SFIT/IQAC/FE-G1-SS/2024-25/R0

Date:25/07/2024

St. Francis Institute of Technology

(Engineering College)

(An Autonomous Institute, Affiliated to University of Mumbai)

S.V.P. Road, Borivli (W), Mumbai

B. E. Computer Engineering
Scheme and Syllabus

Approved by: - Board of Studies

Approved by: - Academic Council of St. Francis Institute of Technology

w.e.f. Academic Year 2024 – 2025

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AC:
Item No. ____

St. Francis Institute of Technology

Syllabus for Approval

Date:

Sr. No	Heading	Particulars
1.	Title of the Course	**B.E. Computer Engineering**
2.	Eligibility	**After Passing Second Year Engineering as per the Ordinance 0.6243**
3.	Passing Marks	**40%**
4.	No. of Years / Semesters	**4 years / 8 semesters**
6.	Level	~~P.G. /~~ **U.G./** ~~Diploma /~~ Certificate
7.	Pattern	~~Yearly~~ / **Semester**
8.	Status	~~**New**~~ /-Revised
9.	To be implemented from Academic Year	**With effect from Academic Year: 2024-2025**

Dr. Sincy George
Principal
St Francis Institute of Technology

Dr. Kavita Sonawane
HOD, Computer Engineering Dept.
St Francis Institute of Technology

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education, The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year it will be implemented for 24-25, Third year for 24-25, and 25-26. For Final Year of Engineering it will be implemented for the academic year 2024-25. 2025-26, 2026-27.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C ' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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Dr. Kavita Sonawane
HOD, Computer Engineering Dept.
St Francis Institute of Technology

Preface by Board of Studies in Computer Engineering

Dear Students and Teachers, we, the members of Board of Studies Computer Engineering, are very happy to present Second Year Computer Engineering syllabus effective from the Academic Year 2020-21 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting and challenging.

Computer Engineering is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Computer Engineering. It aims at producing trained professionals who can successfully acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date the knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The revised syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the revised syllabus are:

1. Reduction in credits to 170 is implemented to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increases the chance of employability
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratefulness to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Board of Studies in Computer Engineering

Dr. Kavita Sonawane	:	Chairperson
Dr. Sudip Thepade	:	Subject Expert
Dr. Sunil Mane	:	Subject Expert
Dr. Narendra Shekokar	:	VC Nominee
Mr. Mukesh Jain	:	Industry Expert
Dr. Raj Dabre	:	Alumni
Dr. Padmaja Joshi	:	Special Courses -Expert

1. Program Structure for Second Year B.E Computer Engineering (with Effect from 2024-25)

1.1 Final Year Scheme of the Syllabus

Table 1: Contact hours and credit distribution of courses of B.E Computer Engineering

Course Code	Course	Contact Hours				Credits Assigned			
		Theory (Th)	Practical (P)	Tutorial (T)	Total	Theory (Th)	Practical (P)	Tutorial (T)	Total
Semester VIII									
CSC801	Distributed Computing	3	-	-	3	3	-	-	3
CSDC 801X	Department Level Optional Course -5	3	-	-	3	3	-	-	3
CSDC 802X	Department Level Optional Course -6	3	-	-	3	3	-	-	3
ILO 801X	Institute Level Optional Course -2	3	-	-	3	3	-	-	3
CSL801	Distributed Computing Lab	-	2	-	2	-	1	-	1
CSDL 801X	Department Level Optional Course -5 Lab	-	2	-	2	-	1	-	1
CSDL 802X	Department Level Optional Course -6 Lab	-	2	-	2	-	1	-	1
CSP801	Major Project 2	-	12	-	12	-	6	-	6
	Total	**12**	**18**	**-**	**30**	**12**	**9**	**-**	**21**

1.2 Evaluation and Examination Scheme

Table 2: Marks distribution of courses for B.E Computer Engineering

S.No.	Course Code	Course	ISE 1	ISE2	MSE	ESE	Total	ISE(LAB)	Prac. / Oral	Total
Semester VIII										
1	CSC801	Distributed Computing	10	10	20	60	100	-	-	-
2	CSDC 801X	Department Level Optional Course -5	10	10	20	60	100	-	-	-
3	CSDC 802X	Department Level Optional Course -6	10	10	20	60	100	-	-	-
4	ILO 801X	Institute Level Optional Course -2	10	10	20	60	100	-	-	-
5	CSL801	Distributed Computing Lab	-	-	-	-	-	25	25	50
6	CSDL 801X	Department Level Optional Course -5 Lab	-	-	-	-	-	25	25	50
7	CSDL 802X	Department Level Optional Course -6 Lab	-	-	-	-	-	25	25	50
8	CSP801	Major Project 2	-	-	-	-	-	100	50	150
		Total	**40**	**40**	**80**	**240**	**400**	**175**	**125**	**700**

Note:

Evaluations includes In Semester Evaluation (ISE), Mid-Semester Examination (MSE), End Semester Examination (ESE), Practical Examination (PE), Oral Examination (OrE) and Project Examination (PrE). Detailed evaluation pattern given in the Examination Conduction rules and Guidelines.

- **ISE** - Includes home assignments, group assignments, quizzes, presentations, experiments, mock tests, tutorials, etc.
- **MSE** - A written assessment covering up to 50% of the syllabus, conducted at mid-semester.
- **ESE** - A written assessment covering 100% of the syllabus, conducted at the end of the semester. Modules covered in the mid-semester exam will have a 30-40 % weightage, with the remaining 60 -70% weightage assigned to the rest of the modules.
- **PE, OrE and PrE** - Practical, oral, project examinations are conducted by a pair of internal and external examiner at the end of the semester

Program Structure for Computer Engineering

ST. FRANCIS INSTITUTE OF TECHNOLOGY (With Effect 2024-2025)

Department and Institute Optional Courses and Labs

Semester	Department/ Institute Optional Courses and Labs	Subject
VIII	Department Optional Course – 5	CSDC8011 : Deep Learning CSDC8012 : Digital Forensic CSDC8013 : Applied Data Science
	Department Optional Lab - 5	CSDL8011 : Deep Learning Lab CSDL8012 : Digital Forensic Lab CSDL8013 : Applied Data Science Lab
	Department Optional Course - 6	CSDC8021 : Optimization in Machine Learning CSDC8022: High Performance Computing CSDC8023: Social Media Analytics
	Department Optional Lab -6	CSDL8021 : Optimization in Machine Learning Lab CSDL8022: High Performance Computing Lab CSDL8023: Social Media Analytics Lab
	Institute level Optional Courses-II	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management

2. Distributed Computing (CSC801)

2.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSC801	Distributed Computing	03	03

2.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

2.3 Course Objectives

S. No.	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.

2.4 Course Outcomes

The student will be able to:	
CO1	*demonstrate* the knowledge of basic elements and concepts related to distributed system technologies.
CO2	*illustrate* the middleware technologies that support distributed applications such as RPC, RMI and Object-based middleware.
CO3	*analyze* the various techniques used for clock synchronization, mutual exclusion and deadlock.
CO4	*demonstrate* the concepts of Resource and Process management.
CO5	*demonstrate* the concepts of Consistency, Replication Management and fault Tolerance.
CO6	*apply* the knowledge of Distributed File systems in building large-scale distributed applications.

2.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites:		
		Computer Networks	
1	**Introduction to Distributed Systems**		**04**
	1.1	Characterization of Distributed Systems: Issues, Goals, Types of distributed systems, Grid and Cluster computing Models, Hardware and Software Concepts: NOS, DOS.	
	1.2	Middleware: Models of middleware, Services offered by middleware.	
2	**Communication**		**04**
	2.1	Interprocess communication (IPC): Remote Procedure Call (RPC), Remote Method Invocation (RMI).	
	2.2	Message-Oriented Communication, Stream Oriented Communication, Group Communication.	

3	**Synchronization**		**10**
	3.1	Clock Synchronization: Physical clock, Logical Clocks, Election Algorithms	
	3.2	Distributed Mutual Exclusion, Requirements of Mutual Exclusion Algorithms and Performance measures. Non- token Based Algorithms: Lamport, Ricart–Agrawala‘s and Maekawa‘s Algorithms; Token-based Algorithms: Suzuki-Kasami‘s Broadcast Algorithms and Raymond‘s Tree-based Algorithm; and Comparative Performance Analysis.	
	3.3	Deadlock: Introduction, Deadlock Detection: Centralized approach, Chandy - Misra_Hass Algorithm.	
4	**Resource and Process Management**		**07**
	4.1	Desirable Features of Global Scheduling algorithm, Task assignment approach, Load balancing approach and load sharing approach.	
	4.2	Introduction to Process Management, Process Migration, Code Migration.	
5	**Replication, Consistency and Fault Tolerance**		**08**
	5.1	Distributed Shared Memory: Architecture, design issues.	
	5.2	Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management.	
	5.3	Fault Tolerance: Introduction, Process resilience, Recovery.	
6	**Distributed File Systems**		**06**
	6.1	Introduction and features of DFS, File models, File Accessing models, FileCaching Schemes, File Replication, Case Study: Network File System (NFS).	
	6.2	Designing Distributed Systems: Google Case Study.	
		Total Hours	**39**

2.6 Suggested Learning Resources

2.6.1 Textbooks

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", MC Graw Hill education.
3. Pradeep K.Sinha, "Distributed Operating System-Concepts and design", PHI.

2.6.2 Reference Books

1. M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson Addison Wesley, 2004
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

2.6.3 Web Resources

1. https://nptel.ac.in/courses/106106107
2. https:// nptel.ac.in/courses/106106168
3. https://csis.pace.edu/~marchese/CS865/Lectures/Chap7/Chapter7fin.htm
4. https://nptel.ac.in/courses/106104182

3. Deep Learning (CSDC8011)

3.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8011	Deep Learning	03	03

3.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		*ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

3.3 Course Objectives

S. No.	Objectives
1	To learn the fundamentals of Neural Network.
2	To gain an in-depth understanding of training Deep Neural Networks.
3	To acquire knowledge of advanced concepts of Convolution Neural Networks, Autoencoders and Recurrent Neural Networks.
4	Students should be familiar with the recent trends in Deep Learning.

3.4 Course Outcomes

The students will be able to:	
CO1	*gain* basic knowledge of Neural Networks.
CO2	*acquire* in depth understanding of training Deep Neural Networks.
CO3	*design* appropriate DNN model for supervised, unsupervised and sequence learning applications.
CO4	*gain* familiarity with recent trends and applications of Deep Learning.

3.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		-	
1	**Fundamentals of Neural Network**		**04**
	1.1	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes	
	1.2	Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning	
2	**Training, Optimization and Regularization of Deep Neural Network**		**10**
	2.1	**Training Feedforward DNN** Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function	
	2.2	**Optimization** Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp	
	2.3	**Regularization** Overview of Overfitting, Types of biases, Bias Variance Tradeoff	

		Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output	
3	**Autoencoders: Unsupervised Learning**		**06**
	3.1	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders	
	3.2	Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders	
	3.3	Application of Autoencoders: Image Compression	
4	**Convolutional Neural Networks (CNN): Supervised Learning**		**07**
	4.1	Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function	
	4.2	Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture	
5	**Recurrent Neural Networks (RNN)**		**08**
	5.1	Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT	
	5.2	Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit	
6	**Recent Trends and Applications**		**04**
	6.1	Generative Adversarial Network (GAN): Architecture	
	6.2	Applications: Image Generation, DeepFake	
		Total Hours	**39**

3.6 Suggested Learning Resources

3.6.1 Textbooks

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. “Deep Learning”, MIT Press Ltd, 2016
2. Li Deng and Dong Yu, “Deep Learning Methods and Applications”, Publishers Inc.
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. JM Zurada “Introduction to Artificial Neural Systems”, Jaico Publishing House
5. M. J. Kochenderfer, Tim A. Wheeler. “Algorithms for Optimization”, MIt Press.

3.6.2 Reference Books

1. Buduma, N. and Locascio, N., “Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc.".
2. François Chollet. “Deep learning with Python “(Vol. 361). 2018 New York: Manning.
3. Douwe Osinga. “Deep Learning Cookbook”, O’REILLY, SPD Publishers, Delhi.
4. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc
5. S.N.Sivanandam and S.N. Deepa, Principles of soft computing-Wiley India

3.6.3 Web Resources :

1. https://deeplearning.cs.cmu.edu/S21/index.html
2. http://www.cse.iitm.ac.in/~miteshk/CS6910.html
3. https://nptel.ac.in/courses/106/106/106106184/
4. https://www.deeplearningbook.org/

4. Digital Forensics (CSDC8012)

4.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8012	Digital Forensics	03	03

4.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

4.3 Course Objectives

S. No.	Objectives
1	To discuss the need and process of digital forensics and Incident Response Methodology.
2	To explore the procedures for identification, preservation, and acquisition of digital evidence.
3	To explore techniques and tools used in digital forensics for Operating system and malware investigation.
4	To explore techniques and tools used for Mobile forensics and browser, email forensics

4.4 Course Outcomes

The student will be able to:	
CO1	*discuss* the phases of Digital Forensics and methodology to handle the computer security incident.
CO2	*describe* the process of collection, analysis and recovery of the digital evidence.
CO3	*explore* various tools to analyze malwares and acquired images of RAM/hard drive.
CO4	*acquire* adequate perspectives of digital forensic investigation in mobile devices
CO5	*analyze* the source and content authentication of emails and browsers.
CO6	*produce* unambiguous investigation reports which offer valid conclusions.

4.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		Cryptography	
1	**Introduction to Digital Forensics**		**6**
	1.1	Digital Forensics Definition, Digital Forensics Goals, Digital Forensics Categories - Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics	
	1.2	Introduction to Incident - Computer Security Incident, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident	
2	**Digital Evidence, Forensics Duplication and Digital Evidence Acquisition**		**8**
	2.1	Digital evidence, Types of Digital Evidence, Challenges in acquiring Digital evidence, Admissibility of evidence, Challenges in evidence handling, Chain of Custody	
	2.2	Digital Forensics Examination Process - Seizure, Acquisition, Analysis, Reporting. Necessity of forensic duplication, Forensic image formats, Forensic duplication techniques,.	

	2.3	Acquiring Digital Evidence - Forensic Image File Format, Acquiring Volatile Memory (Live Acquisition), Acquiring Nonvolatile Memory (Static Acquisition), Hard Drive Imaging Risks and Challenges, Network Acquisition	
3	**Forensics Investigation**		**4**
	3.1	Analyzing Hard Drive Forensic Images, Analyzing RAM Forensic Image, Investigating Routers	
	3.2	Malware Analysis - Malware, Viruses, Worms, Essential skills and tools for Malware Analysis, List of Malware Analysis Tools and Techniques	
4	**Windows and Unix Forensics Investigation**		**8**
	4.1	Investigating Windows Systems - File Recovery, Windows Recycle Bin Forensics, Data Carving, Windows Registry Analysis, USB Device Forensics, File Format Identification, Windows Features Forensics Analysis, Windows 10 Forensics, Cortana Forensics	
	4.2	Investigating Unix Systems - Reviewing Pertinent Logs, Performing Keyword Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships	
5	**Mobile Forensics**		**8**
	5.1	Android Forensics, Mobile Device Forensic Investigation – Storage location, Acquisition methods, Data Analysis	
	5.2	GPS forensics - GPS Evidentiary data, GPS Exchange Format (GPX), GPX Files, Extraction of Waypoints and TrackPoints, Display the Tracks on a Map.	
	5.3	SIM Cards Forensics - The Subscriber Identification Module (SIM), SIM Architecture, Security, Evidence Extraction.	
6	**Browser, Email Forensic & Forensic Investigation Reporting**		**5**
	6.1	Web Browser Forensics, Google chrome, Other web browser investigation Email forensics - Sender Policy Framework (SPF), Domain Key Identified Mail (DKIM), Domain based Message Authentication Reporting and Confirmation (DMARC)	
	6.2	Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report	
		Total Hours	**39**

4.6 Suggested Learning Resources

4.6.1 Textbooks

1. Kevin Mandia, Chris Prosise, “Incident Response and computer forensics”, Tata McGrawHill, 2006
2. Digital Forensics Basics A Practical Guide Using Windows OS — Nihad A. Hassan, APress Publication, 2019

4.6.2 Reference Books

1. Xiaodong Lin, “Introductory Computer Forensics: A Hands-on Practical Approach”, Springer Nature, 2018

4.6.3 Web Resources

1. Course on — “Ethical Hacking” https://nptel.ac.in/courses/106/105/106105217/
2. Course on — “Digital Forensics” https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3. Course on Cyber Incident Response https://www.coursera.org/learn/incident-response
4. Course on —Penetration Testing, Incident Responses and Forensics https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics

5. Applied Data Science (CSDC8013)

5.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8013	Applied Data Science	03	03

5.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

5.3 Course Objectives

S. No.	Objectives
1	To introduce students to the basic concepts of data science.
2	To acquire an in-depth understanding of data exploration and data visualization.
3	To be familiar with various anomaly detection techniques.
4	To understand the data science techniques for different applications.

5.4 Course Outcomes

The student will be able to:	
CO1	*gain* fundamental knowledge of the data science process.
CO2	*apply* data exploration and visualization techniques.
CO3	*apply* anomaly detection techniques.
CO4	*gain* an in-depth understanding of time-series forecasting.
CO5	*apply* different methodologies and evaluation strategies.
CO6	*apply* data science techniques to real world applications.

5.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		Python Programming	
1	**Introduction to Data Science**		**07**
	1.1	Introduction to Data Science, Data Science Process	
	1.2	Motivation to use Data Science Techniques: Volume, Dimensions and Complexity, Data Science Tasks and Examples	
	1.3	Overview of Data Preparation, Modeling, Difference between data science and data analytics	
2	**Data Exploration**		**05**
	2.1	Types of data, Properties of data **Descriptive Statistics:** Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Kurtosis Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution	
	2.2	**Inferential Statistics:** Overview of Various forms of distributions: Normal, Poisson, Test	

		Hypothesis, Central limit theorem, Confidence Interval, Z-test, t-test, Type-I, Type-II Errors, ANOVA	
3	**Methodology and Data Visualization**		**08**
	3.1	**Methodology:** Overview of model building, Cross Validation, K-fold cross validation, leave-1 out, Bootstrapping	
	3.2	**Data Visualization** Univariate Visualization: Histogram, Quartile, Distribution Chart Multivariate Visualization: Scatter Plot, Scatter Matrix, Bubble chart, Density Chart, Roadmap for Data Exploration	
	3.3	**Self-Learning Topics:** Visualizing high dimensional data: Parallel chart, Deviation chart, Andrews Curves.	
4	**Anomaly Detection**		**06**
	4.1	Outliers, Causes of Outliers, Anomaly detection techniques, Outlier Detection using Statistics	
	4.2	Outlier Detection using Distance based method, Outlier detection using density-based methods, SMOTE	
5	**Time Series Forecasting**		**10**
	5.1	Taxonomy of Time Series Forecasting methods, Time Series Decomposition	
	5.2	**Smoothening Methods:** Average method, Moving Average smoothing, Time series analysis using linear regression, ARIMA Model, Performance Evaluation: Mean Absolute Error, Root Mean Square Error, Mean Absolute Percentage Error, Mean Absolute Scaled Error	
	5.3	**Self-Learning Topics:** Evaluation parameters for Classification, regression and clustering.	
6	**Applications of Data Science**		**03**
	6.1	Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation	
		Total Hours	**39**

5.6 Suggested Learning Resources

5.6.1 Textbooks

1. Vijay Kotu, Bala Deshpande. ―Data Science Concepts and Practice‖, Elsevier, M.K. Publishers.
2. Steven Skiena, ―Data Science Design Manual‖, Springer International Publishing AG
3. Samir Madhavan. ―Mastering Python for Data Science‖, PACKT Publishing
4. Dr. P. N. Arora, Sumeet Arora, S. Arora, Ameet Arora, ―Comprehensive Statistical Methods‖, S.Chand Publications, New Delhi.

5.6.2 Reference Books

1. Jake VanderPlas. ―Python Data Science Handbook‖, O‘reilly Publications.
2. Francesco Ricci, LiorRokach, BrachaShapira, Paul B. Kantor, ―Recommender Systems Handbook‖, Springer.
3. S.C. Gupta, V. K. Kapoor ―Fundamentals of Mathematical Statistics‖, S. Chand and Sons, New Delhi.
4. B. L. Agrawal. ―Basic Statistics‖, New Age Publications, Delhi.

5.6.3 Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs69/preview

6. Optimization in Machine Learning (CSDC8021)

6.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8021	Optimization in Machine Learning	03	03

6.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

6.3 Course Objectives

S. No.	Objectives
1	Understand, analyze and apply existing derivative based optimization algorithms
2	Analyze and apply stochastic methods in optimization
3	Analyze convex optimization for machine learning problems
4	Understand real life problems and apply evolutionary methods to optimize them

6.4 Course Outcomes

The student will be able to:	
CO1	*understand* foundational optimization ideas including gradient descent, stochastic gradient methods
CO2	*apply* convex optimization algorithm
CO3	*analyze* and *demonstrate* several population methods in Evolutionary Computation
CO4	*apply* advanced evolutionary optimization algorithms
CO5	*apply* particle swarm evolutionary optimization algorithm
CO6	*apply* ant colony evolutionary optimization algorithms

6.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1	**Introduction and Background to Optimization Theory**		**03**
	1.1	Basic Ingredients of Optimization Problems, Optimization Problem Classifications, Optima Types, Optimization Method Classes, Overview of Unconstrained and Constrained Optimization, Basics of convex optimization	
2	**Derivative based Optimization**		**09**
	2.1	The Basics of Optimization (univariate, bivariate and multivariate optimization), Convex Objective Functions	
	2.2	First-Order optimization Methods: Gradient Descent, Conjugate Gradient, Momentum, Nesterov Momentum, Adagrad, RMSProp, learning rate optimization	
	2.3	Second order optimization: Newton method	
3	**Stochastic Methods**		**10**

	3.1	Noisy Descent, Mesh Adaptive Direct Search, Cross-Entropy Method, Natural Evolution Strategies, Covariance Matrix Adaptation	
4	**Convex Optimization**		**07**
	4.1	Optimization problems, Convex optimization, Linear optimization problems, Quadratic optimization problems, Geometric programming, Overview of Generalized inequality constraints and Vector optimization	
5	**Evolutionary Methods**		**05**
	5.1	Introduction to Evolutionary Computation: Generic Evolutionary Algorithm, Representation: The Chromosome, Initial Population, Fitness Function, Selection: Selective Pressure, Random Selection, Proportional Selection, Tournament Selection, Rank-Based Selection, Elitism and Evolutionary Computation versus Classical Optimization, Stopping conditions	
	5.2	Canonical Genetic Algorithm, Binary Representations of Crossover and Mutation: Binary Representations, Control Parameters	
6	**Advance Evolutionary Methods**		**05**
	6.1	Basic Particle Swarm Optimization, Global Best PSO, Local Best PSO, g-best versus l-best PSO, Velocity Components, Geometric Illustration, Algorithm Aspects, Social Network Structures	
	6.2	Ant Colony Optimization Meta-Heuristic, Foraging Behavior of Ants, Stigmergy and Artificial Pheromone, Simple Ant Colony Optimization, Ant System, Ant Colony System	
		Total Hours	**39**

6.6 Suggested Learning Resources

6.1.1 Textbooks

1. Mykel J. Kochenderfer, Tim A.Wheeler, Algorithms for Optimization, MIT Press (2019)
2. Andries P Engelbrecht, Computational Intelligence-An Introduction, Second-Edition, Wiley publication
3. Charu C. Aggarwal, Linear Algebra and Optimization for Machine Learning, , Springer ,2020.

6.1.2 Reference Books

1. SuvritSra, Sebastian Nowozin, Stephen J. Wright, Optimization for Machine Learning, The MIT Press
2. Xin-She Yang Middlesex ,Optimization techniques and applications with examples, Wiley
3. A.E. Eiben, J. E. Smith, Introduction to Evolutionary Computing, Springer

6.6.1 Web Resources

1. Convex optimization (NPTEL) : NPTEL :: Mathematics - Convex Optimization
2. Constrained and Unconstrained optimization (NPTEL): NOC | Essential Mathematics for Machine Learning
3. Machine-learning-model-performance (Coursera): Optimizing Machine Learning Performance | Coursera
4. Deep-neural-network optimization (Coursera): Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization | Coursera

7. High Performance Computing (CSDC8022)

7.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8022	High Performance Computing	03	03

7.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

7.3 Course Objectives

S. No.	Objectives
1	Introduce the fundamental concepts of high-performance computing (HPC) architecture and parallel computing.
2	Provide foundations for developing, analyzing, and implementing parallel algorithms using parallelization paradigms like MPI, OpenMP, OpenCL, and CUDA.
3	Introduce range of activities associated with HPC in Cloud

7.4 Course Outcomes

The student will be able to:	
CO1	*understand* parallel and pipeline processing approaches
CO2	*design* a parallel algorithm to *solve* computational problems and *identify* issues in parallel programming.
CO3	*analyze* the performance of parallel computing systems for clusters in terms of execution time, total parallel overhead, speedup.
CO4	*develop* efficient and high-performance parallel algorithms using OpenMP and message passing paradigm
CO5	*develop* high-performance parallel programming using OpenCL and CUDA framework
CO6	*perform* the range of activities associated with High Performance Computing in Cloud Computing

7.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites:		
		Computer Architecture	
1	**Introduction to Parallel Computing**		**05**
	1.1	Parallelism (What, Why, Applications), Levels of parallelism(instruction, transaction, task, thread, memory, function)	
	1.2	**Classification Models:** Architectural Schemes(Flynn‘s, Shore‘s, Feng‘s, Handler‘s)	
	1.3	**Memory Access:** Distributed Memory, Shared Memory, Hybrid Distributed Shared Memory	
	1.4	**Parallel Architecture:** Pipeline Architecture: Arithmetic pipelines, Floating Point, Array Processor	

2	**Parallel Programming Platform and Algorithm Design**		**06**
	2.1	**Parallel Programming Platform:** Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	
	2.2	**Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.	
3	**Performance Measures**		**06**
	3.1	**Performance Measures:** Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks, The Karp Flatt Metric.	
4	**HPC Programming: OpenMP and MPI**		**07**
	4.1	Introduction: Threads, Share memory Architecture, Multi-core processors and Hyperthreading, Fork and join model.	
	4.2	OpenMP directives: #pragma omp parallel, Hello world with openMP, #pragma omp for, #pragma omp for schedule.Serial vs Parallel PI program.	
	4.3	Synchronisation: Introduction, Private vs Shared variables. Critical section, #pragma omp critical, #pragma omp atomic, #pragma omp barrier, #pragma omp reduction	
	4.4	Introduction: Processes, Multiprocessor programming model, Distributed system programming model, Inter-process communication using message passing: Asynchronous and Synchronous	
	4.5	MPI Programming: Hello world problem, mpi_initMPI_sendMPI_Recv, Synchronisation: MPI_Barrier	
	4.6	Hybrid (MPI + OpenMP) programming, Hardware requirement, Threads inside Processes, Hybrid Matrix multiplication	
	4.7	Message passing vs Share memory communication: Advantages and disadvantage	
5	**Parallel programming using accelerators**		**08**
	5.1	An Overview of GPGPUs, Introduction to CUDA, Introduction to Heterogeneous Computing using OpenCL, An Overview of OpenCL API, Heterogeneous Programming in OpenCL.	
6	**High Performance Computing in the Cloud**		**07**
	6.1	Virtualization and Containerization, Parallel Computing Frameworks, Scaling, HPC in the Cloud Use Cases.	
		Total Hours	**39**

7.6 Suggested Learning Resources

7.6.1 Textbooks

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar "Introduction to Parallel Computing", 2nd edition, Addison Wesley, 2003.
2. Shane Cook, Morgan Kaufmann "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", 2012.
3. M. R. Bhujade "Parallel Computing", 2nd edition, New Age International Publishers, 2009.
4. Kai Hwang, Naresh Jotwani, ―Advanced Computer Architecture: Parallelism, Scalability, Programmability" McGraw Hill, Second Edition, 2010.
5. Georg Hager, Gerhard Wellein, Chapman "Introduction to High Performance Computing for Scientists and Engineers" Hall/CRC Computational Science Series, 2011.

7.6.2 Reference Books

1. Michael J. Quinn ―Parallel Programming in C with MPI and OpenMPI‖ by, McGraw Hill Education, 2008.
2. Kai Hwang ,Zhiwei, ―Scalable Parallel Computing: Technology, Architecture, Programming‖, McGraw-Hill Education, 1998.
3. Laurence T. Yang, Minyi Guo, ―High-Performance Computing: Paradigm and Infrastructure‖, by, Wiley, 2006.

7.6.3 Web Resources

1. https://nptel.ac.in/courses/112105293
2. https://archive.nptel.ac.in/courses/128/106/128106014/

8. Social Media Analytics (CSDC8023)

8.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDC8023	Social Media Analytics	03	03

8.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

8.3 Course Objectives

S. No.	Objectives
1	Familiarize the learners with the concept of social media.
2	Familiarize the learners with the concept of social media analytics and understand its significance.
3	Enable the learners to develop skills required for analyzing the effectiveness of social media.
4	Familiarize the learners with different tools of social media analytics.
5	Familiarize the learner with different visualization techniques for Social media analytics.
6	Examine the ethical and legal implications of leveraging social media data.

8.4 Course Outcomes

The student will be able to:	
CO1	*understand* the concept of Social media
CO2	*understand* the concept of social media Analytics and its significance.
CO3	*analyze* the effectiveness of social media
CO4	*use* different social media analytics tools effectively and efficiently.
CO5	*use* different effective visualization techniques to represent social media analytics.
CO6	*acquire* the fundamental perspectives and hands-on skills needed to work with social media data.

8.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		Graph Theory, Data Mining, Python/R programming	
1	**Social Media Analytics: An Overview**		**06**
	1.1	Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. Purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools	
2	**Social Network Structure, Measures & Visualization**		**06**
	2.1	Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph	

		Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools.	
3	**Social Media Text, Action & Hyperlink Analytics**		**08**
	3.1	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools	
4	**Social Media Location & Search Engine Analytics**		**08**
	4.1	Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools	
5	**Social Information Filtering**		**08**
	5.1	Social Information Filtering - Social Sharing and filtering, Automated Recommendation systems, Traditional Vs social Recommendation Systems Understanding Social Media and Business Alignment, Social Media KPI, Formulating a Social Media Strategy, Managing Social Media Risks	
6	**Social Media Analytics Applications and Privacy**		**03**
	6.1	Social media in the public sector - Analyzing public sector social media, analyzing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy online.	
		Total Hours	**39**

8.6 Suggested Learning Resources

8.6.1 Textbooks

1. Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan,(ISBN-10: 1507823207).
2. Analyzing the Social Web 1st Edition by Jennifer Golbeck
3. Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, Matthew A Russell, O'Reilly
4. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

8.6.2 Reference Books

1. Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, AvinashKohirkar, IBM Press
2. Social Media Analytics Strategy_ Using Data to Optimize Business Performance, Alex Gonçalves, APress Business Team
3. Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulus (2019), Wiley, ISBN 978-1-118-82485-6

8.6.3 Web Resources

1. https://cse.iitkgp.ac.in/~pawang/courses/SC16.html
2. https://onlinecourses.nptel.ac.in/noc20_cs78/preview
3. https://nptel.ac.in/courses/106106146
4. https://7layersanalytics.com/

9 Distributed Computing Lab (CSL801)

9.2 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL801	Distributed Computing Lab	02	01

9.3 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	15	25	-	10	50

9.4 Course Objectives

S. No.	Objectives
1	To understand basic underlying concepts of forming distributed systems.
2	To learn the concept of clock Synchronization
3	To learn Election Algorithms.
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

9.5 Course Outcomes

The students will be able to:	
CO1	*develop* test and debug using Message-Oriented Communication or RPC/RMI based client-server programs.
CO2	*implement* techniques for clock synchronization.
CO3	*implement* techniques for Election Algorithms.
CO4	*demonstrate* mutual exclusion algorithms and deadlock handling.
CO5	*implement* techniques of resource and process management.
CO6	*describe* the concepts of distributed File Systems with some case studies.

9.6 Course Contents

S. No.	Suggested List of Experiments
1	Inter-process communication
2	Client/Server using RPC/RMI
3	Group Communication
4	Clock Synchronization algorithms
5	Election Algorithm.
6	Mutual Exclusion Algorithm
7	Deadlock Management in Distributed System
8	Load Balancing
9	Distributed shared Memory
10	Distributed File System (AFS/CODA)
11	Case Study: CORBA
12	Case Study: Android Stack

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

10 Deep Learning Lab (CSDL8021)

10.2 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDL8021	Deep Learning Lab	02	01

10.3 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	15	25	0	10	50

10.4 Course Objectives

S. No.	Objectives
1	To implement basic neural network models for simulating logic gates.
2	To implement various training algorithms for feedforward neural networks.
3	To design deep learning models for supervised, unsupervised and sequence learning.

10.5 Course Outcomes

The students will be able to:	
CO1	*implement* basic neural network models to learn logic functions.
CO2	*design* and train feedforward neural networks using various learning algorithms.
CO3	*build* and train deep learning models such as CNNs
CO4	*build* and train deep learning models such as RNN
CO5	*build* and train deep learning models such as LSTM.
CO6	*build* and train deep learning models such as Autoencoders.

10.6 Course Contents

S. No.	Suggested List of Experiments
1	**Based on Module 1 (Any two) using Virtual Lab:** 1. Implement Mc-Culloch Pitts model for binary logic functions. 2. Implement Perceptron algorithm to simulate any logic gate. 3. Implement Multilayer Perceptron algorithm to simulate XOR gate. 4. To explore python libraries for deep learning e.g. Theano, TensorFlow etc.
2	**Module 2 (Any Two) :** 5. Apply any of the following learning algorithms to learn the parameters of the supervised single layer feed forward neural network. a. Stochastic Gradient Descent b. Mini Batch Gradient Descent c. Momentum GD d. Nestorev GD e. Adagrad GD f. Adam Learning GD 6. Implement a backpropagation algorithm to train a DNN with at least 2 hidden layers. 7. Design and implement a fully connected deep neural network with at least 2

	hidden layers for a classification application. Use appropriate Learning Algorithm, output function and loss function.
3	**Module 3 (Any One) :** 8. Design the architecture and implement the autoencoder model for Image Compression. 9. Design the architecture and implement the autoencoder model for Image denoising.
4	**Module 4 (Any One)** 10. Design and implement a CNN model for digit recognition application. 11. Design and implement a CNN model for image classification.
5	**Module 5 (Any One)** 12. Design and implement LSTM for Sentiment Analysis. 13. Design and implement GRU for classification on text data. 14. Design and implement RNN for classification of temporal data.

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

11 Digital Forensics Lab (CSDL8022)

11.2 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDL8022	Digital Forensics Lab	02	01

11.3 Examination and Evaluation Scheme

Evaluation	ISE	PE	ORE	PrE	Total
Marks	15	25	0	10	50

11.4 Course Objectives

S. No.	Objectives
1	To demonstrate the procedures for identification, preservation, and acquisition of digital evidence.
2	To demonstrate techniques and tools used in digital forensics for operating systems and malware investigation.
3	To demonstrate tools for mobile forensics and browser, email forensics
4	To explore scenario based crime forensics investigations.

11.5 Course Outcomes

The students will be able to:	
CO1	*explore* various forensics tools and use them to acquire, duplicate and analyze data and recover deleted data.
CO2	*implement* penetration testing using forensics tools.
CO3	*explore* various forensics tools and use them to acquire and analyze live and static data.
CO4	*verification* of source and content authentication of emails and browsers.
CO5	*demonstrate* Timeline Report Analysis using forensics tools.
CO6	*discuss* real time crime forensics investigations scenarios.

11.6 Course Contents

S. No.	Suggested List of Experiments
1	Analysis of forensic images using open source tools. ● FTK Imager ● Autopsy
2	Explore forensics tools in kali linux for acquiring, analyzing and duplicating data. ● dd ● dcfldd
3	Performing penetration testing using Metasploit - kali Linux.
4	Performing RAM Forensic to analyze memory images to find traces of an attack. ● Capturing RAM Using the DumpIt Tool ● Volatility tool
5	Network forensics using Network Miner.
6	Windows Recycle Bin Forensics
7	Data Carving using open source tools ● Foremost ● Scalpel ● Jpegcarver

8	USB Device Forensics using ● USBDeview ● USB Detective
9	Web Browser Forensics using DB Browser for SQLite
10	Generate a Timeline Report Using Autopsy
11	Email Analysis
12	Case Study

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

12 Applied Data Science Lab (CSL8023)

12.2 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSL8023	Applied Data Science Lab	02	01

12.3 Examination and Evaluation Scheme

Evaluation	ISE	PE	ORE	PrE	Total
Marks	15	25	0	10	50

12.4 Course Objectives

S. No.	Objectives
1	To explore various stages in the data science lifecycle.
2	To understand data preparation techniques.
3	To understand data exploration techniques.
4	To understand data visualization techniques.
5	To model and evaluate different supervised learning techniques.
6	To model and evaluate different unsupervised learning techniques.

12.5 Course Outcomes

The students will be able to:	
CO1	*apply* various stages of the data science lifecycle for the selected case study.
CO2	*demonstrate* data preparation, exploration and visualization techniques.
CO3	*implement* different supervised techniques.
CO4	*evaluate* different supervised techniques.
CO5	*implement* different unsupervised techniques.
CO6	*evaluate* different unsupervised techniques.

12.6 Course Contents

S. No.	Suggested List of Experiments
1	Explore the descriptive and inferential statistics on the given dataset.
2	Apply data cleaning techniques (e.g. Data Imputation).
3	Explore data visualization techniques.
4	Implement and explore performance evaluation metrics for Data Models (Supervised/Unsupervised Learning)
5	Use SMOTE technique to generate synthetic data. (to solve the problem of class imbalance)
6	Outlier detection using distance based/density based method.
7	Implement time series forecasting.
Illustrate data science lifecycle for selected case study. (Prepare case study document for the selected case study) **Suggested Case Studies:** 1. Customer Segmentation 2. Fraud Detection 3. House Price prediction 4. Product Recommendation 5. Stock price prediction 6. Weather prediction	

Suggested Assignment List
Assignments can be given on self learning topics or data deployment tools.

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

13 Optimization in Machine Learning Lab (CSDL8021)

13.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDL8021	Optimization in Machine Learning Lab	02	01

13.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	ORE	PrE	Total
Marks	15	25	0	10	50

13.3 Course Objectives

S. No.	Objectives
1	To apply derivative based optimization techniques
2	To understand evolutionary optimization to a given machine learning problem.
3	To apply advanced evolutionary optimization
4	To design and analyze optimization problems for real world applications

13.4 Course Outcomes

The students will be able to:	
CO1	*implement* derivative based optimization techniques
CO2	*implement* evolutionary optimization
CO3	*implement* advanced evolutionary optimization
CO4	*implement* genetic algorithms
CO5	*implement* particles swarm optimization
CO6	*implement* ant colony optimization

13.5 Course Contents

S. No.	Suggested List of Experiments
1	To implement Gradient Descent algorithm
2	To implement the Stochastic Gradient Descent algorithm
3	To implement Newton method
4	To apply Genetic Algorithm for real world problem
5	To compare and implement different selection mechanism using genetic algorithm
6	To implement various mutation and crossover mechanisms
7	To implement Particles Swarm optimization
8	To implement Ant colony optimization

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

14 High Performance Computing Lab (CSDL8022)

14.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDL8022	High Performance Computing Lab	02	01

14.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	ORE	PrE	Total
Marks	15	25	0	10	50

14.3 Course Objectives

S. No.	Objectives
1	Enable students to build the logic to parallelize the programming task.
2	Give insight about performance of parallel computing systems.
3	Provide hands-on experience on parallel programming platforms/frameworks

14.4 Course Outcomes

The students will be able to:	
CO1	*perform* Linux based commands on remote machine
CO2	*compare* the performance of sequential algorithms with parallel algorithms in terms of execution time, speedup and throughput.
CO3	*implement* parallel program using OpenMP library and analyze its performance
CO4	*implement* parallel program using MPI platform and analyze its performance
CO5	*implement* parallel program using OpenCL framework and analyze its performance
CO6	*implement* parallel program using CUDA framework and analyze its performance

14.5 Course Contents

S. No.	Suggested List of Experiments
1*	To analyse the Linux based computer systems using following commands: **a.** top , **b.**ps , **c.** kill, **d.** cat /proc/cpuinfo**e.**vmstat **Hardware/Software Requirement:** Linux Operating System
2*	To setup SSH passwordless logins for two or more Linux based machines and execute commands on a remote machine. **Hardware/Software Requirement:** Linux Operating System, Multi-core computer systems
3*	Write a program in C to multiply two matrices of size 10000 x 10000 each and find it's execution-time using "time" command. Try to run this program on two or more machines having different configurations and compare execution-times obtained in each run. Comment on which factors affect the performance of the program. **Hardware/Software Requirement:** Linux Operating System, gcc compiler, Multi-core computer systems
4*	Write a "Hello World" program using OpenMP library also display number of threads created during execution. **Hardware/Software Requirement:** Linux Operating System, gcc compiler, Dual core with HT or Quad-core or higher computer system.
5*	Write a parallel program to calculate the value of PI/Area of Circle using OpenMP library. **Hardware/Software Requirement:** Linux Operating System, gcc compiler, Dual

	core with HT or Quad-core or higher computer system.
6	Write a parallel program to multiply two matrices using openMP library and compare the execution time with its serial version. Also change the number of threads using omp_set_num_threads() function and analyse how thread count affects the execution time. **Hardware/Software Requirement:** Linux Operating System, gcc compiler, Dual core with HT or Quad-core or higher computer system.
7	Install MPICH library and write a "Hello World" program for the same. **Hardware/Software Requirement:** Linux Operating System, MPICH, Multi-processor systems or MPI Cluster.
8	Write a parallel program to multiply two matrices using MPI library and compare the execution-time with it's OpenMP and serial version. **Hardware/Software Requirement:** Linux Operating System, MPICH, gcc, Multi-processor systems, or MPI Cluster.
9	Install MPICH on two and more machines and create a MPI cluster. Execute MPI programs on this cluster and check the performance. **Hardware/Software Requirement:** Linux Operating System, MPICH, Multi-processor systems or MPI Cluster.
10	Implement a program to demonstrate balancing workload on MPI platform. **Hardware/Software Requirement**: Linux Operating System, MPICH, Multi-processor systems or MPI Cluster.
11	Implement a parallel program to demonstrate the cube of N number within a set range using MPI/OpenMP/OpenCL/CUDA. **Hardware/Software Requirement:** Linux Operating System, MPICH, Multi-processor systems or MPI Cluster. A CUDA-capable GPU, A supported version of Microsoft Windows, A supported version of Microsoft Visual Studio, The NVIDIA CUDA Toolkit
12	Implement DFT computation of vector using OpenCL/CUDA/ Parallel Matlab **Hardware/Software Requirement:** A CUDA-capable GPU,A supported version of Microsoft Windows, A supported version of Microsoft Visual Studio, The NVIDIA CUDA Toolkit
13	Implement Two Vector addition using OpenCL/CUDA/ Parallel Matlab **Hardware/Software Requirement:** A CUDA-capable GPU, A supported version of Microsoft Windows, A supported version of Microsoft Visual Studio, The NVIDIA CUDA Toolkit
14	Implement even-odd/Bucket /Radix /Shell sort using OpenCL/CUDA/ Parallel Matlab **Hardware/Software Requirement:** A CUDA-capable GPU, A supported version of Microsoft Windows, A supported version of Microsoft Visual Studio, The NVIDIA CUDA Toolkit

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

15 Social Media Analytics Lab (CSDL8023)

15.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSDL8023	Social Media Analytics Lab	02	01

15.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	ORE	PrE	Total
Marks	15	25	0	10	50

15.3 Course Objectives

S. No.	Objectives
1	To understand the fundamental concepts of social media networks.
2	To learn various social media analytics tools and evaluation matrices.
3	To collect and store social media data.
4	To analyze and visualize social media data
5	To design and develop social media analytics models.
6	To design and build a social media analytics application.

15.4 Course Outcomes

The students will be able to:	
CO1	*understand* characteristics and types of social media networks.
CO2	*use* social media analytics tools for business
CO3	*collect*, *monitor*, *store* and *track* social media data
CO4	*analyze* and *visualize* social media data from multiple platforms
CO5	*design* and *develop* content and structure based social media analytics models.
CO6	*design* and *implement* social media analytics applications for business.

15.5 Course Contents

S. No.	Suggested List of Experiments
1	Study various - i) Social Media platforms (Facebook, twitter, YouTube etc) ii) Social Media analytics tools (Facebook insights, google analytics netlytic etc) iii) Social Media Analytics techniques and engagement metrics (page level, post level, member level) iv) Applications of Social media analytics for business. e.g. Google Analytics https://marketingplatform.google.com/about/analytics/ https://netlytic.org/
2	Data Collection-Select the social media platforms of your choice (Twitter, Facebook, LinkedIn, YouTube, Web blogs etc), connect to and capture social media data for business (scraping, crawling, parsing).
3	Data Cleaning and Storage- Preprocess, filter and store social media data for business (Using Python, MongoDB, R, etc).
4	Exploratory Data Analysis and visualization of Social Media Data for business.
5	Develop Content (text, emoticons, image, audio, video) based social media analytics model for business. (e.g. Content Based Analysis: Topic, Issue, Trend, sentiment/opinion analysis, audio, video, image analytics)

6	Develop Structure based social media analytics model for any business. (e.g. Structure Based Models -community detection, influence analysis)
7	Develop a dashboard and reporting tool based on real time social media data.
8	Design the creative content for promotion of your business on social media platform.
9	Analyze competitor activities using social media data.
10	Develop social media text analytics models for improving existing product/ service by analyzing customer‘s reviews/comments.

Note: Lab course shall consist minimum of 08 experiments covering the syllabus of corresponding theory course but not limited to the suggested list.

* indicates compulsory experiment

15.6 Suggested Learning Resources

15.6.1 Reference Books

1. Python Social Media Analytics: Analyze and visualize data from Twitter, YouTube, GitHub, and more Kindle Edition by Siddhartha Chatterjee , Michal Krystyanczuk
2. Learning Social Media Analytics with R, byRaghav Bali, Dipanjan Sarkar, Tushar Sharma.
3. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann, 2013
4. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media, 2013
5. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

16 Major Project 2 (CSP801)

16.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
CSP801	Major Project 2	12	06

16.2 Examination and Evaluation Scheme

Evaluation	ISE	PE	OrE	PrE	Total
Marks	100	-	50	-	150

16.3 Course Objectives

S. No.	Objectives
1	**Technical and Professional Skill Development**
1	**Technical and Professional Skill Development** The Project work facilitates students in developing and demonstrating technical, professional, and ethical skills acquired throughout their graduation program. It enables them to apply their knowledge effectively, fostering critical thinking and problem-solving abilities.
2	**Application and Implementation** From problem identification to the successful completion of the project, students engage in a comprehensive process that involves analyzing, designing, and implementing solutions. This hands-on experience prepares them for real-world challenges and professional growth.

16.4 Course Outcomes

The students will be able to:	
CO1	*implement* solutions for the selected problem by applying technical and professional skills.
CO2	*analyze* impact of solutions in societal and environmental context for sustainable development.
CO3	*collaborate* best practices along with effective use of modern tools.
CO4	*develop* proficiency in oral and written communication with effective leadership and teamwork.
CO5	*nurture* professional and ethical behavior.
CO6	*gain* expertise that helps in building lifelong learning experience.

16.5 Course Contents

S. No.	Guidelines
1	**Implementation (Coding & Development)** • Set up the development environment • Develop the core functionalities and Integrate front-end and back-end components
2	**Testing, Deployment and Final Report Submission** • Unit testing (testing individual components),Integration testing (checking module interactions),System testing (end-to-end testing) • Prepare final project documentation • Submit final report and project presentation

3	**Project Report Format:** At the end of semester, each group needs to prepare a project report as per the guidelines. A project report should preferably contain at least following details: • **Acknowledgment** • **Declaration** • **Abstract** • **Contents** • **List of Figures, tables,** • **Abbreviations** **Chapter 1: Introduction** ● Introduction ● Background study Terminologies/ Definitions of new terms (if any) ● Fundamental study points of the selected topic and the domain ● Identification of challenges in the selected topic ● Problem Statement and Proposed Solution ● Scope of the system **Chapter 2: Literature Survey** (For proposed solution) ● Survey of Existing systems **(Either through Research papers or Real time case studies or problem domains)** ● Limitations of Existing systems or research gaps ● Motivation (Challenges that are encouraging to choose the problem) **Chapter 3: Proposed System: Analysis** ● Detailed explanation of Proposed system o Block diagram of Proposed system/ Workflow o Working Principle(Algorithm) o Phase/ Module - wise explanation (as per workflow) ● System Analysis: o Functional Requirements o Non- Functional Requirements o Specific Requirements (if any) o Software and Hardware requirements o Use Case Modelling with (**Use Case Template** for any 2-3 Major Use cases) ● Proposed System: **Analysis, Modelling and Design** o Draw only applicable and more appropriate to understand the given problem statement (UML- Diagrams (Activity/statchart/Class/Sequecne/Collaboration/Component/Deployment) o Draw ER- Diagram for the Database (if applicable and required) (Give Sample Schema) o DFD (Min level2) o Architectural View (Apply Architectural Styles-Applicable for the Project)

	o Algorithms / Methodology (Algorithms/ Pseudocode /Equations – special Algorithmic Logics developed (if any) o UI/UX design **Chapter 4: Implementation Plan and Experimental Set up of the Proposed system** o Experimental Set up ▪ Details discussion of input/Dataset (along with screenshot/ Samples) details about input to systems or selected data ▪ Performance Evaluation Parameters (for Validation) ▪ Special Requirement (if any e.g. use of any External resources/ HW /Cloud Requirements etc) o Code for Sem VIII **Chapter 5 : Results and Discussions** o Presentation and validation of the results for the proposed system (step by step) (Graphical/Tabular based on the performance evaluation parameters) o Comparative Analysis with existing systems **Chapter 6: Conclusion: Summary of study completed as Major Project part2(Sem8)** **Chapter 7: References** - Follow IEEE format **Desirable:** Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)
4	**Term Work:** Distribution of marks for term work shall be done based on following: ● Weekly Log Report ● Project Work Contribution ● Project Report (Black Book) (both side print) ● Term End Presentation (Internal) The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.
5	**Oral and Practical:** Oral and Practical examination (Final Project Evaluation) of Project 2 should be conducted by the panel of Internal and External examiners at the end of the semester.

16.6 Evaluation parameters are as follows:

PERFORMANCE INDICATORS (PI)	Quality and clarity of the problem **GA**	Application of software Engg best practices **GA**	Objective and scope **GA**	Identification of methodologies **GA**	Synopsis and Presentation **IA**
Maximum Marks	5	5	5	5	5

GA – Group Assessment
IA – Individual Assessment

Poor 1	**Average 2**	**Good 3**	**Very Good 4**	**Excellent 5**
Up to 20%	Up to 40%	Up to 60%	Up to 80%	Up to 100%

Institute Level Optional Course

17 Project Management (ILO8021)

17.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8021	Project Management	03	03

17.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

17.3 Course Objectives

S. No.	Objectives
1	To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2	To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

17.4 Course Outcomes

The student will be able to:	
CO1	*apply* selection criteria and select an appropriate project from different options.
CO2	*write* work breakdown structure for a project and develop a schedule based on it.
CO3	*identify* opportunities and threats to the project and decide an approach to deal with them strategically.
CO4	*use* earned value technique and determine & predict status of the project.
CO5	*capture* lessons learned during project phases and document them for future reference
CO6	*create* document of lessons learned during project phases for future reference

17.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		-	
1	**Project Management Foundation:**		**04**
	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	
2	**Initiating Projects:**		**08**
	2.1	How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	
3	**Project Planning and Scheduling:**		**08**

	3.1	Work Breakdown structure (WBS) and linear responsibility chart, Interface Coordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	
4	**Planning Projects:**		**08**
	4.1	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
5	**Project Executing, Monitoring and Contracting**		**06**
	5.1	**Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings	
	5.2	**Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	
	5.3	**Project Contracting** Project procurement management, contracting and outsourcing,	
6	**Project Leadership Ethics and Closing**		**05**
	6.1	**Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects	
	6.2	**Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	
		Total Hours	**39**

17.6 Suggested Learning Resources

17.6.1 Textbooks

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA

17.6.2 Reference Books

1. Project Management, Gido Clements, Cengage Learning
2. Project Management, Gopalan, Wiley India
3. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

18 Finance Management (ILO8022)

18.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8022	Finance Management	03	03

18.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

18.3 Course Objectives

S. No.	Objective
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

18.4 Course Outcomes

The students will be able to:	
CO1	*understand* concept of return and risk
CO2	*understand* capital budgeting and management
CO3	*evaluate* sources of finance
CO4	*understand* capital structure
CO5	*understand* Indian finance system and corporate finance
CO6	*take* investment, finance as well as dividend decisions

18.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1			**04**
	1.1	**Overview of Indian Financial System:** Components and Functions of Financial System.	
	1.2	**Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.	
	1.3	**Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	
	1.4	**Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2			**08**
	2.1	**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.	

	2.2	**Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3			**08**
	3.1	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	
	3.2	**Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4			**08**
	4.1	**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)	
	4.2	**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.	
5			**06**
	5.1	**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.	
	5.2	**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	
6			**05**
	6.1	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	
		Total Hours	**39**

18.6 Suggested Learning Resources:

18.6.1 Textbooks

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.

18.6.2 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.

19 Entrepreneurship Development and Management (ILO8023)

19.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8023	Entrepreneurship Development and Management	03	03

19.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

19.3 Course Objectives

S. No.	Objective
1	To acquaint with entrepreneurship and management of business
2	Understand Indian environment for entrepreneurship
3	Idea of MSME
4	Idea of EDP

19.4 Course Outcomes

The students will be able to:	
CO1	*understand* the concept of business plan
CO2	*understand* the concept of ownerships
CO3	*understand* Indian Environment for Entrepreneurship
CO4	*interpret* key regulations of entrepreneurship in India
CO5	*interpret* legal aspects of entrepreneurship in India
CO6	*understand* government policies for entrepreneurs

19.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1			**04**
	1.1	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
2	2.1	**Business Plans and Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur	**09**
	2.2	**Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development,	

		Business Growth and the Entrepreneur Law and its Relevance to Business Operations	
3	3.1	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	**05**
4	4.1	**Indian Environment for Entrepreneurship:** key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	**08**
5	5.1	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	**08**
6	6.1	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	**05**
		Total Hours	**39**

19.6 Suggested Learning Resources:

19.6.1 Text Books

19.6.2 Reference Books

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar

19.6.3 Web Resources

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

20 Human Resource Management (ILO8024)

20.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8024	Human Resource Management	03	03

20.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

20.3 Course Objectives

S. No.	Objective
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 interpersonal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

20.4 Course Outcomes

The students will be able to:	
CO1	*understand* the concepts and aspects of human resource management.
CO2	*understand* the techniques and practices of human resource management.
CO3	*understand* the Human resource management (HRM) processes and functions in today ‘s emerging organizational perspective.
CO4	*understand* the Human resource management (HRM) changes and challenges in today ‘s emerging organizational perspective.
CO5	*gain* knowledge about the latest developments and trends in HRM.
CO6	*apply* the knowledge of behavioral skills learnt and integrate it within an interpersonal and intergroup environment emerging as future stable engineers and managers.

20.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		-	
1	**Introduction to HR**		**5**
	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions	
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing,	

		Empowerment, TQM, Managing ethical issues	
2	**Organizational Behaviour (OB)**		**7**
	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues	
	2.2	Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness	
	2.3	Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour	
	2.4	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);	
	2.5	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	
3	3.1	**Organizational Structure & Design** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	**6**
	3.2	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	
	3.3	Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
4	4.1	**Human resource Planning** Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale	**5**
	4.2	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning	
	4.3	Training & Development: Identification of Training Needs, Training Methods	
5	5.1	**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	**6**
	5.2	Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	
6	6.1	**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	**10**
	6.2	**Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	
	6.3	**Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	
		Total Hours	**39**

20.6 Suggested Learning Resources:

20.6.1 Reference

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

21 Professional Ethics and Corporate Social Responsibility (CSR) (ILO8025)

21.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8025	Professional Ethics and Corporate Social Responsibility (CSR)	03	03

21.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

21.3 Course Objectives

S. No.	Objective
1	To understand professional ethics in business
2	To recognized corporate social responsibility

21.4 Course Outcomes

The students will be able to:	
CO1	*understand* rights of business
CO2	*understand* duties of business
CO3	*distinguish* different aspects of corporate social responsibility
CO4	*demonstrate* professional ethics
CO5	*understand* legal aspects of corporate social responsibility
CO6	*understand* Corporate Social Responsibility in Globalizing India

21.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1	**Introduction to HR**		**04**
	1.1	**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	
2	2.1	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	**08**
3	3.1	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm‘s Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	**06**

4	4.1	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	**05**
5	5.1	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	**08**
6	6.1	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	**08**
		Total Hours	**39**

21.6 Suggested Learning Resources:

21.6.1 Reference

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

22 Research Methodology (ILO8026)

22.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8026	Research Methodology	03	03

22.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

22.3 Course Objectives

S. No.	Objective
1	To understand Research and Research Process
2	To acquaint students with identifying problems for research
3	To acquaint students with developing research strategies
4	To familiarize students with the techniques of data collection
5	To familiarize students with the techniques of analysis of data
6	To familiarize students with the techniques of interpretation

22.4 Course Outcomes

The students will be able to:	
CO1	*prepare* a preliminary research design for projects in their subject matter areas
CO2	*accurately* collect data
CO3	accurately *analyze* data
CO4	accurately *report* data
CO5	*present* complex data or situations clearly
CO6	*review* and *analyze* research findings

22.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1	**Introduction and Basic Research Concepts**		**09**
	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	
	1.2	Need of Research in Business and Social Sciences	
	1.3	Objectives of Research	
	1.4	Issues and Problems in Research	
	1.5	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	
2	**Types of Research**		**07**
	2.1	Basic Research	
	2.2	Applied Research	
	2.3	Descriptive Research	

	2.4	Analytical Research	
	2.5	Empirical Research	
	2.6	Qualitative and Quantitative Approaches	
3	**Research Design and Sample Design**		**07**
	3.1	Research Design – Meaning, Types and Significance	
	3.2	Sample Design – Meaning and Significance Essentials of a good sampling stages in Sample Design Sampling methods/techniques sampling errors	
4	**Research Methodology**		**08**
	4.1	Meaning of Research Methodology	
	4.2	**Stages in Scientific Research Process:** a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
5	**Formulating Research Problem**		**04**
	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	
6	**Outcome of Research**		**04**
	6.1	Preparation of the report on conclusion reached	
	6.2	Validity Testing & Ethical Issues	
	6.3	Suggestions and Recommendation	
		Total Hours	**39**

22.6 Suggested Learning Resources:

22.6.1 Reference

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

23 IPR and Patenting (ILO8027)

23.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8027	IPR and Patenting	03	03

23.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

23.3 Course Objectives

S. No.	Objective
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

23.4 Course Outcomes

The students will be able to:	
CO1	*understand* Intellectual Property assets
CO2	*assist* individuals and organizations in capacity building
CO3	*work* for development of Intellectual Property and Patenting
CO4	*work* for promotion of Intellectual Property and Patenting
CO5	*work* for protection of Intellectual Property and Patenting
CO6	*work* for compliance, and enforcement of Intellectual Property and Patenting

23.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		-	
1	1.1	**Introduction to Intellectual Property Rights (IPR):** Different categories 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:** IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	**05**
2	2.1	**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	**07**

		India, Procedure for submitting patent and Enforcement of IPR at national level etc.	
3	3.1	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	**05**
4	4.1	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	**07**
5	5.1	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	**08**
6	6.1	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	**07**
		Total Hours	**39**

23.6 Suggested Learning Resources:

23.6.1 Reference

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

24 Digital Business Management (ILO8028)

24.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8028	Digital Business Management	03	03

24.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

24.3 Course Objectives

S. No.	Objective
1	To familiarize with digital business concept
2	To acquaint with E-commerce
3	To give insights into E-business and its strategies

24.4 Course Outcomes

The students will be able to:	
CO1	*identify* drivers of digital business
CO2	*understand* E-Commerce and E Governance
CO3	*understand* various approaches and techniques for E-business
CO4	*demonstrate* various E-business management skills
CO5	*illustrate* various strategies for E-business and management
CO6	*prepare* E-business plan

24.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
1	1.1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business-** Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	**09**
2	2.1	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing	**06**

		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	
3	3.1	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	**06**
4	4.1	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	**06**
5	5.1	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company ‘s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	**04**
6	6.1	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	**08**
		Total Hours	**39**

24.6 Suggested Learning Resources:

24.6.1 Reference

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

25 Environment Management (ILO8029)

25.1 Teaching Scheme

Course Code	Course Name	Contact Hours	Credits
ILO8029	Environmental Management	03	03

25.2 Examination and Evaluation Scheme

Formative Assessment		Summative Assessment				Total Marks
ISE		MSE		ESE		
Marks	Duration	Marks	Duration (Hrs.)	Marks	Duration (Hrs.)	
20	CA	20	1	60	2.5	100

25.3 Course Objectives

S. No.	Objective
1	Understand and identify environmental issues relevant to India
2	Understand and identify environmental issues relevant to global concerns
3	Learn concepts of ecology
4	Familiarise environment related legislations

25.4 Course Outcomes

The students will be able to:	
CO1	*understand* the concept of environmental management
CO2	*understand the* ecosystem and interdependence
CO3	*understand the* food chain.
CO4	*understand* role and functions of Government to manage environment
CO5	*understand* total quality Environmental Management and certification
CO6	*understand* and interpret environment related legislations

25.5 Course Contents

Module	Unit	Detailed Contents	Hours
	Prerequisites		
		-	
1	**Introduction of Environment**		**10**
	1.1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	
2	**Global Environment Concerns**		**06**
	2.1	Global Environmental concerns: Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3	**Ecology**		**05**
	3.1	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	
4	**Environment Management**		**10**
	4.1	Scope of Environment Management, Role and functions of Government as a planning and regulating agency	

		Environment Quality Management and Corporate Environmental Responsibility	
5	**Environmental Management Quality**		**05**
	5.1	Total Quality Environmental Management, ISO-14000, EMS certification.	
6	**Environment Protection Legislations**		**03**
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	
		Total Hours	**39**

25.6 Suggested Learning Resources:

25.6.1 Reference

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
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015