AC – 11 July, 2022

Item No. – 6.41 (R)

University of Mumbai

Bachelor of Engineering

in

Computer Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

University of Mumbai

Sr. No.	Heading	Particulars
1	Title of the Course	**Fourth Year Engineering (Computer Engineering)**
2	Eligibility for Admission	**After Passing Second Year Engineering as per the Ordinance 0.6243**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6243**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	~~**New**~~/ Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	**With effect from Academic Year:2021-2022**

Dr. S.K.Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

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 of Engineering from the academic year 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

Dr. S.K. Ukarande

Associate Dean

Faculty of Science and Technology

University of Mumbai

Dr Anuradha Muzumdar

Dean

Faculty of Science and Technology

University of Mumbai

Incorporation and Implementation of Online Contents fromNPTEL/ 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.

Dr. S.K.Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

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 Third Year Computer Engineering syllabus effective from the Academic Year 2021-22 (REV-2019'C' Scheme). We are sure you will find this syllabus interesting, challenging, fulfill certain needs and expectations.

Computer Engineering is one of the most sought-after courses amongst engineering students. The syllabus needs revision in terms of preparing the student for the professional scenario relevant and suitable to cater the needs of industry in present day context. 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 is finalized through a brain storming session attended by Heads of Departments or senior faculty from the Department of Computer Engineering of the affiliated Institutes of the Mumbai University. The 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. The department Optional Courses will provide the relevant specialization within the branch to a student.
3. 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.
4. 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

Prof. Sunil Bhirud	: Chairman
Prof. SunitaPatil	: Member
Prof. Leena Ragha	: Member
Prof. Subhash Shinde	: Member
Prof .Meera Narvekar	: Member
Prof. Suprtim Biswas	: Member
Prof. Sudhir Sawarkar	: Member
Prof. Dayanand Ingle	: Member
Prof. Satish Ket	: Member

Program Structure for Fourth Year Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2022-2023)

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract.	Total
CSC701	Machine Learning	3	--	3	--	3
CSC702	Big Data Analytics	3	--	3		3
CSDC 701X	Department Level Optional Course-3	3	--	3	--	3
CSDC 702X	Department Level Optional Course-4	3	--	3	--	3
ILO 701X	Institute Level Optional Course-1	3	--	3	--	3
CSL701	Machine Learning Lab	--	2	--	1	1
CSL702	Big Data Analytics Lab	--	2	--	1	1
CSDL 701X	Department Level Optional Course-3 Lab	--	2	--	1	1
CSDL 702X	Department Level Optional Course-4 Lab	--	2	--	1	1
CSP701	Major Project 1	--	6#	--	3	3
Total		**15**	**14**	**15**	**7**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract. & oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
CSC701	Machine Learning	20	20	20	80	3	--	--	100
CSC702	Big Data Analysis	20	20	20	80	3	--	--	100
CSDC 701X	Department Level Optional Course-3	20	20	20	80	3	--	--	100
CSDC 702X	Department Level Optional Course-4	20	20	20	80	3	--	--	100
ILO 701X	Institute Level Optional Course-1	20	20	20	80	3	--	--	100
CSL701	Machine Learning Lab	--	--	--	--	--	25	25	50
CSL702	Big Data Analytics Lab	--	--	--	--	--	25	25	50
CSDL 701X	Department Level Optional Course-3 Lab						25	-	25
CSDL 702X	Department Level Optional Course-4 Lab	--	--	--	--	--	25	-	25
CSP701	Major Project 1	--	--	--	--	--	50	25	75
Total		**--**	**--**	**100**	**400**	--	**150**	**75**	**725**

Program Structure for Fourth Year Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2022-2023)

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract.	Total
CSC801	Distributed Computing	3	--	3	--	3
CSDC 801X	Department Level Optional Course -5	3	--	3	--	3
CSDC 802X	Department Level Optional Course -6	3	--	3	--	3
ILO 801X	Institute Level Optional Course -2	3	--	3	--	3
CSL801	Distributed Computing Lab	--	2	--	1	1
CSDL 801X	Department Level Optional Course -5 Lab	--	2	--	1	1
CSDL 802X	Department Level Optional Course -6 Lab	--	2	--	1	1
CSP801	Major Project 2	--	12#	--	6	6
Total		**12**	**18**	**12**	**9**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
CSC801	Distributed Computing	20	20	20	80	3	--	--	100
CSDC 801X	Department Level Optional Course -5	20	20	20	80	3	--	--	100
CSDC 802X	Department Level Optional Course -6	20	20	20	80	3	--	--	100
ILO 801X	Institute Level Optional Course -2	20	20	20	80	3	--	--	100
CSL801	Distributed Computing Lab	--	--	--	--	--	25	25	50
CSDL 801X	Department Level Optional Course -5 Lab	--	--	--	--	--	25	25	50
CSDL 802X	Department Level Optional Course -6 Lab						25	25	50
CSP801	Major Project- 2	--	--	--	--	--	100	50	150
Total		**--**	**--**	**80**	**320**	**--**	**175**	**125**	**700**

Major Project 1 and 2 :

- Students can form groups with minimum 2 (Two) and not more than 4 (Four)
- Faculty Load : In Semester VII – ½ hour per week per project group
  In Semester VIII – 1 hour per week per project group

Program Structure for Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2022-2023)

Department and Institute Optional Courses and Labs

Semester	**Department/ Institute Optional Courses and Labs**	**Subject**
VII	Department Optional Course -3	CSDC7011: Machine Vision CSDC7012: Quantum Computing CSDC7013: Natural Language Processing
	Department Optional Lab -3	CSDL7011: Machine Vision Lab CSDL7012: Quantum Computing Lab CSDL7013: Natural Language Processing Lab
	Department Optional Course -4	CSDC7021 : Augmented and Virtual Reality CSDC7022 : Block Chain CSDC7023 : Information Retrieval
	Department Optional Lab -4	CSDL7021 : Augmented and Virtual Reality Lab CSDL7022 : Block Chain Lab CSDL7023 : Information Retrieval Lab
	Institute level Optional Courses-I	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering

Program Structure for Computer Engineering

UNIVERSITY OF MUMBAI (With Effect from 2022-2023)

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

Course Code:	Course Title	Credit
CSC801	Distributed Computing	3

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

Module	Content	Hrs
1	**Introduction to Distributed Systems**	**4**
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**	**4**
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**	**7**
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**	
5.1	Distributed Shared Memory: Architecture, design issues.	8
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**	**6**
6.1	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Network File System (NFS).	
6.2	Designing Distributed Systems: Google Case Study.	

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.
References:	
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.

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

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and the second-class test when an additional 40% syllabus is completed. The duration of each test shall be one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only four questions need to be solved.
5	In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code:	Course Title	Credit
CSDC8011	Deep Learning	3

Prerequisite: Basic mathematics and Statistical concepts, Linear algebra, Machine Learning	
Course 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.
Course Outcomes:	
1	Gain basic knowledge of Neural Networks.
2	Acquire in depth understanding of training Deep Neural Networks.
3	Design appropriate DNN model for supervised, unsupervised and sequence learning applications.
4	Gain familiarity with recent trends and applications of Deep Learning.

Module		Content	39Hrs
1		**Fundamentals of Neural Network**	**4**
	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**	**6**
	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**	**7**
	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)**	**8**
	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**	**4**
	6.1	Generative Adversarial Network (GAN): Architecture	
	6.2	Applications: Image Generation, DeepFake	

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.
References:	
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

Assessment:	
Internal Assessment:	
The assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise a total of six questions.
2	All questions carry equal marks.
3	Question 1 and question 6 will have questions from all modules. Remaining 4 questions will be based on the remaining 4 modules.
4	Only four questions need to be solved.

5	In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Useful Links	
1	https://nptel.ac. 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/

Course Code:	Course Title	Credit
CSDC8012	Digital Forensics	3

Prerequisite: Computer Network, Cryptography and System Security	
Course 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
Course Outcomes:	
1	Discuss the phases of Digital Forensics and methodology to handle the computer security incident.
2	Describe the process of collection, analysis and recovery of the digital evidence.
3	Explore various tools to analyze malwares and acquired images of RAM/hard drive.
4	Acquire adequate perspectives of digital forensic investigation in mobile devices
5	Analyze the source and content authentication of emails and browsers.
6	Produce unambiguous investigation reports which offer valid conclusions.

Module		Content	Hrs
1		**Introduction to Digital Forensics**	**6**
	1.1	Digital ForensicsDefination, 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**	**9**
	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**	**4**
	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	

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

Suggested MOOC Course Links	
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

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise a total of six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to the number of respective lecture hours as mention in the syllabus.

Course Code	Course Name	Credit
CSDC8013	Applied Data Science	03

Prerequisite: Machine Learning, Data Structures & Algorithms	
Course 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.
Course Outcomes:	
1	To gain fundamental knowledge of the data science process.
2	To apply data exploration and visualization techniques.
3	To apply anomaly detection techniques.
4	To gain an in-depth understanding of time-series forecasting.
5	Apply different methodologies and evaluation strategies.
6	To apply data science techniques to real world applications.

Module		Detailed Content	Hours
1		**Introduction to Data Science**	2
	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**	8
	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**	**06**
	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**	4
	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**	4
		Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation	

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.

References:	
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.

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

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise a total of six questions.
2	All questions carry equal marks.
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4	Only Four questions need to be solved.

Course Code:	Course Title	Credit
CSDC8021	Optimization in Machine Learning	3

Prerequisite: Engineering Mathematics, Algorithms and data structures
Course 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
Course Outcomes:
1. To understand foundational optimization ideas including gradient descent, stochastic gradient methods
2. To apply convex optimization algorithm
3. To analyze and demonstrate several population methods in Evolutionary Computation
4.Toapply advanced evolutionary algorithms such as particle swarm and ant colony optimization

Module		Content	Hrs
1		**Introduction and Background to Optimization Theory**	**4**
	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**	**10**
	2.1 2.2 2.3	The Basics of Optimization (univariate, bivariate and multivariate optimization), Convex Objective Functions First-Order optimization Methods : Gradient Descent, Conjugate Gradient, Momentum, Nesterov Momentum, Adagrad, RMSProp, learning rate optimization Second order optimization: Newton method	
3		**Stochastic Methods**	**6**
		Noisy Descent, Mesh Adaptive Direct Search, Cross-Entropy Method, Natural Evolution Strategies, Covariance Matrix Adaptation	
4		**Convex Optimization**	**6**
		Optimization problems, Convex optimization, Linear optimization problems, Quadratic optimization problems,	

		Geometric programming, Overview of Generalized inequality constraints and Vector optimization	
5		**Evolutionary Methods**	**8**
	5.1 5.2	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 Canonical Genetic Algorithm, Binary Representations of Crossover and Mutation: Binary Representations, Control Parameters	
6		**Advance Evolutionary Methods**	**5**
	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	

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.
References:	
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

Useful Links	
1	**Convex optimization (NPTEL)**
2	**Constrained and Unconstrained optimization (NPTEL)**
3	**Machine-learning-model-performance (Coursera)**
4	**Deep-neural-network optimization (Coursera)**

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise a total of six questions.
2	All questions carry equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Course Code:	Course Title	Credit
CSDC8022	High Performance Computing	3

Prerequisite: Computer Architecture, Operating System, Cloud Computing	
Course Objectives: The objective of the course is to	
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
Course Outcomes: After learning the course, the students will be able to:	
1	Understand parallel and pipeline processing approaches
2	Design a parallel algorithm to solve computational problems and identify issues in parallel programming.
3	Analyze the performance of parallel computing systems for clusters in terms of execution time, total parallel overhead, speedup.
4	Develop efficient and high-performance parallel algorithms using OpenMP and message passing paradigm
5	Develop high-performance parallel programming using OpenCL and CUDA framework
6	Perform the range of activities associated with High Performance Computing in Cloud Computing

Module		Content	Hrs
1		**Introduction to Parallel Computing**	**5**
	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**	**11**
	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**	**3**
		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**	**10**

		HPC Programming: OpenMP	
	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	
		HPC Programming: MPI	
	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**	**4**
		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**	**4**
		Virtualization and Containerization, Parallel Computing Frameworks, Scaling, HPC in the Cloud Use Cases.	

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.

References:

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.

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

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Course Code	Course Name	Credit
CSDC8023	Social Media Analytics	03

Prerequisite: Graph Theory, Data Mining, Python/R programming	
Course Objectives: The course aims:	
1	Familiarize the learners with the concept of social media.
2	Familiarize the learners with the concept of social media analytics and understand its significance.
3	Enable the learners to develop skills required for analyzing the effectiveness of social media.
4	Familiarize the learners with different tools of social media analytics.
5	Familiarize the learner with different visualization techniques for Social media analytics.
6	Examine the ethical and legal implications of leveraging social media data.
Course Outcomes:	
1	Understand the concept of Social media
2	Understand the concept of social media Analytics and its significance.
3	Learners will be able to analyze the effectiveness of social media
4	Learners will be able to use different Social media analytics tools effectively and efficiently.
5	Learners will be able to use different effective Visualization techniques to represent social media analytics.
6	Acquire the fundamental perspectives and hands-on skills needed to work with social media data.

Module	Detailed Content	Hours
1.	**Social Media Analytics: An Overview**	
	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	6
2.	**Social Network Structure, Measures & Visualization**	
	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.	6
3.	**Social Media Text, Action & Hyperlink Analytics**	
	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text	8

	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**	
	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	6
5.	**Social Information Filtering**	
	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
6.	**Social Media Analytics Applications and Privacy**	
	Social media in 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.	7

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
References:	
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

Useful Links	
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/

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
ILO 8021	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and 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	6
05	**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:**	8

	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,	
06	**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.	6

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

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

Course Code	Course Name	Credits
ILO 8022	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's	10

	Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO8023	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

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

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	5
02	**Organizational Behaviour (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • 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	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	6

	• Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale • Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning • Training & Development: Identification of Training Needs, Training Methods	5
05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	6
06	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

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

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

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

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

Course Code	Course Name	Credits
ILO8026	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **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	**09**
02	**Types of Research** **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	**07**
03	**Research Design and Sample Design** **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	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**

06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCES:

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

Course Code	Course Name	Credits
ILO8027	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

REFERENCE BOOKS:

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

Course Code	Course Name	Credits
ILO 8028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

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

References:

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

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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

End Semester Examination:

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

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**

3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management 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

Lab Code	Lab Name	Credit
CSL801	**Distributed Computing Lab**	**1**

Prerequisite: Computer Networks and Operating Systems.	
Lab Objectives:	
1	To understand basic underlying concepts of forming distributed systems.
2	To learn the concept of clock Synchronization
3	To learn Election Algorithm.
4	To explore mutual exclusion algorithms and deadlock handling in the distributed system
5	To study resource allocation and management.
6	To understand the Distributed File System
Lab Outcomes: At the end of the course, the students will be able to	
1	Develop test and debug usingMessage-Oriented Communication or RPC/RMI based client-server programs.
2	Implement techniques for clock synchronization.
3	Implement techniques for Election Algorithms.
4	Demonstrate mutual exclusion algorithms and deadlock handling.
5	Implement techniques of resource and process management.
6	Describe the concepts of distributed File Systems with some case studies.

Suggested List of Experiments	
Sr. No.	**Title of Experiment**
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

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of CSC801 and CSL801(Distributed Computing)
3	The final certification and acceptance of term work ensure satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Oral and Practical exam	
Based on the entire syllabus of CSC801: Distributed Computing and CSL801: Distributed Computing Lab	

Lab Code	Lab Name	Credit
CSDL8021	**Deep Learning Lab**	**1**

Prerequisite: Python Programming, Engineering Mathematics	
Lab 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.
Lab Outcomes: At the end of the course, the students will be able to	
1	Implement basic neural network models to learn logic functions.
2	Design and train feedforward neural networks using various learning algorithms.
3	Build and train deep learning models such as Autoencoders, CNNs, RNN, LSTM etc.

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.
4.	**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.
5	**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.
6	**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.

Term Work:	
1	Term work should consist of 8 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignment: 05-marks)
Practical and Oral exam	
	Based on the entire syllabus of CSDC8011: Deep Learning and CSDL8011: Deep Learning Lab

Lab Code	Lab Name	Credit
CSDL8022	**Digital Forensics Lab**	**1**

Prerequisite: Computer Network, Cryptography and System Security	
Lab 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 formobile forensics and browser, email forensics
4	To explore scenario based crime forensics investigations.
Lab Outcomes: At the end of the course, the students will be able to	
1	Explore various forensics tools and use them to acquire, duplicate and analyze data and recover deleted data.
2	Implement penetration testing using forensics tools.
3	Explore various forensics tools and use them to acquire and analyze live and static data.
4	Verification of source and content authentication of emails and browsers.
5	Demonstrate Timeline Report Analysis using forensics tools.
6	Discuss real time crime forensics investigations scenarios.

Suggested List of Experiments	
Sr. No.	**Title of Experiment**
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

Term Work:	
1	Term work should consist of 7 experiments covering all the modules and one case study.
2	Journal must include at least 2 assignments on content of theory and practical
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments & Case Study : 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus of CSDC8012- Digital Forensics and CSDL8012- Digital Forensics Lab

Lab Code	Lab Name	Credit
CSL8023	Applied Data Science Lab	1

Prerequisite: Engineering Mathematics, Machine Learning, Programming fundamentals	
Lab Objectives:	
1	To explore various stages in the data science lifecycle.
2	To understand data preparation, exploration and visualization techniques.
3	To model and evaluate different supervised/unsupervised learning techniques.
Lab Outcomes: At the end of the course, the students will be able to	
1	Apply various stages of the data science lifecycle for the selected case study.
2	Demonstrate data preparation, exploration and visualization techniques.
3	Implement and evaluate different supervised and unsupervised techniques.

Suggested List of Experiments
(Select a case study and perform the experiments 1 to 8.).

Star (*) marked experiments are compulsory.

Name of the Experiment

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.

Term Work:	
1	Term work should consist of 8 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignment: 05-marks)
Practical and Oral exam	
	Based on the entire syllabus of CSDC 8013: Applied Data Science and CSDL 8013: Applied Data Science Lab

Lab Code	Lab Name	Credit
CSDL8021	Optimization in Machine Learning Lab	1

Prerequisite: Algorithms and data structures	
Lab 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
Lab Outcomes: At the end of the course, the students will be able to	
1	To implement derivative based optimization techniques
2	To implement evolutionary optimization
3	To implement advanced evolutionary optimization
4	To apply efficient optimization algorithm for real world applications

Suggested List of Experiments	
Sr. No.	**Title of Experiment**
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

Term Work:	
1	Term work should consist of 6 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of "**Optimization in Machine Learning**"
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments and assignments: 15-marks, Attendance Theory & Practical: 05-marks, Case study /Mini project: 05-marks)
Practical and Oral exam	
	Based on the entire syllabus of CSDC8021: Optimization in Machine Learning and CSDL8021: Optimization in Machine Learning

Lab Code	Lab Name	Credit
CSDL8022	**High Performance Computing Lab**	**1**

Prerequisite: C Programming	
Lab Objectives: The objective of the course is to:	
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
Lab Outcomes: After learning the course, the students will be able to:	
1	Perform Linux based commands on remote machine
2	Compare the performance of sequential algorithms with parallel algorithm in terms of execution time, speedup and throughput.
3	Implement parallel program using OpenMP libraryand analyze its performance
4	Implement parallel program using MPIplatform and analyze its performance
5	Implement parallel program using OpenCL framework and analyze its performance
6	Implement parallel program using CUDA framework and analyze its performance

Suggested Experiments: Students are required to complete at least 8 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
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

Term Work:	
1	Term work should consist of 8 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Practical and Oral Exam	
	Based on the entire syllabus of CSDC8022 : High Performance Computing and CSDL8022 High Performance Computing Lab

Lab Code	Lab Name	Credit
CSDL8023	**Social Media Analytics Lab**	**1**

Prerequisite: Types of Graphs, Data Mining, Data Analytics	
Lab 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.
Lab Outcomes: The students will be able to	
1	Understand characteristics and types of social media networks.
2	Use social media analytics tools for business
3	Collect, monitor , store and track social media data
4	Analyze and visualize social media data from multiple platforms
5	Design and develop content and structure based social media analytics models.
6.	Design and implement social media analytics applications for business.

Suggested Experiments:	
Sr. No.	**Name of the Experiment**
1	Study various - i) Social Media platforms (Facebook, twitter, YouTubeetc) ii) Social Media analytics tools (Facebook insights, google analytics net lyticetc) iii) Social Media Analytics techniques and engagement metrics (page level, post level, member level) iv) Applications of Social media analytics for business. e.g. Google Analytics https://marketingplatform.google.com/about/analytics/ https://netlytic.org/
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 visualizationof 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.

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

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	**Total 25 Marks** (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Practical and Oral Exam	
Based on the entire syllabus of CSDC8023: **Social Media Analytics** and CSDL80223: **Social Media Analytics Lab**	

Course Code	Course Name	Credit
CSP801	Major Project 2	06

Course Objectives::	
The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification to successful completion of the project by implementing the solution.	
Course Outcomes: Student will able to	
1	Implement solutions for the selected problem by applying technical and professional skills.
2	Analyze impact of solutions in societal and environmental context for sustainable development.
3	Collaborate best practices along with effective use of modern tools.
4	Develop proficiency in oral and written communication with effective leadership and teamwork.
5	Nurture professional and ethical behavior.
6	Gain expertise that helps in building lifelong learning experience.

Guidelines:

1. Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.

2. **Project Report Format:**

   At the end of semester, each group needs to prepare a project report as per the guidelines issued by the University of Mumbai. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.

   A project report should preferably contain at least following details:
   - Abstract
   - Introduction
   - Literature Survey/ Existing system
   - Limitation Existing system or research gap
   - Problem Statement and Objective
   - Proposed System
     - Analysis/Framework/ Algorithm
     - Design details
     - Methodology (your approach to solve the problem) Proposed System
   - Experimental Set up

    - Details of Database or details about input to systems or selected data
    - Performance Evaluation Parameters (for Validation)
    - Software and Hardware Set up
  - Results and Discussion
  - Conclusion and Future Work
  - References
  - Appendix – List of Publications or certificates

Desirable:

Students should be encouraged -

- to participate in various project competition.
- to write minimum one technical paper & publish in good journal.
- to participate in national / international conference.

3. Term Work:

Distribution of marks for term work shall be done based on following:

a. Weekly Log Report
b. Completeness of the project and Project Work Contribution
c. Project Report (Black Book) (both side print)
d. Term End Presentation (Internal)

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

4. Oral & Practical:

Oral &Practical examination (Final Project Evaluation) of Project 2 should be conducted by Internal and External examiners approved by University of Mumbai at the end of the semester.

Suggested quality evaluation parameters are as following:

a. Relevance to the specialization / industrial trends
b. Modern tools used
c. Innovation
d. Quality of work and completeness of the project
e. Validation of results
f. Impact and business value
g. Quality of written and oral presentation
h. Individual as well as team work