \$ don tapscott and alex tapscot, portfolio penguin, 856157449.									
Online References:										
https://andersbrownworth.com/blockchain/ https://andersbrownworth.com/blockchain/public-private-keys/ https://www.coursera.org/learn/cryptocurrency https://coinmarketcap.com/										
Assessment:	Continuous Assessment (CA): The distribution of Continuous Assessment marks will be as follows – <table border="1" data-bbox="472 495 1154 630"> <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>	1.	Class Test 1	30 marks	2.	Class Test 2	30 marks	3.	Internal Assessment	10 marks
	1.	Class Test 1	30 marks							
2.	Class Test 2	30 marks								
3.	Internal Assessment	10 marks								
	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.									
End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.										

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:	<p>The course aims:</p> <ol style="list-style-type: none"> 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

	<p>voting applications using smart contract, Dapp Architecture.</p> <p>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.</p> <p>Ethereum 2., Concept of Beacon chain, POS (Proof of Stake), Sharding of Chain.</p> <p>Self-learning Topics: Study case study on any ethereum blockchain.</p>			
4. Private Blockchain	<p>4.1 Introduction, Key Characteristics, Need of Private Blockchain.</p> <p>Consensus Algorithm for private Blockchain (Ex. RAFT and PAXOS), Smart Contract in Private Blockchain, Case Study of E-commerce Website, Design Limitations.</p> <p>Self-learning Topics: Case study on private block chain.</p>	CO4	8	8
5. Hyperledger Blockchain	<p>5.1 Introduction to Hyperledger, tools and frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies, Distributed Ledgers.</p> <p>Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes etc., Transaction Flow, Advantages of Hyperledger Fabric Blockchain, working of Hyperledger Fabric, Creating Hyperledger network, Case Study of Supply chain management using Hyperledger</p> <p>Self-learning Topics: Case study on Hyperledger blockchain.</p>	CO5 , CO6	12	12
6. Other Blockchain platforms	<p>6.1 Corda, Ripple, Quorum and other emerging blockchain platforms, Case Study on any of the blockchain platforms.</p> <p>Developing Blockchain application on Cloud(AWS/Azure)</p> <p>Self-learning Topics: Compare different blockchain platforms.</p>	CO5	4	4
Total hours			48	
Books:				
Text Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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:				

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>

Assessment:

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1	30 marks
2.	Class Test 2	30 marks
3.	Internal Assessment	10 marks

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.

End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.

Course Code	Course Name	Credits Assigned (TH+P+TUT)		
HBCC701	Block chain Development	(04+0+0)		
Prerequisite:	Blockchain cryptocurrency, Blockchain platform			
Course Objectives:	<p>The course aims:</p> <ol style="list-style-type: none"> 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. Blockchain 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/				

Assessment:

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Test 1	30 marks
2.	Test 2	30 marks
3.	Internal Assessment	10 marks

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.

End Semester Theory Examination will be of 60-Marks with 2 hours 30 mins duration.

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:	<p>The Lab aims:</p> <ol style="list-style-type: none"> 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):	<p>On successful completion, of lab, learner/student will be able to:</p> <ol style="list-style-type: none"> 1. To understand how blockchain systems (mainly Ethereum) 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 Madiseti, Paperback – 31 January 2017. Mastering Blockchain, Imran Bashir, Packt Publication. 			
Online References:				
<ol style="list-style-type: none"> 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:				
<p>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.</p> <p>Term Work Marks: 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)</p>				
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:	<p>The course aims:</p> <ol style="list-style-type: none"> 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	<p>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</p> <p>Self-learning Topics: The Potential Impact of Decentralized Finance</p>	CO1	06	06
2. What is decentralized finance (defi)?	<p>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</p> <p>Self-learning Topics: How Decentralized Finance Could Make Investing More Accessible.</p>	CO2	06	06

<p>3. DeFi Primitives and Business Models</p>	<p>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 Tokens NFT: 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 Collateralized Loans Flash Loans (Uncollateralized 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.</p>	CO3	10	10
<p>4. DeFi Architecture and EcoSystem</p>	<p>4.1 DeFi 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</p>	CO4	10	10
<p>5. DeFi Deep Dive</p>	<p>5.1 Maker 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,</p>	CO5	10	10

	<p>Borrowing, Liquidation, Price Feeds, Comptroller, Governance</p> <p>5.4. wBTC: Need for wBTC: Tokenization and common Issues</p> <p>wBTC Implementation and Technology: Users, Custodian Wallet Setup, Minting, Burning</p> <p>wBTC Governance, wBTC vs Atomic Swaps, Fees, Legal Binding, Trust Model and Transparency</p> <p>Self-learning Topics:</p> <p>MakerDAO Governance, UniSwap Governance Protocol Math, Compound Protocol Math</p>			
6. Use Cases	<p>6.1 Decentralized Exchanges</p> <p>6.2 Decentralized Stablecoins</p> <p>6.3 Decentralized Money Markets</p> <p>6.4 Decentralized Synthetix</p> <p>6.5 Decentralized Insurance</p> <p>6.6 Decentralized Autonomous Organization (DAO),</p> <p>Self-learning Topics:</p> <p>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</p>	CO6	08	08
Total hours			52	
Books:				
Text Books	<ol style="list-style-type: none"> 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:				
	<ol style="list-style-type: none"> 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 			

	<p>13. https://consensys.net/blockchain-use-cases/decentralized-finance/</p> <p>14. https://tokenlon.zendesk.com/hc/en-us/articles/360041114431-DeFi-Explained-Synthetic-Assets,</p> <p>15. https://www.blockchain-council.org/synthetic/synthetic-snx-the-biggest-ecosystem-in-decentralized-finance/</p>									
Online References:										
<p>1. https://www.udemy.com/</p> <p>2. https://www.coursera.org/</p>										
Assessment:	<p>Continuous Assessment (CA): The distribution of Continuous Assessment marks will be as follows –</p> <table border="1" data-bbox="472 554 1151 688"> <tr> <td data-bbox="472 554 532 604">1.</td> <td data-bbox="532 554 946 604">Class Test 1</td> <td data-bbox="946 554 1151 604">30 marks</td> </tr> <tr> <td data-bbox="472 604 532 646">2.</td> <td data-bbox="532 604 946 646">Class Test 2</td> <td data-bbox="946 604 1151 646">30 marks</td> </tr> <tr> <td data-bbox="472 646 532 688">3.</td> <td data-bbox="532 646 946 688">Internal Assessment</td> <td data-bbox="946 646 1151 688">10 marks</td> </tr> </table> <p>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.</p> <p>Internal Assessment(IA): Marks will be allotted as per designed rubrics.</p>	1.	Class Test 1	30 marks	2.	Class Test 2	30 marks	3.	Internal Assessment	10 marks
1.	Class Test 1	30 marks								
2.	Class Test 2	30 marks								
3.	Internal Assessment	10 marks								
End Semester Theory Examination will be of 60-Marks with 2 hours and 30 mins duration.										

Course Code	Course Name	Credits Assigned (TH+P+TUT)		
HCSC501	Ethical Hacking	04+0+0		
Prerequisite:	Computer Networks, Databases, system security			
Course Objectives:	<p>The course aims:</p> <ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. UNIX Network Programming –Richard Steven, Addison Wesley, 2003 2. Cryptography and Network Security -- Atul Kahate, 3rd edition, Tata Mc Graw