Program Structure for Last Year Computer Engineering

Semester-VIII-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC801	Distributed Computing	3– 0 – 0	03	3 – 0 – 0	03	PC
CEDLC802	Department Level Elective -V	3– 0 – 0	03	3 – 0 – 0	03	DLE
CEDLC803	Department Level Elective-VI	3– 0 – 0	03	3 – 0 – 0	03	DLE
ILC804	Institute Level Elective -II	3 – 0 –0	03	3 – 0 – 0	03	ILE
CEL801	Distributed Computing Lab	0– 2 – 0	02	0 – 1 – 0	01	PC
CEDLL802	Department Level Elective -V Lab	0 – 2 –0	02	0 – 1 – 0	01	DLE
CEDLL803	Department Level Elective -VI Lab	0 – 2 – 0	02	0 – 1 – 0	01	DLE
CEPR86	Project Based Learning - Major Project B	0 – 12 – 0	12[#]	0 – 6 – 0	06	PBL
INT81	Internship-VII	2 to 4 Weeks		--	--	INT
Total		**12- 18-0**	**30**	**12 - 09- 00**	**21**	

[#] Load of learner, not the faculty [#] PBL-PR-2-(1 hour- Conference /Journal Publication Filling Patent, Creation of Product & Licencing, Startup, SIH,Participation etc)

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

Semester-VIII Examination Scheme

Course Code	Course Name	Marks									
		CA				ESE	TW	O	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA						
CEC801	Distributed Computing	30	30	30	10	60	--	--	--	--	100
CEDLC802	Department Level Elective -V	30	30	30	10	60	--	--	--	--	100
CEDLC803	Department Level Elective-VI	30	30	30	10	60	--	--	--	--	100
ILC804	Institute Level Elective -II	30	30	30	10	60	--	--	--	--	100
CEL801	Distributed Computing Lab	--	--		--	--	25	25	--	--	50
CEDLL802	Department Level Elective -V Lab	--	--		--	--	25	25	--	--	50
CEDLL803	Department Level Elective -VI Lab	--	--		--	--	25	--	25	--	50
CEPR86	Project Based Learning - Major Project B	--	--		--	--	50	--	--	100	150
INT81	Internship-VII	--	--	--	--	--	--	--	--	--	--
Total		**120**	**120**	**120**	**40**	**240**	**125**	**50**	**25**	**100**	**700**

Department Level Electives Courses

Department Optional Courses	Semester	Group (A, B, C, D)	Choice of Group
Department Level Elective -V	VIII	CEDLC8021: Applied Data Science CEDLC8022: Software Defined Network CEDLC8023: Digital Forensic CEDLC8024: Deep Learning	Group A: Databases/Data Science Group B: Network & Communications Group C: Security / IoT / Blockchain Group D: AI/ ML/ DL
Department Level Elective -VI	VIII	CEDLC8031: Social Media Analytics CEDLC8032: High Performance Computing CEDLC8033: Secure Application Development CEDLC8034: Optimization in Machine Learning CEDLC8035: Quantum Computing	

Institute Level Electives Courses

Institute level Optional Courses	Semester	Subject
Institute Level Elective -II	VIII	ILC8041: Project Management ILC8042: Finance Management ILC8043: Entrepreneurship Development and Management ILC8044: Human Resource Management ILC8045: Professional Ethics and CSR ILC8046: Research Methodology ILC8047: IPR and Patenting ILC8048: Digital Business Management ILC8049: Environmental Management

Course Code	Course Name	Credits (TH+P+TUT)
CEC801	**Distributed Computing**	**3-0-0**

Prerequisite:	1. Operating Systems 2. Computer Networks
Course Objectives:	1. To provide students with contemporary knowledge in distributed systems. 2. To explore the various methods used for communication in distributed systems. 3 .To provide skills to measure the performance of distributed synchronization algorithms. 4. To provide knowledge of resource management, and process management Including process migration. 5. To learn issues involved in replication, consistency, and file management. 6. To equip students with skills to analyze and design distributed applications.
Course Outcomes:	1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies 2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware. 3. Analyze the various techniques used for clock synchronization and mutual exclusion 4. Demonstrate the concepts of Resource and Process management and synchronization algorithms 5. Demonstrate the concepts of Consistency and Replication Management 6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1.Introduction to Distributed Systems	Characterization of Distributed Systems:Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept. NOS,DOS	**CO1**	**02**	**04**
	Middleware: Models of Middleware, Services offered by middleware, Client Server model.		**02**	
2.Communication	Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)	**CO2**	**03**	**06**
	Message Oriented Communication, Stream Oriented Communication, Group Communication		**03**	

3.Synchronization	Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.	**CO3**	**04**	**10**
	Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawal's Algorithm, Maekawa's Algorithm		**02**	
	Token Based Algorithms: Suzuki-Kasami's Broardcast Algorithms, Singhal's Heurastic Algorithm, Raymond's Tree based Algorithm, Comparative Performance Analysis		**06**	
4.Resource and Process Management	Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach	**CO4**	**03**	**06**
	Introduction to process management, process migration, Threads, Virtualization, Clients, Servers, Code Migration		**03**	
5.Consistency, Replication and Fault Tolerance	Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management	**CO5**	**03**	**06**
	Fault Tolerance: Introduction, fault Tolerance in RPC, Grp communication, RMI		**03**	
6.Distributed File Systems and Name Services	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Andrew File System (AFS)	**CO6**	**03**	**07**
	Introduction to Name services and Domain Name System, Directory Services, Case Study: The Global Name Service, The X.500 Directory Service		**02**	
	Designing Distributed Systems: Google Case Study		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**		**01**
Total hours				**42**

Books:	
Text Books	1. Andrew S. Tanenbaum and Maarten Van Steen, ―Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education. 2. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", MCGraw Hill education. 3. Pradeep K.Sinha, "Distributed Operating System-Concepts and design",PHI.

Reference Books	1. A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006 2. M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson Addison Wesley, 2004 3. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.
Useful Links:	
https://nptel.ac.in/courses/106106107 https://nptel.ac.in/courses/106106168 http://csis.pace.edu/~marchese/CS865/Lectures/Chap7/Chapter7fin.htm https://nptel.ac.in/courses/106104182	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 2.30 hrs duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8021	**Applied Data Science**	3 - 0 – 0
Prerequisite:	1. Fundamentals of Data Mining 2. machine learning	
Course Objectives:	1. Acquire a good understanding of both the theory and application of applied statistics mathematics and computer science based on existing data science models to analyze huge data sets originating from diversified application areas. 2. Be able to create models using the knowledge acquired from the program to solve future challenges and real-world problems requiring large-scale data analysis. 3. Be better-trained professionals to cater to the growing demand for data scientists and engineers in the industry. .	
Course Outcomes:	**After successful completion of this course, the learner will be able to:** 1. Develop practical data analysis skills, which can be applied to practical problems. 2. Develop fundamental knowledge of concepts underlying data science projects. - To develop practical skills needed in modern analytics. 3. Explain how math and information sciences can contribute to building better algorithms and software. - 4. Develop strong foundations in Python, mathematics, and statistics for data science. 5. Describe the theory behind recommendation systems and explore their applications to multiple industries and business contexts. 6. Build an industry-ready portfolio of projects to demonstrate your ability to extract business insights from data.	

Module No.& Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i.Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction	-		**02**
1.Foundations for Data Science	Introduction; Statistical Learning, Modeling and Prediction, Data Visualization and Analytic. Importance of linear algebra, statistics, and optimization from a data science perspective.	**CO1**	**04**	**07**

	Structured thinking for solving data science problems; Probability, Statistics, and Random Processes: Probability theory and axioms; Random variables.		**03**	
2.Data Analysis & Visualization	Matrices and their properties (determinants, traces, rank, nullity, etc.).	**CO2**	**02**	**06**
	Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures.		**04**	
3.Exploratory Data Analysis	Elements of structured data; Estimates of location; Estimates of variability; Expectations and moments.	**CO3**	**03**	**06**
	Exploring the data distribution; Exploring binary and categorical data; Covariance and correlation; Exploring two or more variables.		**03**	
4.Data and Sampling Distributions	Random sampling and sample bias; Selection bias; Central limit theorem; Standard error; Bootstrap Confidence intervals; Normal distribution;	**CO4**	**03**	**07**
	Long-tailed distributions; Student's t-distribution; Binomial distribution; Poisson distributions; Exponential distribution; Weibull distribution; Fitting a model.		**04**	
5.Statistics and Significance Testing	Hypothesis tests; A/B testing; Chi-square test; confidence intervals; p-values;	**CO5**	**02**	**06**
	ANOVA; t-test; Confidence (statistical) intervals; Degrees of freedom; White-noise process.		**04**	
6.Evaluation and Optimization	Mathematics in algorithmic performance evaluation: Confusion matrix; Precision; Recall; Specificity; ROC Curve; AUC; Lift	**CO6**	**03**	**07**
	Optimization: Global and local optima; Unconstrained and constrained optimization; Introduction to least-squares optimization		**04**	
ii**. Course Conclusion**	Recap of Modules, Outcomes, Applications, and Summarization.	**-**		**01**
Total Hours				**42**

Books:

Text Books

1. Fatemeh Emdad, SeyedZekavat , "High Dimensional Data Analysis: Overview, Analysis, and Applications, VDM Verlag, 2008
2. Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
3. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015
4. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

	5. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Globa 6. Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. — Springer, 2009 7. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012. 8. Barabási, A-L., 2014, "Network Science", Creative Commons: CC BY-NCSA 2.0. PDF V26, 05.09.2014
Reference Books	1. "Practical Data Science with R". Nina Zumel, John Mount. Manning, 2014 "Data Science for Business", F. Provost, T Fawcett, 2013 2. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.
Useful Links:	
https://www.edx.org/course/high-dimensional-data-analysis	
https://nptel.ac.in/courses/106/107/106107220/	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks **3.** Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8022	**Software Defined Networks**	3 - 0 – 0
Prerequisite:	**Computer Networks**	
Course Objectives:	1. To learn the fundamentals of software defined networks. 2. To understand the separation of the data plane and the control plane. 3. To explore the various applications of SDN.	
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Analyze the key benefits of SDN by the separation of data and control planes 2. Interpret the SDN data plane devices and Openflow protocols 3. Implement the operation of SDN control plane with different controllers 4. Apply techniques that enable applications to control the underlying network using SDN 5. Illustrate Network Functions Virtualization components and their roles in SDN 6. Evaluate recent research based SDN applications and use cases	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
4. Introduction	Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, and Characteristics of Software-Defined Networking.	**CO1**	**03**	**05**
	SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.	**CO1**	**02**	
2. SDN Data plane and OpenFlow	SDN data plane: Data plane Functions, Data plane protocols,	**CO2**	**02**	**07**
	Openflow logical network Device: Flow table Structure, Flow Table Pipeline,		**03**	
	The Use of Multiple Tables, Group Table-OpenFlow Protocol		**02**	
3. SDN Control Plane	SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface.	**CO3**	**03**	**07**
	SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu and Open Daylight.	**CO3**	**04**	
4. SDN Application Plane	SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring	**CO4**		**06**

	Security- Data Center Networking- Mobility and Wireless			
5. Network Functions Virtualization	Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework.	**CO5**	**05**	**07**
	NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration.	**CO5**	**02**	
6. Applications and Case Studies	SDN solution for the Data center	**CO6**	**02**	**07**
	Network, Network Security,		**02**	
	5G, Wireless network, IOT.		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-		**01**
Total Hours				**42**

Books:

Text Books	1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014. 2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013. 3. William Stallings, "Foundations of Modern Networking", Pearson Ltd., 2016.
Reference Books	1. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98. 2. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.

Useful Links:

1. https://www.coursera.org/learn/sdn
2. https://www.coursera.org/lecture/tcp-ip-advanced/openflow-sdn-and-nfv-dYiey
3. https://www.coursera.org/lecture/sdn/the-road-to-sdn-qJVpA
4. https://www.coursera.org/learn/sdnetworking
5. https://github.com/mininet/openflow-tutorial/wiki
6. https://github.com/mininet/mininet/wiki
7. https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8023	**Digital Forensics**	**3 -0 – 0**
Prerequisite:	1. Computer Network 2. Cryptography and System Security	
Course Objectives:	1. To focus on the procedures for identification, preservation, and extraction of electronic evidence, auditing and investigation of network and host system intrusions, analysis and documentation of information gathered, and preparation of expert testimonial evidence. 2. To learn various forensic techniques used by information system security officers. 3. To focus on the role of computer forensics in both the business and private world.	
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Describe the procedure to deal with incident response and remediation. 2. Identify initial response and forensic duplication process as per scenario. 3. Describe the procedure to preserve and recover digital evidence. 4. Analyse the different types of network attack from collected network based evidence. 5. Describe the procedure to system investigation in different scenarios. 6. Document investigation steps and prepare technical report**.**	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**-**	**02**
1.Introduction	Introduction of Cybercrime: Types, The Internet spawns crime, malwares and its types	**CO1**	**02**	**06**
	Computers' roles in crimes and Introduction to digital forensics		**02**	
	Introduction to Incident - Incident Response Methodology Steps - Activities in Initial Response, Phase after detection of an incident.		**02**	
2. Initial Response and forensic duplication	Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system -	**CO2**	**03**	**09**
	Forensic Duplication: Forensic Duplicates as Admissible Evidence		**02**	
	Forensic Duplication Tool Requirements, Creating a Forensic.		**02**	
	Duplicate/Qualified Forensic Duplicate of a Hard Drive		**02**	
	File Systems: FAT, NTFS - Forensic Analysis of File Systems	**CO3**	**02**	**06**

3. Preserving and Recovering Digital Evidence	Storage Fundamentals: Storage Layer, Hard Drives		**02**	
	Evidence Handling: Types of Evidence, Challenges in evidence handling, Overview of evidence handling procedure		**02**	
4. Network Forensics	Intrusion detection; Different Attacks in network	**CO4**	**02**	**06**
	analysis of Collected Network Based Evidence - Investigating Routers - Network Protocols -		**02**	
	Email Tracing- Internet Fraud		**02**	
5. System investigation	Data Analysis Techniques	**CO5**	**02**	**06**
	Investigating Live Systems (Windows & Unix) Investigating		**02**	
	Hacker Tools - Ethical Issues — Cybercrime		**02**	
6. Forensic Report	Computer Forensics report: Report goals	**CO6**	**02**	**06**
	Report writing guidelines		**02**	
	Document Investigative Steps Immediately and Clearly, A template for computer forensic reports		**02**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**		**01**
Total Hours				**42**

Books:

Text Books	1. Kevin Mandia, Chris Prosise, “Incident Response and computer forensics”, Tata McGrawHill, 2006 2. Peter Stephenson, Investigating Computer Crime: A Handbook for Corporate Investigations, Sept 1999 3. Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001
Reference Books	1. Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses.Prentice Hall Professional Technical Reference. 2001 2. Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000 3. Bill Nelson, Amelia Philips and Christopher Steuart, “Guide to computer forensics investigation “Course technology, 4th edition

Useful Links:

1. https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
2. https://www.coursera.org/learn/forensic-accounting

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment--10 marks

Internal assessment will be based on assignments/quizzes/case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8024	**Deep Learning**	3 - 0 – 0

Prerequisite:	1. Machine Learning 2. Basic Mathematics and Statistics Concepts
Course Objectives:	1. To acquire knowledge of the basic concepts of Neural Network & Deep Learning 2. To design the Deep Neural Network and layered learning approach 3. To explain the concept of Convolution Neural Network and Recurrent Neural Network 4. To explore advanced technology in Deep Neural Network through various applications
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Explain the fundamentals of Deep Neural networks 2. Perceive the role of Multilayer feedforward Network into Deep Neural Network 3. Comprehend the meaning of Regularization and Optimization for deep Learning 4. Describe the concept of Convolution Neural Network and Recurrent Neural Network 5. Explore the deep neural network concepts in developing real world applications 6. Analyze the advanced technology of Neural Networks

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisites concepts and course introduction	**-**		**02**
1. Introduction to Deep Learning	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes	**CO1**	**02**	**04**
	Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning		**02**	
2. Multilayer Feedforward Network	Multi Layered Feed Forward Neural Network,Generalized delta learning rules, Feedforward recall, Error backpropagation training	**CO2**	**03**	**07**
	Learning factors, Training and convergence-Practical and Designs issues, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU. Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function	**CO2**	**04**	
3. Regularization and Optimizati	Regularization: Overfitting, Dropout, Parameter Norm Penalties, Dataset Augmentation	**CO3**	**04**	**08**

on for Deep Learning	Optimization: How learning Differ from Pure Optimization, Challenges in Neural Network Optimization, Gradient Descent, Stochastic Gradient Descent Algorithm, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp.	**CO3**	**04**	
4. Convolutional Neural Networks	Inroduction to Convolutional Neural Networks, Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer,Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function, Depth wise separable CNN	**CO4**	**04**	**08**
	Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture,VGG	**CO4**	**04**	
5. Recurrent and Recursive Networks	Unfolding Computational Graph, Recurrent Neural Network(RNN), Bidirectional RNNs, Encoder-Decoder sequence to sequence Architecture, Deep Recurrent Network	**CO4, CO6**	**04**	**08**
	Recursive Neural Network, Long Short Term Memory networks(LSTM) and Gated RNN(GRU), Introduction to attention network and transformer	**CO4, CO6**	**04**	
6. Miscellaneous topics and Applications of Deep Learning	Overview of auto encoders: Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders, Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders. Generative adversarial network (GAN):architecture	**CO5, CO6**	**02**	**04**
	Application in Object Recognition: Unsupervised or generative feature learning, Supervised feature learning, and classification, Application on Natural Language Processing :Language Modeling, Natural language processing.		**02**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**		**01**
Total Hours				**42**
Books:				
Text Books	1. Ian Goodfellow, Yoshua Bengio, Aaron Courvile, "*Deep Learning*", MIT Press Ltd, 1st Edition 2. JM Zurada, "*Introduction to Artificial Neural Systems*", Jaico Publishing House			

	3. .Li Deng and Dong Yu, "*Deep Learning Methods and Applications*", Now publishers Inc 4. Buduma, N. and Locascio, N., "*Fundamentals of deep learning: Designing next-generation machine intelligence algorithms*" 2017, O'Reilly Media, Inc.
Reference Books	1. Satish Kumar, "*Neural Networks A Classroom Approach*", Tata McGraw-Hill. 2. Charu.C.Aggarwal, "*Neural Networks and Deep Learning*" , Springer, 1st Edition 3. François Chollet. "*Deep learning with Python* "(Vol. 361). 2018 New York: Manning.
Useful Links:	
1. https://nptel.ac.in/courses/106/106/106106184/	
2. https://deeplearningbook.org	
3. https://keras.io/guides/	
4. https://paperswithcode.com/	
5. https://www.manning.com/books/deep-learning-with-python	
6. https://d2l.ai/d2l-en.pdf	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1– 30 marks 2. Test 2– 30 marks (average of both tests will be considered as a head of passing) **3.** Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 2hr 30min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8031	**Social Media Analytics**	**3-0-0**

Prerequisite:	1 Basic knowledge of Graphs. 2. Data mining. 3. Data Analysis.
Course Objectives:	1. To understand foundations of Social Media Analytics. 2. To Visualize and understand the data mining aspects in social networks. 3. To solve mining problems by different algorithms. 4. To understand network measures for social data. 5. To understand behavioral part of web applications for Analysis. 6. To analyze the data available on any social media applications.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Explain the basics of Social Media Analytics. 2. Explain the significance of Data mining in Social media. 3. Demonstrate the algorithms used for text mining. 4. Apply network measures for social media data. 5. Explain Behavior Analytics techniques used for social media data. 6.Apply social media analytics for Face book and Twitter kind of applications.

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisites concepts and course introduction	**-**		**02**
1. Analytics in Social Media And Types of Analytics Tools	The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels,	**CO1**	**03**	**06**
	Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics.		**03**	
2. Visualizing Social Networks	Introduction, A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics.	**CO2**	**03**	**06**
	Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media, Related Efforts.		**04**	
3. **Text Mining In Social Networks**	Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering,	**CO3**	**03**	**07**

	Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining,tools for text mining		**04**	
4. Network Measures	Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Betweenness Centrality, Closeness Centrality ,Group Centrality	**CO4**	**04**	**07**
	Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence.		**03**	
5. Behavior Analytics	Individual Behavior : Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior,	**CO5**	**03**	**07**
	Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction		**04**	
6. Case Study	Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters	**CO6**	**03**	**06**
	Mining Facebook:Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**		**01**
Total Hrs				**42**

Books:	
Text Books	1 Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854. 2 Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6.
Reference Books	1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, andUsing Metrics, McGraw Hill Education, 978-0-07-176829-0. 2. .Matthew A. Russell, Mining the Social Web, O'Reilly, 2ndEdition,ISBN:10:1449367615. 3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6. 4. Bing Liu, Web Data Mining : Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19-7
Useful Links:	
1. https://www.coursera.org/learn/social-media-management	
2. https://nptel.ac.in/courses/106/106/106106168/	
Assessment:	

Continuous Assessment for 40 marks: 1.Test 1 – 30 marks 2.Test 2 – 30 marks 3.Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8032	High Performance Computing	03

Prerequisite:	Operating Systems
Course Objectives:	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	**After the successful completion of this course, learner will be able to:** 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/ Sub topic	Total Hrs / Module
i. Prerequisites and Course Outline	Prerequisites concepts and course introduction	**-**		**02**
1.Introduction	Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function)	**CO1**	**02**	**05**
	Classification Models: Architectural Schemes (Flynn‘s, Shore‘s, Feng‘s, Handler‘s) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory)		**02**	
	Parallel Architectures: Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture		**01**	
2.**Pipeline Processing**	Introduction, Pipeline Performance, Arithmetic Pipelines,	**CO2**	**02**	**06**
	Pipeline instruction processing, Pipeline stage design,		**02**	
	Hazards, Dynamic instruction scheduling		**02**	
	Parallel Programming Platforms: Implicit Parallelism:	**CO3**	**01**	**07**

3.**Parallel Programming Platforms**	Trends in Microprocessor & Architectures, Limitations of Memory System Performance,		**02**	
	Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines		**04**	
4.**Parallel Algorithm Design**	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques	**CO4**	**02**	**08**
	Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing		**03**	
	Methods for Containing Interaction Overheads, Parallel Algorithm Models		**03**	
5.**Performance Measures**	Performance Measures: Speedup, execution time, efficiency, cost, scalability	**CO5**	**01**	**05**
	Effect of granularity on performance, Scalability of Parallel Systems		**02**	
	Amdahl‘s Law, Gustavson‘s Law, Performance Bottlenecks		**02**	
6.**HPC Programming**	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming	**CO6**	**02**	**08**
	The Building Blocks: Send and Receive Operations		**03**	
	MPI: The Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Introduction to OpenMP		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-		**01**
Total Hours				**42**

Books:	
Text Books	1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, ―Introduction to Parallel Computing‖, Pearson Education, Second Edition, 2007 2. M. R. Bhujade, ―Parallel Computing‖, 2nd edition, New Age International Publishers, 2009. 3. Kai Hwang, Naresh Jotwani, ―Advanced Computer Architecture: Parallelism, Scalability, Programmability‖, McGraw Hill, Second Edition, 2010

	4. Georg Hager, Gerhard Wellein, ―Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.
Reference Books	1. Michael J. Quinn, ―Parallel Programming in C with MPI and OpenMP‖, McGraw-Hill International Editions, Computer Science Series, 2008. 2. Kai Hwang, Zhiwei Xu, ―Scalable Parallel Computing: Technology, Architecture, Programming‖, 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, Programmability‖, McGraw Hill, Second Edition, 2010

Useful Links:

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

Assessment:

Continuous Assessment for 40 marks:

1.Test 1– 30 marks

2.Test 2– 30 marks

3.Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8033	**Secure Application Development**	3 - 0 - 0

Prerequisite:	1. Computer Networks. 2. Cryptography and System Security
Course Objectives:	1. This course is an introductory study of the principles, practices, procedures, and methodologies to ensure security of data within web-based applications. 2. This course and it appraises the convergence between System application security and associated threat vectors/attack methods. 3. This course is a study within the Information Assurance discipline of Web Application Security as it relates to security assessments and secure deployment. 4. Discuss various security issues in Android platform
Course Outcomes:	**After successful completion of the course student will be able to** 1. Describe web-based applications. 2. Identify common security threats, risks, attacks and vectors for software system. 3. Identify the weak points of application (web and mobile) architecture. 4. Identify web and mobile application security controls and risk mitigation techniques 5. Interpret a security strategy for stored data. 6. Classify the attack surface for android application.

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Modules
i. Prerequisites and Course Outline	Prerequisites concepts and course introduction	**-**		**02**
1 Introduction of different Applications	Types of Applications, Web-Based Applications, Mainframe, Client-Server, Thick Client, Thin Client.	**CO1**	**01**	**04**
	The History of Software Security, categorization of various web and mobile application, Introduction to Web Application Reconnaissance, The Structure of a Modern Web Application, Finding Subdomains		**01**	
	Identifying Weak Points in Application Architecture, Recognizing Web Application Security Threats : Hidden Manipulation ,Parameter Tampering, Cross-Site Scripting ,Buffer Overflow, Cookie Poisoning		**02**	
2. Securing Modern Web Applications	Defensive Software Architecture, Comprehensive Code Reviews ,Vulnerability Discovery ,Vulnerability Analysis ,Vulnerability Management ,Regression Testing ,Mitigation Strategies ,Applied Recon and Offense Techniques.	**CO2**	**02**	**07**

	Secure Application Architecture: Analyzing Feature Requirements, Authentication and Authorization, Secure Sockets Layer and Transport Layer Security, Secure Credentials, Hashing Credentials.		**03**	
	, Reviewing Code for Security: How to Start a Code Review Archetypical Vulnerabilities Versus Custom Logic Bugs ,Where to Start a Security Review ,Secure-Coding Anti-Patterns ,Blacklists ,Boilerplate Code ,Trust-By-Default Anti-Pattern ,Client/Server Separation		**02**	
3 Vulnerability Discovery and Vulnerability Management	Security Automation, Static Analysis, Dynamic Analysis ,Vulnerability Regression Testing ,Responsible Disclosure Programs ,Bug Bounty Programs.	**CO2 , CO3**	**02**	**06**
	,Third-Party Penetration Testing, Reproducing Vulnerabilities ,Ranking Vulnerability Severity ,Common Vulnerability Scoring System ,CVSS: Base Scoring ,CVSS: Temporal Scoring ,CVSS: Environmental Scoring		**02**	
	Advanced Vulnerability Scoring ,Beyond Triage and Scoring, Defending Against: CSRF Attacks, Advanced XXE Risks, Injection, DoS,Introduction to Cypress tool.		**02**	
4. The Current State of Mobile Application Security on Android	Security Risk = Vulnerability + Threat + Consequences , Evolution of Information Security: Why Applications Matter the Most ,Your Role: Protect the Data	**CO3, CO4**	**01**	**06**
	,Secure Software Development Techniques ,Unique Characteristics of Android, Introduction to the Android Architecture ,The Linux Security Model ,The Resulting Android Security Model		**02**	
	,Application Signing, Attribution, and Attestation ,Process Design ,Android Filesystem Isolation ,Android Preferences and Database Isolation Moving up the Layers to System API and Component Permissions		**03**	
5. Protecting Stored Data	The Threats and Vulnerabilities Against Stored Data , Vulnerabilities of Stored Data ,Threats to, and Mitigations for, Stored Data , Protection Principles, Component Security and Permissions.	**CO4, CO5**	**03**	**09**

	The Types of Android Components Intercomponent Signalling Using Intents , Public and Private Components		**02**	
	Imposing Restrictions on Access to Components Securing Activities, Securing Services. Securing Content Providers.		**02**	
	Securing Broadcast Intents, Putting It All Together: Securing Communications in a Multi-Tier App		**02**	
6. Understanding Android's Attack Surface	An Attack Terminology Primer: Attack Vectors, Attack Surfaces Classifying Attack Surfaces: Surface Properties, Classification Decisions	**CO5, CO6**	**02**	**07**
	Remote Attack Surfaces: Networking Concepts, Networking Stacks, Exposed Network Services, Mobile Technologies Client-side Attack Surface, Google Infrastructure		**02**	
	Physical Adjacency: Wireless Communications, Other Technologies Local Attack Surfaces, Exploring the File System, Finding Other Local Attack Surfaces		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**		**01**
Total Hrs				**42**

Books:

Text Books	1. Andrew Hoffman, "Web Application Security Exploitation and Countermeasures for Modern Web Applications", Published by O'Reilly Media, Inc., 1005, O′Reilly; Illustrated edition (13 March 2020) 2. Jeff Six ,"Application Security for the Android Platform" Published by O'Reilly Media, First edition 2011 3. Michael Cross, "Developer's Guide to Web Application Security", Published by Syngress Publishing
Reference Books	1. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Wiley; 2nd edition (7 October 2011) 2. Web Application Defender's Cookbook: Battling Hackers and Protecting Users ,Wiley; 1st edition (7 December 2012) 3. "Android Hackers Handbook",Joshua J. Drake, Pau Oliva Fora 2014 Edition

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC8034	**Optimizations in Machine Learning**	**3-0-0**

Prerequisite:	Machine Learning Algorithms
Course Objectives:	1. To study optimization algorithms with single and multi-variables for large datasets. 2. To provide the understanding of Genetic Algorithms and their applications in developing solutions to real-world problems. 3. To provide optimization ideas including gradient descent, stochastic gradient methods, higher-order methods, and more advanced optimization algorithms.
Course Outcomes:	**On successful completion, of course, learner will be able to:** 1. Understand AI concepts used to develop solutions to solve real-world problems. 2. Analyze and evaluate whether a problem can be solved using AI techniques. 3. Recognize classes of optimization problems in machine learning and related disciplines. 4. Understand the fundamental knowledge of Linear Programming and Dynamic Programming problems. 5. Use classical optimization techniques and numerical methods of optimization. 6. Describe the basics of different evolutionary algorithm and apply different techniques to solve various optimization problems arising from engineering areas.

Module No. & Name	Sub Topics/ Detailed Contents	CO mapped	Hrs / Sub Topics	Total Hrs /Module
i. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction	**-**		**02**
1. Introduction: Optimization and Machine Learning	Introduction to Machine Learning, Vector Machines. Unconstraint, optimization. Regression, Regularized Optimization. Optimizing and satisficing metrics	**CO1**	**05**	**05**
2. Convex Optimization with Sparsity-Inducing Norms	Basics of Convex Analysis, Convexity, Convex Sets. Convex Functions, Subgradient Generic Methods, Proximal Methods, Block) Coordinate Descent Algorithms, Reweighted-2Algorithms, Working-Set Methods, Quantitative Evaluation, Extensions..	**CO2**	**06**	**06**
3 Gradient Descent Algorithm	Primal-Dual Interior-Point Methods, Linear and Quadratic Programming, Second-Order Cone Programming, Semidefinite Programming, steepest Descent Direction. Strongly Convex Functions, Convex Functions with Lipschitz Continous	**CO3, CO4**	**04**	**09**

	Gradient, Fenchel Duality, Bregman Divergence, Unconstrained Smooth Convex .			
	Minimization, Minimizing a One-Dimensional Convex Function, Coordinate Descent, Gradient Descent, Mirror Descent, Conjugate Gradient, Higher Order Methods, Bundle Methods, Constrained Optimization, Projection Based Methods, Lagrange Duality, Linear and Quadratic Programs, Stochastic Optimization, Stochastic Gradient Descent, Nonconvex Optimization, Concave-Convex Procedure.		**05**	
4. Interior-Point Methods for Large-Scale Cone Programming	Primal-Dual Interior-Point Methods Linear and Quadratic Programming Second-Order Cone Programming, Semidefinite Programming	**CO4**	**05**	**05**
5. Robust Optimization in Machine Learning	Background on Robust Optimization, Robust Optimization, and Adversary Resistant Learning, Robust Optimization and Regularization.	**CO5**	**03**	**07**
	Robustness and Consistency, Robustness and Generalization, Noisy Optimization, Concentration Inequalities, Discrete Optimization, Online Optimization		**04**	
6. Hybrid Systems	Minimizing Sums and Expectations, Batch Gradient Descent (BGD), Gradient Descent (SGD), Stochastic Gradient Descent with Averaging (SGA), Stochastic Averaged Gradient Descent (SAG), The RFTL Algorithm and Its Analysis, The "Primal-Dual" Approach	**CO6**	**07**	**07**
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**	**01**	**01**
Total Hours				**42**

Books:

Text Books	1. T. Cormen, C. Leiserson, R Rivest, and C. Stein, Introduction to Algorithms, 3rd edition, Prentice-Hall. 2. G. Brassard, P. Bratley, Fundamentals of Algorithms, PHI. 3. Tom M. Mitchell. "Machine Learning" McGraw-Hill, 1997. 4. Lin, Zhouchen, Li, Huan, Fang, Cong"Accelerated Optimization for Machine Learning".Springer 5. Kulkarni, Anand J., Satapathy, Suresh Chandra" Optimization in Machine Learning and Applications".Springer 6. Suvrit Sra, Sebastian Nowozin and Stephen J. Wright" Optimization for Machine Learning" Neural Information Processing series

Reference Books	1. A. Levitin, Introduction to Design and Analysis of Algorithms, Pearson. 2. S. Basu, Design Methods and Analysis of Algorithms, PHI. 3. A. Bhargava, Grokking Algorithms: An illustrated guide for programmers and other curious people, Manning Publications
Useful Links:	
1. https://nptel.ac.in/courses/106/101/106101060/ 2. https://www.coursera.org/learn/calculus-and-optimization-for-machine-learning	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks **3.** Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Title	Credit
CSDC7012	Quantum Computing	3

Prerequisite: Engineering Mathematics, Data Structures and Algorithm, Python Programming

Course Objectives:

1. To understand basics of quantum computing
2. To understand mathematics required for quantum computing
3. To understand building blocks of quantum computing and design algorithms
4. To understand quantum hardware principles and tools for quantum computing.

Course Outcomes: After successful completion of the course student will be able to

1. Understand basic concepts of quantum computing
2. Illustrate building blocks of quantum computing through architecture andprogramming models.
3. Appraise various mathematical models required for quantum computing
4. Discuss various quantum hardware building principles.
5. Identify the various quantum algorithms
6. Describe usage of tools for quantum computing.

Module	Content	Hrs
i. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction	**02**
1.0 Introduction to Quantum Computing	Motivation for studying Quantum Computing,Origin of Quantum Computing, Quantum Computer vs. Classical Computer,Introduction to Quantum mechanics, Overview of major concepts in Quantum Computing, Qubits and multi-qubits states, Bloch Sphere representation,Quantum Superposition, Quantum Entanglement. Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)	**07**
2.0 Mathematical Foundations for Quantum Computing	Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.	**05**
3.0 Building Blocks for Quantum	Architecture of a Quantum Computing platform Details of q-bit system of information representation:Block Sphere Multi-qubits States Quantum superposition of qubits (valid and	**08**

Program	invalid superposition), Quantum Entanglement Useful states from quantum algorithmic perceptive e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit, No Cloning Theorem and Teleportation, Programming model for a Quantum Computing ProgramSteps performed on classical computer, Steps performed on Quantum Computer,Moving data between bits and qubits.	
4.0 Quantum Algorithms and Error correction	Quantum Algorithms, Shor's Algorithm, Grover's Algorithm. Deutsch's Algorithm, Deutsch -Jozsa Algorithm, Quantum error correction using repetition codes, 3 qubit codes, Shor's 9 qubit error correction Code	**06**
5.0 Quantum Hardware	Ion Trap Qubits ,The DiVincenzo Criteria , Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor Quantum Mechanics of a Free Rotor: A Poor Person's AtomicModel: Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates, The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, Light-Induced Rotor-Phonon Interactions, Trapped Ion Qubits, Mølmer-Sørenson Coupling .. Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits Quantum computing with spins: Quantum inverter realized with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate.	**10**
6.0 OSS Toolkits for implementing Quantum program	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM)	**03**
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**02**
Total Hours		**42**

Textbooks:	
1	Michael A. Nielsen, –Quantum Computation and Quantum Information, Cambridge University Press.
2	David McMahon, –Quantum Computing Explained, Wiley ,2008
3	Qiskit textbook https://qiskit.org/textbook-beta/
4	Vladimir Silva, Practical Quantum Computing for Developers,2018
References:	
1	Bernard Zygelman, A First Introduction to Quantum Computing and Information,2018
2	Supriyo Bandopadhyay and Marc Cahy, –Introduction to Spintronics‖, CRC Press, 2008
3	The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4	La Guardia, Giuliano Gladioli ―Quantum Error correction codes‖Springer,2021

Digital References:
https://onlinecourses.nptel.ac.in/noc21_cs103/preview
https://www.coursera.org/courses?query=quantum%20computing
https://www.cl.cam.ac.uk/teaching/1617/QuantComp/

Assessment:
Continuous Assessment for 40 marks: 4. Test 1 – 30 marks 5. Test 2 – 30 marks **6.** Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

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 andevery 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):	Upon completion of the course, the learners will be able to: 1. Apply selection criteria and select an appropriate project from different options. 2. Explain 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 themstrategically. 4. Use earned value technique and determine & predict status of the project. 5. Elaborate lessons learned during project phases and document them for future reference 6. Inculcate leadership qualities and ethics.

Module No.and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Project Management Foundation	Definition of a Project, Project versus Operations, Necessity of Project Management, Triple Constraints, Project Life Cycles (Typical & Atypical) Project Phases and Stage Gate Process, Role of Project Manager.	CO1	03	05
	Role of Project Manager, Negotiations and Resolving Conflicts. Project Management in Various OrganizationStructures, PM Knowledge Areas as per Project Management Institute (PMI).	CO1	02	

2. Initiating Project	How to get a Project Started, Selecting Project Strategically, Project Selection Models (Numeric /ScoringModels and Non-numeric models), Project Portfolio Process.	CO2	03	06
	Project Portfolio Process, Project Sponsor and Creating Charter, Project Proposal, Effective Project Team, Stagesof Team Development & Growth (Forming, Storming, Norming & Performing), Team Dynamics.	CO2	03	
3. Project Planning and Scheduling	Work Breakdown Structure (WBS) and Linear Responsibility Chart, Interface Co-ordination and Concurrent Engineering, Project Cost Estimation and Budgeting.	CO3	04	08
	Project Cost Estimation and Budgeting, Top Down and Bottoms Up Budgeting, Networking and SchedulingTechniques, PERT, CPM, Gnatt Chart.	CO3	03	
	Introduction to Project Management Information System.	CO3	01	
4. Planning Project	Crashing Project Time, Resource Loading and Leveling, Goldratt's Critical Chain, Project Stakeholders andCommunication Plan.	CO4	02	06
	Risk Management in Projects: Risk Management Planning, Risk Identification and Risk Register.	CO4	02	
	Qualitative and Quantitative Risk Assessment, Probabilityand Impact Matrix, Risk Response Strategies for Positive and Negative Risks.	CO4	02	
5. Executing, Monitoringand Controlli	Executing Projects: Planning Monitoring and ControllingCycle, Information Needs and Reporting, Engaging with All Stakeholders of the Projects, Team Management, Communication and Project Meetings.	CO5	03	08
	Monitoring and Controlling Projects: Earned Value Management Techniques for Measuring Value of Work Completed, Using Milestones for Measurement, Change Requests and Scope Creep, Project Audit.	CO5	03	

ng	Project Contracting, Project Procurement Management, Contracting and Outsourcing.	CO5	02	
6. Project Leadership and Ethics and Closing the Projects	Project Leadership and Ethics: Introduction to project Leadership, Ethics in Projects, Multicultural and virtual projects.	CO6	03	06
	Closing the Project: Customer Acceptance, Reasons of Project Termination, Various types of Project Terminations (Extinction, Addition, Integration, Starvation), Process of Project Termination, Completing aFinal Report, doing a Lesson Learned Analysis, Acknowledging Successes and Failures, Project Management Templates and Other Resources, Managing Without Authority, Areas of Further Study.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. J. Meredith, S. Mantel, Project Management: A Managerial Approach, Wiley. 2. M. Gopalan, Project Management, Wiley.
Reference Books:	1. A Guide to Project Management Body of Knowledge, Project Management Institute, USA. 2. G. Clements, Project Management, Cengage Learning. 3. D. Lock, Project Management, Gower Publishing.
Useful Links:	1. https://nptel.ac.in/courses/110/104/110104073/ 2. https://www.coursera.org/search?query=project%20management
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2:15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits (TH+P+TUT)
ILC8042	Finance Management	3+0+0
Prerequisite:		
Course Objectives:	1. Overview of Indian financial system, instruments and market 2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management 3. Knowledge about sources of finance, capital structure, dividend policy	
Course Outcomes:	**After successful completion of course student will be able to:** 1. Students will be able to describe Indian financial system 2. Students will be able to apply basic concepts of returns and risks. 3. Students will be able to use basic concepts of Time value of money. 4. Students will be able to understand sources of finance, capital structure, dividend policy 5 Students will be able to discuss basic concepts of corporate finance 6 Students will be apply to use 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	Characteristics, Components and Functions of Financial System.,	**CO1**	**02**	**06**
	Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.		**02**	
	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market		**02**	
	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges			
2. Concepts of Returns and Risks	. Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio	**CO2**	**04**	**08**
	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. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement.	**CO3**	**04**	**08**
	Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis		**04**	
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)	**CO4**	**02**	**04**
	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.		**02**	
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.	**CO5**	**03**	**05**
	Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure		**02**	
6. Dividend Policy:	Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend	**CO6**	**04**	**08**
	Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach		**04**	
Total Hours				**42**

Text Books

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.

2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.

Reference Books

1. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

2. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits Assigned (TH+P+TUT)
ILC8043	**Entrepreneurship Development and Management**	**3-0-0**

Prerequisites :	Fundamentals of Technology.
Course Objectives (COBs):	1. To Acquaint with Entrepreneurship and Management of Business. 2. Understand Indian environment for entrepreneurship. 3. Idea of EDP, MSME. 4. Discuss the Government Plan for Startup Business. 5. Analyze the Business Risk. 6. Discuss the Business Life Cycle.
Course Outcomes (COs):	**Upon completion of the course, the learners will be able to:** 1. Explain the concept of Business Plan and the Role of Money and Capital Markets in Entrepreneurial Development. 2. Analyze Key regulations and legal aspects of entrepreneurship in India. 3. Explain Government Policies for Startup. 4. Describe Different Government initiatives for Startup. 5. Explain Issues and Problems Faced by Micro and Small Enterprises. 6. Describe Growth Strategies for small businesses.

Module	Detailed Contents	CO Mapped	Hrs/ Subtopic	Total Hr/Module
i.Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. **Overview Of Entrepreneurship**	Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development.	**CO1**	**01**	**04**
	Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur.	**CO1**	**01**	
	Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship.	**CO1**	**02**	
2.**Business Plans and Importance of Capital to Entrepreneurship**	Introduction: Preliminary and Marketing Plans, Management and Personnel.	**CO2**	**02**	**09**
	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.	**CO2**	**03**	
	Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business.	**CO2**	**02**	
	New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations.	**CO2**	**02**	

3.**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**	**04**	**04**
4.**Indian Environment for Entrepreneurship**	Key Regulations and Legal Aspects, MSMED Act 2006 and its Implications, Schemes and Policies of the Ministry of MSME, Role and Responsibilities of various Government Organisations, Departments, Banks etc.	**CO4**	**03**	**09**
	Role of State Governments in Terms of Infrastructure Developments and Support etc.	**CO4**	**04**	
	Public Private Partnerships, National Skill Development Mission, Credit Guarantee Fund, PMEGP, Discussions, Group Exercises etc.	**CO4**	**02**	
5.**Effective Management of Business**	Issues and Problems Faced by Micro and Small Enterprises and Effective Management of M and S Enterprises.	**CO5**	**04**	**08**
	Risk Management, Credit Availability, Technology Innovation, Supply Chain Management, Linkage with Large Industries, Exercises, E-Marketing.	**CO5**	**04**	
6.**Achieving Success in The Small Business**	Stages of the Small Business Life Cycle, Four Types of Firm-Level Growth Strategies, Options – Harvesting or Closing Small Business Critical Success Factors of Small Business.	**CO6**	**05**	**05**
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**
Total				**42**

Text Books:	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:	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:

1. www.msme.gov.in/
2. www.dcmesme.gov.in/
3. www.msmetraining.gov.in/

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	Total
ILC8044	Human Resource Management	03	-	-	03

Prerequisites:	
Course Objectives (COBs):	1. To introduce the students with basic concepts, techniques and practices of the human resource management. 2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations. 3. To familiarize the students about the latest developments, trends & different aspects of HRM. 4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.
Course Outcomes (CO's):	**Upon completion of the course, the learners will be able to:** 1. Describe the concepts, aspects, techniques and practices of human resource management. 2. Describe the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective. 3. Apply the knowledge about the latest developments and trends in HRM. 4. Analyze the knowledge of Cross-cultural Leadership and Decision Making. 5. Apply the knowledge of behavioral skills learnt and integrate it with in interpersonal and intergroup environment emerging as future stable engineers and managers. 6. Apply the Labor Laws & Industrial Relations and various Act.

Module	Detailed Contents	COs Mapped	Hrs/ sub topic	Total Hrs/Module
i. **Prerequisite and Course outline**	Prerequisite Concepts and Course Introduction.	-	02	02
1. **Introduction Human Resource Management**	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.	CO1	03	05
	Human Resource Development (HRD): Changing Role of HRM – Human Resource Planning, Technological change, Restructuring and Rightsizing, Empowerment, TQM, Managing Ethical Issues.	CO1	02	
2. **Organizational Behavior (OB**)	Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary Issues.	CO2	02	07

	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness.	**CO2**	**01**	
	Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior.	**CO2**	**01**	
	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);	**CO2**	**01**	
	Group Behaviour and Group Dynamics: Work groups Formal and Informal Groups and Stages of Group Development. Team Effectiveness: High Performing Teams, Team Roles, Cross Functional and Self-Directed Team, Case Study.	**CO2**	**02**	
3. **Organizational Structure & Design**	Structure, Size, Technology, Environment of Organization; Organizational Roles & Conflicts: Concept of Roles; Role Dynamics; Role Conflicts and Stress.	**CO3**	**02**	**06**
	Leadership: Concepts and Skills of Leadership, Leadership and Managerial Roles, Leadership Styles and Contemporary Issues in Leadership.	**CO3**	**02**	
	Power and Politics: Sources and Uses of Power; Politics at Workplace, Tactics and Strategies.	**CO3**	**02**	
4. **Human resource Planning**	Recruitment and Selection Process, Job-Enrichment, Empowerment - Job-Satisfaction, employee morale.	**CO4**	**01**	**05**
	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning.	**CO4, CO6**	**02**	
	Training & Development: Identification of Training Needs, Training Methods.	**CO4**	**02**	
5. **Emerging Trends in HR**	Organizational Development; Business Process Re-Engineering (BPR), BPR as a Tool for Organizational Development, Managing Processes & Transformation in HR. Organizational Change, Culture, Environment.	**CO4**	**03**	**06**
	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.	**CO5,**	**03**	
6. **Strategic HRM**	HR & MIS: Need, Purpose, Objective and Role of Information System in HR, Applications in HRD in Various Industries (e.g. Manufacturing R&D, Public Transport, Hospitals, Hotels and Service Industries.	**CO6**	**04**	**10**
	Strategic HRM: Role of Strategic HRM in the Modern Business World, Concept of Strategy,	**CO6**	**03**	

	Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals			
	Labour Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labour Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act.	**CO6**	**03**	
ii. **Course Conclusion**	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**
Total hours				**42**
Text Books:	4. S. Robbins, Organizational Behavior, Pearson Education Limited. 5. V.S.P. Rao, Human Resource Management, Excel publishing. 6. 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.			
Useful Links:	1. https://nptel.ac.in/courses/110/105/110105069/ 2. https://nptel.ac.in/courses/110/102/110102058/			
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty				
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.				

Course Code	Course Name	Credits Assigned (TH+P+TUT)
ILC8045	Professional Ethics and Corporate Social Responsibility (CSR)	3-0-0

Course Objectives:	1. To understand professional ethics in business 2. To recognized corporate social responsibility
Course Outcomes:	Learner will be able to… 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	Detailed Contents	CO Mapped	Hrs/ sub topic	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**	**08**	**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**	**06**	**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 Public-Private Partnership (PPP)	**CO5**	**08**	**08**

	in India			
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—Companies Act, 2013.	**CO6**	**08**	**08**
ii.Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**
	Total			**42**

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

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	TOTAL
ILC8046	Research Methodology	03	-	-	03

Prerequisite:	Basic level knowledge of research.
Course Objectives (COBs):	1. To infer 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):	**Upon completion of the course, the learners will be able to:** 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	Detailed Contents	COs Mapped	Hours	Total Hours
i.Prerequisite and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction and Basic Research Concepts	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs. Methodology	**CO1**	**02**	**09**
	Need of Research in Business and Social Sciences	**CO1**	**02**	
	Objectives of Research	**CO1**	**01**	
	Issues and Problems in Research	**CO1**	**02**	
	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**CO1**	**02**	
2. Types of Research	Basic Research	**CO1, CO2**	**01**	**07**
	Applied Research	**CO1, CO2**	**01**	
	Descriptive Research	**CO1, CO2**	**01**	
	Analytical Research	**CO1, CO2**	**01**	
	Empirical Research	**CO1, CO2**	**01**	
	Qualitative and Quantitative Approaches	**CO1, CO2**	**02**	
3.Research Design and Sample Design	Research Design – Meaning, Types and Significance	**CO1**	**04**	**07**
	Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample	**CO1**	**03**	

	Design Sampling methods/techniques Sampling Errors			
4.Research Methodology	Meaning of Research Methodology	**CO6**	**01**	**08**
	Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	**CO6**	**07**	
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	Preparation of the report on conclusion reached	**CO3**	**02**	**04**
	Validity Testing & Ethical Issues	**CO3**	**01**	
	Suggestions and Recommendation	**CO3**	**01**	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**
Total hours				**42**

Text Books	C. Kothari, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited, 1985.
Reference Books	1. C. Dawson, Practical Research Methods, New Delhi, UBS Publishers Distributors, 2002. 2. 2. R. Kumar, Research Methodology-A Step-by-Step Guide for Beginners, 2nd edition, Singapore, Pearson Education, 2005.
Useful Links:	https://libguides.newcastle.edu.au/researchmethods

Continuous Assessment (CA)

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment--10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits Assigned (TH+P+TUT)
ILC8047	**IPR and Patenting**	**3-0-0**

Course Objectives:	1. To understand intellectual property rights protection system 2. To promote the knowledge of Intellectual Property Laws of India as well as international treaty procedures 3. To get acquaintance with Patent search and patent filing procedure and applications
Course Outcomes:	**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	Detailed Contents	COs Mapped	Hours	Total Hours
i. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Introduction to Intellectual Property Rights (IPR)	Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	**CO1**	**05**	**05**
2. Enforcement of Intellectual Property Rights	Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	**CO2**	**07**	**07**
3. Emerging Issues in IPR	Challenges for IP in digital economy, e- commerce, human genome, biodiversity and traditional knowledge etc.	**CO3**	**05**	**05**
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),	**CO4**	**07**	**07**

	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			
	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**
	Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	**CO6**	**07**	**07**
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**
Total Hrs				**42**

Text Books:	1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India 2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws 3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International 4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press 5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
Reference Books:	1. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO 2. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH 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

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment--10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
UILC8048	Digital Business Management	3 - 0 – 0

Prerequisite:	Business Intelligence
Course Objectives:	1.To familiarize with digital business concept 2.To acquaint with E-commerce 3.To give insights in to E-business and its strategies
Course Outcomes:	**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 / Sub Topics	Total Hrs/ Module
i. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction.	-	**02**	**02**
1. Introduction to Digital Business	**Introduction to Digital Business** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy. **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business.	**CO1**	**09**	**09**
2. Overview of E-Commerce	Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC.	**CO2**	**06**	**06**
3. Digital Business	ERP as e –business backbone, knowledge Tope Apps, Information and referral system	**CO3**	**06**	**06**

Support services	**Application Development**: 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, Outcome, Applications, and Summarization.	**-**	**01**	**01**
Total Hours				**42**

Books:

Text Books	1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011 2. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014 3. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson 4. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5 5. Measuring Digital Economy-A new perspective DoI:10.1787/9789264221796-enOECD Publishing
Reference Books	1. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002 2. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006 3. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer. 4. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan. 5. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance

Useful Links:

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 30 marks

2. Test 2 – 30 marks 3. Internal assessment--10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits Assigned			
		TH	P	TUT	Total
ILC8049	Environmental Management	03	-	-	03

Prerequisite:	General Awareness of environment and factors affecting the environment
Course Objectives (COBs):	1. Learn and identify environmental issues relevant to India and global concerns. 2. Learn concepts of ecology. 3. Familiarise environment related legislations. 4. Learn 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. Learn the regulating policies of Government in environmental management. 5. Identify solutions to protect the environment from pollution. 6. Examine the quality environmental management.

Module	Detailed Contents	COs Mapped	Hrs/ Sub top	Total Hrs/ Module
i. Prerequisite and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction and Definition of Environment	Significance of Environment Management for contemporary managers	**CO1**	**02**	**10**
	Career opportunities		**01**	
	Environmental issues relevant to India		**02**	
	Sustainable Development		**03**	
	The Energy scenario		**02**	
2. Global Environmental concerns	Global Warming	**CO3**	**01**	**06**
	Acid Rain		**01**	
	Ozone Depletion		**01**	
	Hazardous Waste	**CO3, CO5**	**0.5**	
	Endangered life-species		**0.5**	
	Loss of Biodiversity		**01**	
	Industrial/Man-made disasters/ Atomic/ Biomedical hazards, etc		**01**	
3. Concepts of Ecology	Ecosystems and interdependence between living organisms	**CO2**	**01**	**05**
	Habitats		**0.5**	

	Limiting factors		**0.5**	
	Carrying capacity		**01**	
	Food chain		**01**	
	Ecology		**01**	
4. Scope of Environment Management	Scope of Environment Management	**CO1**	**03**	**10**
	Role and functions of Government as a planning and regulating agency	**CO1,CO4**	**03**	
	Environment Quality Management and Corporate Environmental Responsibility		**04**	
5. Quality Environmental Management	Total Quality Environmental Management	**CO6**	**02**	**05**
	ISO-14000		**02**	
	EMS certification		**01**	
6. General overview of major legislations	Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act	**CO4, CO3**	**03**	**03**
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**

Text Books	1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999 2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing 3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
Reference Books	1. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau of Indian Standards, February 2005 2. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC 3. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015 4. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
Useful Links:	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 for 40 marks:

1. Test 1 – 30 marks
2. Test 2 – 30 marks
3. Internal assessment--10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

Lab Code	Lab Name	Credits (P+TUT)
CEL801	**Distributed Computing Lab**	**1-0**

Lab Prerequisite:	Java / Python Programming Concepts
Lab Objectives:	1. To understand basic underlying concepts of forming distributed systems. 2. To learn the concept of clock Synchronization 3. To learn Election Algorithm. 4. To explore mutual exclusion algorithms and deadlock handling in the distributed system 5. To study resource allocation and management. 6. To understand the Distributed File System
Lab Outcomes (LOs):	1. Develop test and debug usingMessage-Oriented Communication or RPC/RMI based client-server programs. 2. Implement techniques for clock synchronization. 3. Implement techniques for Election Algorithms. 4. Demonstrate mutual exclusion algorithms and deadlock handling. 5. Implement techniques of resource and process management. 6. Describe the concepts of distributed File Systems with some case studies..

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Prerequisite	-	**02**
1	Client/server using RPC/RMI	**LO1 LO6**	**02**
2	Implementation of multi tread application	**LO3 LO6**	**02**
3	Group Communication	**LO2 LO6**	**02**
4	Load Balancing Algorithm.	**LO4 LO6**	**02**
5	Clock Synchronization algorithms	**LO3 LO6**	**02**
6	Mutual Exclusion Algorithm.	**LO3 LO6**	**02**
7	Distributed File System	**LO2 LO6**	**02**
8	Clock Synchronization algorithms	**LO2**	**02**
9	Case Study on latest topics based on IEEE papers/ Springer/ACM-WhatsApp, Facebook, Instagram-working-Application How and why	**LO1-5 LO6**	**02**
10	Case Study: Android Stack	**LO1-5 LO6**	**02**

Term work:

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.

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 Exam Oral examination will be based on theory **CEC801** and practical syllabus **CEL801.**

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8021	**Applied Data Science Lab**	**1-0**

Lab Prerequisite:	Python Programming
Lab Objectives:	1. To study advanced data types, functions, data structures, and Object-Oriented Programming using Python in a python programming language. 2. To explain concepts of modules, packages, multithreading, and exception handling. 3. To study File handling, GUI & database programming, django framework, data analysis, data visualization, and Web Services use python.
Lab Outcomes (LOs):	After the successful completion of this course, the learner will be able to: 1. Apply the structure, syntax, and semantics of the Python/R language. 2. Implement the concept of advanced data types and functions in python 3. Illustrate data structures the concepts of object-oriented programming as used in Python 4. Create Python/R applications using modules, packages, multithreading, and exception handling, File Handling programs, create GUI applications, and evaluate database operations in python. 5. Develop applications for data visualization using Matplotlib, data analysis using Pandas, and Web programming using Flask 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab. No.	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	**-**	**02**
1.	Perform linear Regression on database imported from web storage	**LO1,LO6**	**02**
2.	Perform logistic Regression on database imported from web storage	**LO2, LO6**	**02**
3.	Perform data visualization on dataset imported from web storage	**LO3, LO6**	**02**
4.	Find the correlation matrix and Plot the correlation plot on the dataset and visualize giving an overview of relationships among data on iris data.	**LO4, LO6**	**02**
5.	Performing Singular matric decomposition or any matrix decomposition technique	**LO5, LO6**	**02**
6.	To Perform Hypothesis Testing on any dataset.	**LO3, LO6**	**02**
7.	Install relevant packages for classification and choose a classifier for classification problems. Evaluate the performance of the classifier.	**LO4, LO5, LO6**	**02**

8.	Data Analysis case study: Temperature and Air Quality	**LO1, LO2, LO6**	**03**
9.	Data Analysis case study: Healthcare Data Analysis	**LO1, LO2 LO6**	**02**
10.	Data Analysis case study Attractive Face Recognition Study	**LO1, LO6**	**02**
11.	Data Analysis case study: Job Type and Satisfaction	**LO1 ,LO6**	**02**

Books:

Text Books	1. Dr.R Nageswara Rao, "Core Python Programming", Dreamtech Press 2. Beginning Python : Using Python 2.6 and Python 3.1 . James Payne, Wrox Publication 3. Anurag Gupta , G.P.Biswas , "Python Programming " Mc Graw Hill 4. E. Balagurusamy – "Introduction to computing and problem solving using Python" Mc Graw Hill Education
Reference Books	1. Zed A Shaw , " Learn Python 3 the hardway, Zed Shaw's Hardway series . 2. Martin C .Brown , " Python : The complete reference " , Mc Graw Hill Publication 3. Paul barry , " Head first python " , 2nd edition,O-Reilly Media Inc.

Useful Links:

1. https://docs.scipy.org/doc/numpy/user/quickstart.html
2. https://matplotlib.org/tutorials/
3. https://pandas.pydata.org/docs/getting_started/
4. https://www.geeksforgeeks.org/python-build-a-rest-api-using-flask/

Term work:

Term work should consist of a minimum of 8 experiments.

1. Journal must include at least 2 assignments based on content of theory.
2. The final certification and acceptance of term work is based on satisfactory performance oflaboratory work and minimum passing marks in term work evaluation.
3. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral Exam:

Oral examination will be based on theory **CEDLC8021** and practical syllabus **CDLL8021**

Lab Code	Lab Name	Credits (P+TUT)	
CEDLL8022	**Software Defined Networks Lab**	**1- 0**	
Lab Prerequisite:	Computer Networking Concepts		
Lab Objectives:	1. To understand how to build a network topology. 2. To gain knowledge about working of different SDN controllers. 3. To explore Mininet emulator to perform networking tasks. 4. To design Internet Router using Mininet.		
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Analyze the working of Mininet. 2. Design SDN environment and different custom network topology using Mininet. 3. Design own Internet Router using Mininet and SDN controller. 4. Implement data center network using SDN controller. 5. Implement SDN applications on top of the network controller. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.		
Lab No	**Experiment Title**	**LO mapped**	**Hrs /Lab**
0	Prerequisite	**-**	**02**
1.	Set up Mininet network emulation environment using Virtual Box and Mininet. Demonstrate the basic commands in Mininet.	**LO1, LO6**	**02**
2.	Implement different custom network topology (Simple, Linear, and Tree). Analyze flow tables.	**LO2, LO6**	**02**
3.	Install POX controller and run custom topology using POX. Identify inserted flows by the controller.	**LO2, LO6**	**02**
4	Install floodlight controller and run custom topology using floodlight. Identify inserted flows by the controller.	**LO2, LO6**	**02**
5	Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller.	**LO2, LO6**	**02**
6	Build your own Internet Router using Mininet as an Emulator and POX controller. Write a simple router with a static routing table. The router will receive raw Ethernet frames. It will process the packets just like a real router, and then forward them to the correct outgoing interface. Make sure you receive the Ethernet frame and create the forwarding logic so packets go to the correct interface.	**LO3, LO6**	**02**
7	Emulate a Data Center and manage it via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center.	**LO4, LO6**	**02**
8	Implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management.	**LO5, LO6**	**02**

Term work:

1. Term work should consist of minimum 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Software defined Networks"
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 Exam

Oral examination will be based on theory **CEDLC8022** and practical syllabus **CEDLL8022**

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8023	**Digital Forensic Lab**	**1- 0**
Lab Prerequisite:	1. Computer Network 2. Cryptography and System Security	
Lab Objectives:	1. Learn about evidence collection, cloning, analyzing and recovering digital evidences. 2. Learn disk imaging using commands. 3. Learn steganography tool and password cracking tools. 4. Learn to use forensic tools. 5. Learn to solve the cases using modern tool.	
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Explore evidence collection, cloning, analyzing and recovering digital evidences techniques using tools and commands. 2. Use steganography tool and password cracking tools. 3. Use comprehensive digital forensics tool for disk data analysis. 4. Explore Vulnerability Assessment and Penetration Testing. 5. Use network forensic tools to solve the cases using wireshark tool. 6. Apply ethics and strictly follow rules and regulations of laboratory.	

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	**-**	**02**
1	Cloning a Disk, use hashing to verify the integrity of the disk image and analyzing and recovering digital evidence with WinHex.	**LO1, LO6**	**02**
2	Volatile data collection from Linux system.	**LO1, LO6**	**02**
3	Learn how to acquire disk image. (dd and dc3dd command)	**LO1, LO6**	**02**
4	Learn art of the steganography.	**LO2, LO6**	**02**
5	Use password forensic tools crack zip and rar password protected file.	**LO2, LO6**	**02**
6	Case study on Pro Discover forensic tool.	**LO3, LO6**	**02**
7	Case study on FTK imager.	**LO3, LO6**	**02**
8	Case study on Vulnerability Assessment and Penetration Testing.	**LO4, LO6**	**02**
9	Case study on crime case and explain how you should proceed.	**LO4, LO6**	**02**
10	Network forensic analysis using Network miner.	**LO5, LO6**	**02**

Term work:

1. Term work should consist of minimum 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Digital Forensics"

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:

Oral examination will be based on theory **CEDLC8023** and practical syllabus **CEDLL8023.**

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8024	**Deep Learning Lab**	**1- 0**
Lab Prerequisite:	1. Machine Learning 2. Basic Mathematics and Statistics Concepts	
Lab Objectives:	1. To design and analyze the concept of Deep Neural Network through various applications 2. To implement Convolution Neural Network and Recurrent Neural Network 3. To implement Deep Neural Network and layered learning approach 4. Apply various deep learning techniques to design efficient algorithms for real-world applications.	
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Explore Deep learning libraries and implement deep learning model 2. Build and train Convolution Neural Network 3. Build and train Recurrent Neural Network 4. Demonstrate regularization and optimization schemes in deep learning 5. Apply the deep neural network concepts in developing real world applications 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory	

Lab No	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	**-**	**02**
1.	Implementation of XOR Gate using Backpropagation in Neural Networks	**LO1, LO6**	**02**
2.	To Explore all deep learning libraries e.g.Theano, Tensor Flow ,Lasagne , Keras MXNet etc.	**LO1, LO6**	**02**
3.	To design and implement a Neural Network using Keras API. a) To design a Neural Network using Keras api. b)To plot the model and its subsequent layers(along with the input and output dimensions of each layer) using vis_utils.	**LO1, LO6**	**02**
4.	To design and implement a CNN for Multiclass Object classification on image data. a) Classification of digits from 0 to 9 using keras API and training using layers of Conv2D, Maxpooling, Dropout etc.	**LO2, LO4, LO6**	**02**
5.	To design and implement simple RNN layer for Binary Classification on text data.	**LO3, LO6**	**02**
6.	6a)To design and implement RNN(Recurrent Neural Network) by using LSTM layer for Multiclass Classification on text data 6b)To design and implement a RNN(Recurrent Neural Network) by using GRU layer for Multiclass Classification on text data.	**LO3, LO4, LO6**	**02**
7.	Implement Generative Adversarial network	**LO5, LO6**	**02**

8.	Deployment of Deep Learning models using Docker	**LO5, LO6**	**02**
9.	Mini Project focusing on Agriculture / Healthcare / Education /Society domain need to be carried out by the students by using the concepts of deep learning	**LO1, LO2,LO3 ,LO4, LO5,LO6**	**12**

Term work:

1. Term work should consist of minimum 7 experiments and Mini Project.
2. Journal must include at least 2 assignments on content of theory and practical of "Deep Learning".
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: 15-marks, Miniproject: 10-marks)

Oral Exam

Oral examination will be based on theory **CEDLC8024** and practical syllabus **CDLL8024**

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8031	**Social Media Analytics Lab**	1- 0
Lab Prerequisite:	Programming Language Concepts (Python)	
Lab Objectives:	1. To Understand the components of the social network. 2. To model & visualize the social network. 3. To Mine the users and interest in the social network. 4. To understand the evolution of the network.	
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Work on the internal components of the social network. 2. Apply social media analytics for Twitter kind of applications. 3. Mine the behavior of the users in the social network 4. Predict the possible next outcome of the social network**.** 5. Use of page rank algorithm. 6. Strict to the time and follow the rules and regulation of laboratory.	

Lab No	Experiment Title	LO mapped	Hrs/ Lab
0	**Prerequisite**	**-**	**02**
1	One case study on understanding how social media platform works. The case study relates to following features 1.Web 2.0 Internet based applications or platforms 2.Content is created as well as consumed by users 3.Profiles give users have their own distinct and unique identity 4.Social networks help connect different users, similarly to communities	**LO1, LO6**	**02**
2	Demonstrate a sentiment, trend and follower graph analysis on twitter.	**LO2, LO6**	**02**
3	Demonstrate a social network and brand engagement of facebook	**LO2, LO6**	**02**
4	Implementation of any clustering algorithm to mine the opinion of data set of twitter/facebook/Instagram/youtube	**LO3, LO6**	**02**
5	Predict the individual behavior of users of Twitter/Youtube using any prediction based algorithms	**LO4, LO6**	**02**
6	Build a recommendation engine and sentiment ranking for foursquare application	**LO2, LO6**	**02**
7	Implementation of page ranking algorithm	**LO5, LO6**	**02**
8	Implementation of any clustering algorithm to mine the opinion of data set of twitter/facebook/Instagram/youtube	**LO3, LO6**	**02**
Term work:			

1. Term work should consist of minimum 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Data Warehousing and Mining"
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)

Practical Exam :

Practical examination will be based on Practical syllabus(CEDLL8031)

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8032	**High Performance Computing Lab**	**1-0**

Prerequisite:	Operating Systems
Lab Objectives:	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	**At the end of the lab, students will be able to:** 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 Prerequisites**	**-**	**02**
1	Execution of Simple Hello world program on MPI platform	**LO2, LO5, LO6**	**01**
2	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**	**01**
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	**Mini Project** 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	**LO1, LO2, LO3, LO4, LO5, LO6**	**02**

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 "High Performance Computing"

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)
Practical Exam : **Practical examination will be based on Practical syllabus(CEDLL8032)**

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8033	**Secure Application Development Lab**	1- 0

Lab Prerequisite:	1. Computer Networks. 2. Cryptography and System Security
Lab Objectives:	1. This course lab is an introductory study of the principles, practices, procedures, and methodologies to ensure security of data within web-based applications. 2. It examines secure coding practices and processes, web application security configuration management techniques, and web application security standards
Lab Outcomes (LOs):	**At the end of the course, the students will be able to..** 1. Describe web-based applications and associated threats 2. Demonstrate the role of web-based applications in E-commerce transactions 3. Describe social networking and evaluate associated risks 4. Evaluate web application security vulnerabilities 5. Identify web application security controls and risk mitigation techniques 6. Assess web application security compliance requirements and objectives 7. Apply the ethical principles like timeliness and adhere to the rule of Laboratory

Lab No.	Experiment Title	LO mapped	Hrs/Lab
0	Prerequisite Lab	**--**	**02**
1	Demonstrate the methodologies and guidelines of OWASP (Open Web Application Security Project) for the secure development of applications	**LO1, LO7**	**02**
2	SQL Injection vulnerability Lab	**LO2, LO7**	**02**
3	Cross-Site Scripting (XSS) vulnerability Lab	**LO2, LO7**	**02**
4	OS Command Injection vulnerability Lab	**LO3, LO7**	**02**
5	LFI (Local File Inclusion) and RFI (Remote File Inclusion) vulnerabilities Lab	**LO4, LO7**	**02**
6	Hands-on OWASP Broken Authentication and Session Management tutorial	**LO4, LO7**	**02**
7	Learn XXE by doing hands-on challenges	**LO4, LO7**	**02**
8	OWASP ZAP (Zed Attack Proxy)	**LO1, LO4, LO7**	**02**
9	OWASP Web Goat Demo Web Goat is a deliberately insecure web application maintained by OWASP designed to teach web application security lessons	**LO1, LO4, LO7**	**02**
10	Hands-on Sensitive Data Exposure tutorial	**LO5, LO6, LO7**	**02**
11	One Case study on the topic “Secure Application Development” like real time security of what’s up	**LO5, LO6, LO7**	**02**

	application .		
12	Research paper on Secure Application Development	**LO6, LO7**	**02**

Useful links:

1. https://www.udemy.com/course/secure-coding-secure-application-development/
2. https://www.coursera.org/projects/web-application-security-testing-with-owsap-zap
3. https://www.udemy.com/course/web-application-security-for-absolute-beginners-no-coding/
4. https://www.coursera.org/projects/web-application-security-testing-with-owsap-zap

Above Experiment will be performed using either PHP, Java Script, kali Linux or STAT, DAST etc. open-Source tools

Term Work:

1 Term work should consist of 8 experiments.
2 Journal must include at least 2 assignments on content of theory and practical of "Secure Application Development"
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)
5 Final Practical exam of 25 Marks

Practical Exam :
Practical examination will be based on Practical syllabus(CEDLL8033)

Lab Code	Lab Name	Credits (P+TUT)
CEDLL8034	**Optimization Machine Learning Lab**	1- 0

Lab Prerequisite:	1. Basics of Python 2. Basic Mathematics and Statistics Concepts
Lab Objectives:	1. Make use of Data sets in implementing the machine learning algorithms. 2. 2. Implement the machine learning concepts and algorithms in any suitable language of choice.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Implement procedures for the machine learning algorithms. 2. Design Java/Python programs for various Learning algorithms. 3. Apply appropriate data sets to the Machine Learning algorithms. 4. Identify and apply Machine Learning algorithms to solve real world problems. 5. Apply ethical principles like timeliness and adhere to rules of laboratory.

Lab No	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	-	**02**
1.	Implement Linear and Quadratic Programming.	**LO1, LO5**	**02**
2.	Implement Linear Regression Using Gradient Descent	**LO1, LO5,**	**02**
3.	Implement Reweighted-2Algorithms,	**LO2, LO5**	**02**
4.	Implement Candidate-Elimination algorithm	**LO2, LO5**	**02**
5.	Implement Batch Gradient Descent (BGD)	**LO3, LO5**	**02**
6.	Implement Stochastic Gradient Descent with Averaging	**LO3, LO5**	**02**
7.	Implement Stochastic Averaged Gradient Descent	**LO4, LO5**	**02**
8.	Implement Dual Augmented Lagrangian (DAL) Algorithm	**LO3, LO5**	**02**
9.	Implement Proximal Minimization Algorithm.	**LO3, LO4, LO5**	**02**
10.	Machine Learning Case Studies: i) Text Classification via Convex Optimization ii)Perceptual Tasks via Deep Neural Networks iii)Formal Machine Learning Procedure	**LO4, LO5**	**02**

Term work:

1. Term work should consist of a minimum of 8 experiments and a Mini Project.
2. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3. Total 25 Marks (Experiments: 15-marks, Mini Project: 10 Marks)

Practical Exam:

Practical examination will be based on Practical syllabus(CEDLL8034)

Course code	Course Name	Credits	Course Category
CEPR86	**Project Based Learning: Major Project- B**	**6**	**PR**

Objectives	
1	To encourage students for knowledge acquisition and use latest technology.
2	To make students to develop presentation skills.
3	To use written communications to report and technical writing.

Outcome: Learner will be able to…	
1	Review literature, design solutions, components or processes for complex engineering problems on the basis of research knowledge. (PO1, PO2, PO3, PO4)
2	Implement projects using modern tools which are useful to society. (PO5, PO6)
3	Apply contextual knowledge to assess the public health/safety/societal/environmental issues for sustainable development. (PO7)
4	Document the work in project report and log book by referring reputed material. (PO10)
5	Apply ethical principles and commit to professional ethics, responsibilities norms of the engineering practice and engage in independent and life-long learning. (PO8, PO12)
6	Present their work in clear and effective manner with professional values like team work, time management and make financial arrangements (PO9, PO11)

Guidelines:

Refer general guidelines of Major Project - A.

Project Report Format:

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

Abstract

1. Introduction
2. Literature Survey
   - Survey Existing system
   - Limitation of the Existing system or research gap
   - Problem Statement and Objective
   - Scope
3. Proposed System
   - Analysis/Framework/ Algorithm
   - Details of Hardware and Software
   - Design details
   - Methodology (your approach to solve the problem)
4. System Implementation
5. Result Analysis
6. Conclusion and future scope

References

Published papers and certificates

Major Project -B **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	Effort taken by students • Paper publish/Filing patent/creation of product/start-up • Idea/project/poster/TPP competition (National/international)	10
Review / progress monitoring committee may consider points for assessment based on one year project as mentioned in general guidelines.		
Guidelines for Assessment of Major Project Practical/Oral Examination:		
1. Report should be prepared as per the standard format.		
2. Major Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by the head of Institution.		
3. Project groups have to publish paper/Filing patent/creation of product/start-up Idea/project/poster/TPP competition (National/international) etc.		

Lab Code	Lab Name	Credit
CSDL7012	**Quantum Computing Lab**	**1**

Prerequisite: Python Programming Language.

Lab Objectives:

1	To implement fundamental quantum computing concepts
2	To learn quantum computation and quantum information
3	To understand quantum entanglement, quantum algorithms
4	To understand quantum information theory and channels

Lab Outcomes: Students will be able to

1	Implement basic quantum computing logic by building dice and random numbers using open source simulation tools.
2	Understand quantum logic gates using open source simulation tools.
3	Implement quantum circuits using open source simulation tools.
4	I implement quantum algorithms using open source simulation tools.

Suggested Experiments: Students are required to complete at least 10 experiments.Faculty may develop their own set of experiments for students. List below is only suggestive.

Sr. No.	Name of the Experiment
1	Building Quantum dice
2	Building Quantum Random No. Generation
3	Composing simple quantum circuits with q-gates and measuring the output into classical bits.
4	Implementation of Shor‘s Algorithms
5	Implementation of Grover‘s Algorithm
6	Implementation of Deutsch‘s Algorithm
7	Implementation of Deutsch-Jozsa‘s Algorithm
8	Quantum Circuits
9	Qubit Gates
10	Bell Circuit & GHZ Circuit
11	Accuracy of Quantum Phase Estimation
12	Mini Project such as implementing an API for efficient search using Grover‘s Algorithms or Integer factorization using Shor‘s Algorithm.

Useful Links:

1	IBM Experience: https://quantum-computing.ibm.com/
2	Microsoft Quantum Development Kit https://azure.microsoft.com/en-us/resources/development-kit/quantum-computing/#overview
3	Forest SDK PyQuil: https://pyquil-docs.rigetti.com/en/stable/

4	Google Quantum CIRQ https://quantumai.google/cirq
5	Qiskit Labs IBM https://learn.qiskit.org/course/ch-labs/lab-1-quantum-circuits

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
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)

Course Code	Course Name	Hours/Duration	Credits
INT87	**Internship-VII**	**2-4 Weeks**	--

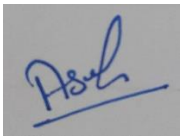
Prerequisite:	**In depth knowledge about filling IPR/ copywriting a product/solution.**
Course Objectives:	1. To gain the knowledge of filling patent and Copy write. 2. Presenting technology solutions across worldwide problems through competitions and publications.
Couse Outcomes:	**Upon completion of the course, students will be able to:** 1. National and international recognition through IPR and/or copy writes and paper publications. 2. Convert problem solution as a business plan for entrepreneurial product.

Activity- PBL Major Project B Work/Conference Presentation	**Supporting Activities to be completed under Internship**
	For Sem VIII PBL Course-Major Project-B, selected topic: 1. File for Project solution Copyright and/or File for Project topic IRP/Patent
	2. Participate at Institute Annual Project Competition-INTECH
	3. Publish the project solution at reputed International Journals, preference should be given to UGC care list and/or SCI indexed journals.

Term Work Assessment:

Duration to be considered for assessment:
Week Ends and during Semester

Guidelines:	1. Batch wise Faculty Supervisor who is the proctor (mentor) of the batch will be allotted as in-charge for the course, at start of the Academic year. 2. Students will submit the participation certificate of the activities to the faculty mentors. 3. Department IIIC Cell coordinator will collect, maintain each student proofs/reports from all faculty mentors, department internship analysis report will be prepared & submitted to Dean, IIIC for AICTE-CII survey data 4. Students will submit evaluation sheet by attaching Xerox copies of all participation/ IPR/ Copyright certificates & faculty mentor will verify it with original copies, for assessment purpose.



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