

Bharatiya Vidya Bhavan's
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai)

Revision: SPIT-4-19



Bachelor of Engineering/Technology (B.E./B.Tech)
in
Computer Engineering

Final Year Engineering
(em. VII and Sem. VIII)
Effective from Academic Year 2019 -20

Board of Studies Approval: 22/10/2018

Academic Council Approval: 16/01/2019

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23/01/19

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Sardar Patel Institute of Technology
Bhavans Andheri Campus
Munshi Nagar, Andheri (West),



to
22/01/19



Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Choice Based Internship Policy Details

Category '1':

Students who want to **register for placement and interested in joining semester long internship** will have following procedure

1. They will follow the regular placement procedure during their 7th Semester
2. They will proceed for internship in the company in which they have been selected from the next January.
3. Their credit requirements of 8th semester will be completed at the end of the '**summer term**' of their semester 6th.
4. The semester long internship will have credits assigned to it with appropriate evaluation mechanism.
5. The detail credit structure for semester 8th of category '1' will be declared in their next term in Jan 2019.

Category '2':

Students who do not want semester long internship (i.e. would want to continue with their **higher education immediately** after their B.Tech./B.E. program).

1. The normal semester 7th and 8th will be working for them as per their regular academic calendar
2. The detail credit structure for semester 8 of category '2' will be declared in their next term in Jan 2019.
3. Students will be allowed to participate for the placement in normal company.

Choice of Category '1' or '2' shall be taken from the students in the mid of SEM VI.

Category '1': Student chooses for institute offered internship:

In this case student attends 'Summer Term' of 6 weeks duration.

Internship should be done by the student from 15th January to 30th June.

All the courses shall run twice a week during 'Summer Term'. Thus 1 hour lecture should be conducted for 12 hours in a summer term to get 1 credit.

ESE for summer term open elective courses shall be conducted in first and second week of July.

Make-up Examination for open elective courses shall be conducted along with SEM VI Make-up Examination.

Category '2': Student opt out of 'Institute offered company internship'

Student attends normal regular semesters as per institute calendar

SEM VIII students will attend OE courses along with SEM VI students.

Student appears for regular ESE examination.

Make-up Examination shall be conducted in first and second week of July.

Internship Related Other Guidelines:

1. Once a particular 'Category' is selected by the student then he/she will **NOT be allowed to change the category** for whatsoever reason.
2. If performance of the student is reported as poor by the industry or industry raises concerns about attendance issues of student during the internship then student may be called back to the institute. In this case he/she will have to complete the coursework equivalent to internship credits. If institute runs 'summer term' then student can take courses (two theory courses and two labs) in summer term. Otherwise student will have to take courses (two theory courses and two labs) in the ODD semester of the next academic year. In this case student will be allowed to sit for the placement after rejoining the institute.
3. Internships will be given by the S.P.I.T. as per the selection criteria of company. Following are the other avenues for internships:
 - a. SPTBI
 - b. Reputed organizations like IIT, BARC, TIFR etc. with condition that the organization selected is ready to do the assessment for 10 credits of internship
 - c. If student get an internship offer on his own in a particular company then he/she needs to connect company.
4. For all internships, S.P.I.T. approval is must and there should be a grade penalty for students accepting internship and not joining a company or joining a company but not completing internship.

MOOC courses can be taken any time during the entire academic year. However MOOC* credits will be added to semester VIII as and when 'pass' certificate is submitted by the student.

List of MOOC courses will be curated by the department and students need to select from the list. If student wish to have course which is not present in the list then written approval from HoD and Dean Academics is necessary.

Computer Engineering Department

Semester VII common to both category '1' and category '2'

SEM VII						
Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits
			L	T	P	Total
CE71	Artificial Intelligence and Soft Computing	PC	3	--	--	3
CE72	Distributed Systems	PC	3	--	--	3
CEE71^	Elective-I	PE	3	--	--	3
CEE72^	Elective-II	PE	3	--	--	3
CEL71	Artificial Intelligence & Soft Computing Lab	PC	--	--	2	1
CEL72	Distributed Systems Lab	PC	--	--	2	1
CEEL71^	Elective-I Lab	PE	--	--	2	1
CEEL72^	Elective-II Lab	PE	--	--	2	1
CEP71	Category-'1': Major Project-II Category-'2': Major Project-I	PR	--	--	10#	5
CEP5	Problem solving module-V (Optional)	CEP				
Total			12	--	18	21

Elective Subjects

CEE71^	Elective-I	A. Advanced Algorithm & Complexity B. Big Data Analytics
CEE72^	Elective-II	A. Image Processing B. Decision Making and Business Intelligence

Summer Term for Category '1': Student chooses for semester long internship

Summer Term						
Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits
			L	T	P	Total
HSS81	Technology Entrepreneurship Lab	HSS	--	--	2	1
OE^	Open Elective @	OE	1@	--	2@	2@
OE^	Open Elective @	OE	1@	--	2@	2@
CEP81	Category-'1': Major Project-I	PR	--	--	10	5
MOOC	MOOC (Min 8 week course)	MOOC	--	--	--	2
INT	Internship	PR	--	--	--	10#
ABL5	Financial Planning, Taxation Policies and Investment (Noncredit)	--	--	--	--	--
Total			2@	--	12+4@	8+4@+10#

Semester VIII for Category ‘2’: Student opt out of ‘Semester Long Internship’

SEM VIII						
Course Code	Course Name	Group	Teaching Scheme (Hrs/week)			Credits Total
			L	T	P	
HSS81	Technology Entrepreneurship Lab	HSS	--	--	2	1
OE^	Open Elective @	OE	1@	--	2@	2@
OE^	Open Elective @	OE	1@	--	2@	2@
CEP81	Category-‘2’: Major Project-II	PR	--	--	10	5
MOOC	MOOC (Min 8 week course)	MOOC	--	--	--	2
ABL5	Financial Planning, Taxation Policies and Investment (Noncredit)	--	--	--	--	--
CEE81^	A. Human Machine Interaction B. Digital Forensic	PE	3	1	--	4
CEE82^	A. High Performance Computing B. Data Science	PE	3	1	--	4
CEEL81^	A. Human Machine Interaction Lab B. Digital Forensic Lab	PE	--	--	2	1
CEEL82^	A. High Performance Computing Lab B. Data Science Lab	PE	--	--	2	1
	Total		6+2@	2	16+4@	18+4@

List of Open Elective Courses:

OE1: Consumer Electronics (ETRX)

OE2: Robotic Vision (ETRX)

OE3: Cyber Security and Digital Forensics (EXTC)

OE4: Internet of Things (EXTC)

OE5: Fundamentals of Computational Intelligence (COMP)

OE6: Fundamentals of Data Structures and Algorithms (COMP)

OE7: Software Testing (IT)

OE8: Database Management Systems (IT)

Evaluation Scheme

B.E. Computers Engineering (SEM VII)					
Course Code	Course Name	Marks			
		ISE	MSE	ESE	Total
CE71	Artificial Intelligence and Soft Computing	20	20	60	100
CE72	Distributed Systems	20	20	60	100
CEE71^	Elective-I	20	20	60	100
CEE72^	Elective-II	20	20	60	100
CEL71	Artificial Intelligence & Soft Computing Lab	40	--	--	40
CEL72	Distributed Systems Lab	40	--	--	40
CEEL71^	Elective-I Lab	40	--	--	40
CEEL72^	Elective-II Lab	40	--	--	40
CEP71	Category-'1': Major Project-II Category-'2': Major Project-I	80&	--	20	100
CEP5	Problem solving module-V (Optional)				660
For Category '2': Computers Engineering (SEM VIII)					
Course Code	Course Name	Marks			
		ISE	MSE	ESE	Total
HSS81	Technology Entrepreneurship Lab	40	--	--	40
OE^	Open Elective @	40	10	20	70
OE^	Open Elective @	40	10	20	70
CEP81	Category-'2': Major Project-II	80&	--	20	100
MOOC	MOOC (Min 8 week course)	--	--	--	100
ABL5	Financial Planning, Taxation Policies and Investment (Noncredit)	--	--	--	--
CEE81^	A. Human Machine Interaction B. Digital Forensic	20	20	60	100
CEE82^	A. High Performance Computing B. Data Science	20	20	60	100
CEEL81^	A. Human Machine Interaction Lab B. Digital Forensic Lab	40	--	--	40
CEEL82^	A. High Performance Computing Lab B. Data Science Lab	40	--	--	40
	Total				660

& Phase-I: 40 Phase-II: 40

SUMMER TERM: For Category '1': B.E. Computers Engineering (SEM VIII)					
Course Code	Course Name	Marks			
		ISE	MSE	ESE	Total
HSS81	Technology Entrepreneurship Lab	40	--	--	40
OE^	Open Elective @	40	10	20	70
OE^	Open Elective @	40	10	20	70
ELP81	Category-'1': Major Project-I	80&	--	20	100
MOOC	MOOC (Min 8 week course)	--	--	--	100
ABL5	Financial Planning, Taxation Policies and Investment (Noncredit)	--	--	--	--
INT	Internship	--	--	--	*280
	Total				660

* Kindly refer internship evaluation guidelines for 280 marks

Monitoring & Evaluation of Internship

Course Name: Internship Course Code: INT	MSE	ESE	Total Marks	Total Credits
Institute Supervisor Evaluation	70	70	140	05
Industry Mentor Evaluation	70	70	140	05
	140	140	280	10

For MSE and ESE: 60 Marks Rubrics Based Evaluation
 10 Marks Internship Report Evaluation

Parameters for Rubrics Based Evaluation of Intern

(Needs improvement=1; Satisfactory=2; Good=3; Excellent=4)

S.N.	Parameters	Scale (1 to 4)
1	Behaviors	
2	Performs in a dependable manner	
3	Cooperates with co-workers and supervisors	
4	Shows interest in work Learns quickly	
5	Shows initiative	
6	Accepts responsibility	
7	Accepts criticism	
8	Demonstrates organizational skills	
9	Shows good judgment	
10	Analyzes problems effectively	
11	Is self-reliant	
12	Communicates well	
13	Has a professional attitude and appearance	
14	Is punctual	
15	Uses time effectively	
Rate the following parameters for Internship Report (Needs improvement=1; Satisfactory=1.5; Good=2; Excellent=2.5)		
17	Writes effectively	
18	Uses technical knowledge and expertise	
19	Demonstrates creativity/originality	
20	Produces high quality work	
Total (Out of 70)		

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CE71	Artificial Intelligence and Soft Computing (AISC)	3	--	--	3	--	--	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	Programming Languages ,Basic Mathematics, Probability	
At end of successful completion of this course, student will be able to		
Course Outcomes	CE71.1	Identify the various characteristics of Artificial Intelligence and soft computing techniques.
	CE71.2	Construct the supervised and unsupervised learning algorithm for real world applications.
	CE71.3	Design fuzzy controller system.
	CE71.4	Appreciate the importance of optimizations and its use in computer engineering fields and other domains.
	CE71.5	Understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.

Module No.	Topics	Ref.	Hrs.
1	Introduction to Artificial Intelligence: Definition of AI, History and Future of AI. Intelligent Agents, Agents and Environments ,Rationality, Nature of Environment, Structure of Agent, Problem solving Approach to Typical AI problem, Introduction to Expert System Design	1,11	04
2	Introduction to Soft Computing Soft computing Constituents, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation.	2-10	04
3	Neural Networks Basics of Neural Networks: Introduction to Neural Networks, Biological Neural Networks, McCulloch Pitt model, Hebb Network, Linear separability. Supervised Learning algorithms: Perceptron (Single Layer, Multilayer), Delta learning rule, Back Propagation algorithm. Un-Supervised Learning algorithms: Winner take all, Self- Organizing Maps, Learning Vector Quantization.	2-10	14
4	Fuzzy Set Theory Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations,	2-10	12

	Properties of membership function, Fuzzy extension principle, Fuzzy Systems- fuzzification, defuzzification and fuzzy controllers.		
5	Hybrid system Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System (ANFIS).	2-10	04
6	Genetic Algorithms and its applications: Inheritance Operators, Cross over types, inversion and Deletion, Mutation Operator, Bit-wise Operators, Convergence of GA, Applications of GA.	2-10	04
Total			42

References:

- [1] Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
- [2] Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.
- [3] S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
- [4] S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
- [5] J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
- [6] Jacek.M.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.
- [7] Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
- [8] Zimmermann H.S "Fuzzy Set Theory and its Applications" Kluwer Academic Publishers.
- [9] Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
- [10] Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition
- [11] N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CE72	Distributed Systems	3	--	--	3	--	--	3
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	CE43, CE51	
At the End of the course students will be able to		
Course Outcomes	CE72.1	Understand the principles and desired properties of distributed systems.
	CE72.2	Understands the message communication, remote procedure call and Remote method invocation (RPC and RMI) along with group communication.
	CE72.3	Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving
	CE72.4	Identify the challenges in developing distributed applications.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	FUNDAMENTALS			5
	1.1	Introduction, Distributed Computing Models	1	
	1.2	Software Concepts, Issues in designing Distributed System	1	
	1.3	Client – Server Model	1	
2	COMMUNICATION			10
	2.1	Message Passing , Introduction to Message Passing, Advantages and features of Message Passing, Message Format, Message Buffering, Multi Data gram Messaging , Group Communication	1,2	
	2.2	Remote Procedure Call (RPC): Basic RPC Operations, Parameter Passing, Extended RPC Models	1,2	
	2.3	Remote Object Invocation: Distributed Objects, Binding a Client to an Object, Static Vs Dynamic RMI, Parameter Passing, Java RMI	1,2	
	2.4	Message Oriented Communication: Persistence and synchronicity in communication, Message Oriented Transient and Persistent Communications	1,2	
3	PROCESS			5
	3.1	Introduction to Threads, Threads in Distributed Systems	1,3	
	3.2	Code Migration: Approaches to Code Migration	1,3	
	3.3	Migration and Local Resources, Migration in Heterogeneous Systems	1,3	



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4	SYNCHRONIZATION			10
	4.1	CLOCK SYNCHRONIZATION : Physical Clocks, Global Positioning System, Clock Synchronization Algorithms	1,2	
	4.2	LOGICAL CLOCKS : Lamport's Logical Clocks , Vector Clocks	1,2	
	4.3	MUTUAL EXCLUSION: Overview, Centralized Algorithm, Decentralized Algorithm, Distributed Algorithm, Token Ring Algorithm , Comparison of the Four Algorithms	1,2	
5	CONSISTENCY AND REPLICATION			7
	5.1	Introduction, Reasons for Replication, Replication as Scaling Technique	1,2	
	5.2	Data-Centric Consistency Models, Continuous Consistency, Consistent Ordering of Operations	1,2	
	5.3	Client Centric Consistency Models, Eventual Consistency, Monotonic Reads, Monotonic Writes, Read Your Writes, Writes Follow Reads	1,2	
	5.4	CONSISTENCY PROTOCOLS: Continuous Consistency, Primary-Based Protocols, Replicated-Write Protocols, Cache-Coherence Protocols, Implementing Client-Centric Consistency	1,2	
6	DISTRIBUTED LOAD BALANCING			5
	6.1	Load balancing Methodology, Need of load Balancing Algorithms, and Classification of Static and Dynamic Load Balancing algorithms, Comparison of LBA.	2,4	
			Total	42

References:

- [1] Andrew S. Tanenbaum & Maarten van Steen”, Distributed Systems – Principles and Paradigms”, 2nd Edition, Publisher: PHI.
- [2] George Coulouris, Jean Dollimore, Tim Kindberg, & Gordon Blair, “Distributed Systems – Concept and Design”, 4th Edition, Publisher: Pearson.
- [3] P. K. Sinha,”Distributed Operating Systems Concepts and Design”, Publisher: PHI.
- [4] Sudhir N. Dhage, “Distributed VOD Systems”, Research India Publication



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE71A	Advanced Algorithm & Complexity	3	--	--	3	--	--	3
		Examination Scheme						
		ISE	MSE	ESE	Total			
		20	20	60	100			

Pre-requisite Course Codes		CE31, CE41
At the end of the course students will be able to		
Course Outcomes	CEE71A.1	Design and analyze various algorithms for solving computational problems efficiently.
	CEE71A.2	Understand and analyze the fundamentals of randomized algorithms and amortized analysis.
	CEE71A.3	Have an idea of applications of algorithms in a variety of areas including maximum flow and linear programming
	CEE71A.4	Design and analyze various algorithms to illustrate the dynamic programming paradigm.
	CEE71A.5	Understand NP completeness and approximation algorithms for different NP complete problems.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction – The Role of Algorithms in Computing- Algorithms as a technology, Analyzing Algorithms, Designing Algorithms. Growth of Functions- Asymptotic Notations and their significance, Standard notations and common functions, Revision of Methods for solving recurrences - the substitution method, the recursion-tree method, the master method.	1,2,3	06
	1.2	Dynamic Programming: Matrix-chain Multiplication, LCS, Optimal Binary Search trees, cutting rod problem and its analysis.	1,2,3	
2	2.1	Probabilistic Analysis and Randomized Algorithms, Sorting in Linear Time.	1,2,3	06
		Amortized Analysis : Aggregate analysis, The accounting Method, Table Doubling, The Potential Method	1,2,3	
		Maximum Flow - Flow networks, The Ford-Fulkerson method, Push-relabel algorithms, The relabel-to-front algorithm	1,3	04
3	3.1	Advanced Topics in Linear Programming- Simplex method, Duality theory and its applications, the Dual Simplex method,	4,5	08



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		Sensitivity analysis in Linear Programming, Parametric Programming, Integer Programming,		
4	4.1	NP-Completeness- Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems	1,3	12
	4.2	Approximation Algorithms The vertex-cover problem, The traveling-salesman problem, The set-covering problem	1,3	
			Total	42

References:

- [1] T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, "Introduction to Algorithms", 3rd edition, PHI publication 2009.
- [2] Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press
- [3] Ellis Horowitz, Sartaj Sahni, S. Rajsekar. "Fundamentals of Computer Algorithms" University press
- [4] Prem Kumar Gupta, D.S. Hira, "Problems in Operation Research Principles and Solution"
- [5] Ravindran, Phillips, Solberg, "Operations Research Principles and Practice", Second Edition, Wiley Publication



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE71B	Big Data Analytics	3	--	--	3	--	--	3
		Examination Scheme						
		ISE	MSE	ESE	Total			
		20	20	60	100			

Pre-requisite Course Codes	CE34	
At the End of the course students will be able to		
Course Outcomes	CEE71B.1	Understand the basic concepts of Big Data and Hadoop Framework.
	CEE71B.2	Implementing distributed computing using Hadoop's HDFS and MapReduce framework and spark stack using Scala
	CEE71B.3	Perform Big Data Analytics using various algorithms for clustering, mining data streams and link analysis for large data sets
	CEE71B.4	Apply NoSQL tools and various analytics techniques to solve big data problems.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		Introduction		4
	1.1	Introduction to Big Data Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach	1-5	
	1.2	Introduction to Hadoop What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Physical Architecture; Hadoop limitations.	1-5	
2	2.1	Distributed File Systems: Physical Organization of Compute Nodes, Large- Scale File-System Organization.	1,2,5	10
	2.2	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks Combiners, Details of MapReduce Execution, Coping With Node Failures.	1,2,5	
	2.3	Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce	1,2,5	
	2.4	Introduction to Scala , Features of Scala and typical use cases where Scala can be used. Strings, Numbers, Control Structures, Classes and	1,4	



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		Properties, Methods, Objects, Functional Programming.		
3	3.1	Finding Similar Items Applications of Near-Neighbor Search, Jaccard Similarity of Sets, Similarity of Documents, Collaborative Filtering as a Similar-Sets Problem. Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.	1-5	11
	3.2	Mining Data Streams The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Query, Issues in Stream Processing. Sampling Data in a Stream : Obtaining a Representative Sample , The General Sampling Problem, Varying the Sample Size. Filtering Streams: The Bloom Filter, Analysis. Counting Distinct Elements in a Stream The Count-Distinct Problem, The Flajolet-Martin Algorithm,	1-5	
	3.3	Link Analysis Page Rank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector.	1-5	
4	4.1	Frequent Itemsets Handling Larger Datasets in Main Memory Algorithm of Park, Chen, and Yu, The Multihash Algorithm. The SON Algorithm and Map Reduce Counting Frequent Items in a Stream Sampling Methods for Streams, Frequent Itemsets in Decaying Windows	1-5	11
	4.2	Clustering CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets, Answering Queries	1-5	
	4.3	Recommendation Systems A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	1-5	
5	5.1	What is NoSQL? NoSQL business drivers; NoSQL case studies. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns; Using NoSQL to manage big data: What is a big data NoSQL solution? Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	1,3	6



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	5.2	Case Study of Big Data Solutions (eg: Twitter data analysis, Sentiment Analysis, Social Networks as Graphs)	1-5	
			Total	42

References:

- [1] AnandRajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,
- [2] Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
- [3] Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.
- [4] Alvin Alexander "Scala CookBook" O'Reilly publications
- [5] Chuck Lam, "Hadoop in Action", Dreamtech Press



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE72A	Image Processing (IP)	3	--	--	3	--	--	3
		Examination Scheme						
		ISE	MSE	ESE	Total			
		20	20	60	100			

Pre-requisite Course Codes	Introductory preparation in mathematical analysis, matrices, probability, statistics, and rudimentary computer programming.
At end of successful completion of this course, student will be able to	
Course Outcomes	CEE72A.1 Apply the fundamentals studied in digital image processing
	CEE72A.2 Analyze image enhancement, segmentation and morphological techniques
	CEE72A.3 Develop discrete image transform algorithms
	CEE72A.4 Elaborate digital image compression and methods.

Module No.	Topics	Ref.	Hrs.
1	Image Fundamentals Introduction to digital image, digital image processing , examples of fields that use digital Image processing, Sampling and quantization, representing digital images, image types, some basic relationships between pixels	1-3	06
2	Image Enhancement in the Spatial domain Basic gray level transformations, Image negatives, Thresholding, Log transformations and Power law transformations. Piecewise-Linear Transformation Functions: Contrast stretching, Gray -level slicing, Bit plane slicing, Histogram Processing, Histogram equalization, Neighborhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.	1-2	12
3	Image Segmentation Thresholding, Segmentation based on Discontinuities Point, Line, Edge detection using Robert, Sobel, Prewitt masks, Image Edge detection using the second derivative- the Laplacian Mask,	1-5	06
4	Morphological Image Processing Preliminaries, Structuring element, Dilation, Erosion, Opening, closing, Hit or Miss transform and Boundary extraction on binary images	1-3	06
5	Image transform Need for transform, Discrete Fourier Transform(DFT), Discrete Cosine Transform(DCT), Discrete Hadamard Transform(DHT), Discrete Walsh Transform(DWT), Hotelling Transform-K-L Transform,	1-3	06



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6	Image Compression Introduction, Redundancy, Fidelity Criteria, Compression metrics, Image Compression Models – The Source Encoder and Decoder model, , lossless and lossy image compression, Run Length Coding, Arithmetic Coding, Huffman Coding, Improved Gray Scale Quantization	1-5	06
Total			42

References:

- [1] Rafael C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,
- [2] S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,
- [3] Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition
- [4] Milan Sonka Vaclav Hlavac Roger Boyle ,” *Image Processing, Analysis, and Machine Vision*, Thomson, Second Edition,
- [5] B. Chandra and D. Dutta Majumder, "Digital Image Processing and Analysis", Prentice Hall of India Private Ltd, 2011



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE72B	Decision Making and Business Intelligence	3	--	--	3	--	--	3
		Examination Scheme						
		ISE	MSE	ESE	Total			
		20	20	60	100			

Pre-requisite Course Codes	Data Mining(CE53), Applied Mathematics
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At end of successful completion of this course, student will be able to

Course Outcomes	CEE72B.1	Identify various decision making methods in industries.
	CEE72B.2	Summarize the characteristics of complex business problems.
	CEE72B.3	Apply prediction and optimization techniques for decision making.
	CEE72B.4	Design expert system for decision making
	CEE72B.5	Analyzing data for the purpose of helping enterprise users make better business decisions.

Module No.	Topics	Ref.	Hrs.
1	Introduction: Introduction to decision making methods, AHP, SAW,WPM MCDM,MADM methods and examples.	1-5	6
2	Characteristics of Complex Business Problems: Number of Possible Solutions, Time-Changing Environment , Problem-Specific Constraints , Multi-objective Problems , Modeling the Problem, A Real-World Example	1-5	7
3	Prediction Methods and Models: Data Preparation, Different Prediction Methods, Mathematical Methods, Distance Methods: Logic Methods, Modern Heuristic Methods ,Additional Considerations, Evaluation of Models	1-5	7
4	Modern Optimization Techniques Local Optimization Techniques, Stochastic Hill Climber, Simulated Annealing, Tabu Search, Evolutionary Algorithms, Constraint Handling	1-5	8
5	Computational Intelligence and Expert Techniques in Decision making Design of an expert system for decision making using Neural network, fuzzy logic and genetic algorithm, Classifiers, Evolutionary Computation :	1-5	10



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	Ant colony optimization, Particle		
6	Applying Business Intelligence : Marketing Campaigns , Manufacturing, Investment Strategies, Emergency Response Services, Credit Card Fraud	1-5	4
Total			42

References :

- 1. Adaptive Business Intelligence** by Zbigniew Michalewicz, Martin Schmidt, Matthew Michalewicz, Constantin Chiriac "Adaptive Business Intelligence" by Springer Publication
- 2. Decision Making in the Manufacturing Environment:** Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods by Venkata Rao ,Springer publications
- 3. Computational Intelligence in Complex Decision Systems** by Da Ruan ,Atlantis Press, Amsterdam Press, World Scientific.
- 4. Fuzzy sets, decision making and expert system** by Hans- Jurgen Zimmermann ,Kluwer Academic Publishers, Boston
- 5. Business Intelligence: Data Mining and Optimization for Decision Making** by Carlo Vercellis ,Wiley Publications



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEL71	Artificial Intelligence and Soft Computing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		-		40

Pre-requisite Course Codes	CE71(AISC)	
At end of successful completion of this course, student will be able to		
Course Outcomes	CEL71.1	Differentiate various Transfer Functions.
	CEL71.2	Apply the supervised and unsupervised learning algorithm.
	CEL71.3	To design and implement an Expert System
	CEL71.4	Apply & design fuzzy controller system.
	CEL71.5	Apply Genetic algorithm for basic optimization problem.

Exp. No.	Experiment Details	Ref.	Marks
1	To implement Mc-Culloch Pitts Model.	1-5	5
2	To implement Transfer/Activation Functions. A symmetric hard limit transfer function. A Binary step activation function. A Bipolar step activation function. A saturating linear transfer function. A hyperbolic tangent sigmoid (tansig) transfer function. A log-sigmoid transfer function	1-5	5
3	To implement Basic Neural Network learning rules. PROBLEM TO DISTINGUISH BETWEEN APPLES AND ORANGES A produce dealer has a warehouse that store a variety of fruits & vegetables. When fruit is brought to the warehouse , a various types of fruits may be mixed together. The dealer wants a machine that will sort the fruit according to type . There is a conveyer belt on which the fruit is loaded .This conveyer passes through a set of sensors, which measure three properties of fruits :shape , texture and weight. Bias= < Any Value>	1-5	5



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	Type of sensor	Output of sensor	Condition		
	Shape sensor	1	if fruit is approx. round		
		0	if fruit is elliptical.		
	Texture Sensor	1	If surface is smooth		
		0	If surface is rough		
	Fruit sensor	1	Apple		
		0	Orange		
	A) Design a perceptron to recognize these patterns using Joone Editor. B) Write a program to design a perceptron to recognize these patterns.(Use Open source tools)				
4	To implement Multilayer Perceptron Learning algorithm.			1-5	5
5	To design and implement an expert system, incorporating the match algorithm and the rule language. 1. It should provide a fact base updating function. 2. It should provide a function that check the rules' LHS and return which rules were matched. 3. It should support firing RHS according to matches.			1,2,3,6	5
6	To implement Fuzzy Sets and Fuzzy Relations			1-5	5
7	To implement Fuzzy Controllers			1-5	5
8	To implement a simple application using Genetic Algorithm.			1-5	5
				Total Marks	40

References:

- [1] Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
- [2] S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
- [3] S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
- [4] Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
- [5] Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.
- [6] Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEL72	Distributed Systems Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CE43, CE51	
At the End of the course students will be able to		
Course Outcomes	CEL72.1	The student gains clear understanding of fundamental principle of Distributed Systems.
	CEL72.2	Understands the remote procedure call and Remote method invocation (RPC and RMI) along with group communication.
	CEL72.3	The student gains clear understanding with design and implementation of key mechanisms, Clock Synchronization, Election Algorithms, Mutual Exclusion, and Load balancing.

Exp. No.	Experiment Details	Ref.	Marks
1	Client Server based program using RPC/RMI.	1	5
2	Implementation of Clock Synchronization (logical/physical).	1	5
3	Implementation of Election algorithm.	1,2	5
4	Implementation of Mutual Exclusion algorithm.	1,4	5
5	Client Server based program to check data consistency.	1,4	5
6	Implement Load Balancing Program in Java.	2,3	5
7	Mini Project	1,3,4	10
Total Marks			40

References:

- [1] Andrew S. Tanenbaum & Maarten van Steen”, Distributed Systems – Principles and Paradigms”, 2nd Edition, Publisher: PHI.
- [2] George Coulouris, Jean Dollimore, Tim Kindberg, & Gordon Blair, “Distributed Systems – Concept and Design”, 4th Edition, Publisher: Pearson.
- [3] P. K. Sinha, ”Distributed Operating Systems Concepts and Design”, Publisher: PHI.
- [4] Sudhir N. Dhage, “Distributed VOD Systems”, Research India Publication



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL71A	Advance Algorithm & Complexity Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CE31, CE41, CEL31, CEL41
At the End of the course students will be able to	
Course Outcomes	CEEL71A.1 Apply and implement the learnt algorithm design techniques.
	CEEL71A.2 Apply and implement the dynamic programming strategy to implement various algorithms.
	CEEL71A.3 Demonstrate NP complete problems and approximation algorithms.
	CEEL71A.4 Implement and analyze the randomized and simplex algorithm
	CEEL71A.5 Apply and implement maximum flow algorithm for different transportation problems.

Exp. No.	Experiment Details	Ref.	Marks
1	Sorting of 2 lacs element using various sorting methods by applying files operation	1,2,3	10
2	Implementation of Dynamic programing: matrix chain multiplication / Cutting rod example / Longest Common Subsequence	1,2,3	5
3	Implementation of Randomized algorithms.	1,2,3	5
4	Implementation of Maximum flow problem: Ford Fulkerson algorithm/ push -relabel to front methods.	1,2,3	5
5	Implementation of Linear Programming problem: Simplex algorithm	1,2,3	5
6	Implementation of NP complete problem: vertex-cover problem	4,5	5
7	Implementation of approximation algorithms: Travelling Salesman problem	1,2,3	5
Total Marks			40

References:

- [1] T.H. Cormen , C.E. Leiserson, R.L. Rivest, and C. Stein, "Introduction to Algorithms",3rd edition , PHI publication 2009.
- [2] Rajeev Motwani and PrabhakarRaghavan, "Randomized Algorithms", Cambridge University Press



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- [3] Ellis Horowitz ,SartajSahni , S. Rajsekar. “Fundamentals of Computer Algorithms” University press
- [4] Prem Kumar Gupta, D.S. Hira, “Problems in Operation Research Principles and Solution”
- [5] Ravindran, Phillips, Solberg, “Operations Research Principles and Practice”, Second Edition, Wiley Publication



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL71B	Big Data Analytics Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes		CE34
At the End of the course students will be able to		
Course Outcomes	CEL71B.1	Apply scalable algorithms based on Hadoop and Map Reduce , and Scala programming to perform Big Data Analytics..
	CEL71B.2	Apply different algorithms of mining, use stream data model to provide real time analysis on big data
	CEL71B.3	Apply NoSQL tools to solve big data problems.
	CEL71B.4	Use any other tool of Hadoop Ecosystem

Exp. No.	Experiment Details	Ref.	Marks
1	Study of Hadoop Ecosystem and execute wordcount program.	1, 2	5
2	Programming in NoSQL.	3	5
3	Use Pig scripting to solve Big Data problem.	1, 2	5
4	Implement a Frequent Itemset algorithm on big data	1, 2	5
5	Implement a Clustering algorithm on big data	1, 2	5
6	Implement a map reduce solution in Scala	4	5
7	Mini Project. One real life large data application to be implemented (Use standard Datasets available on the web)		10
Total Marks			40

References:

- [1] [1] AnandRajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press,
- [2] Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
- [3] Dan McCreary and Ann Kelly "Making Sense of NoSQL" – A guide for managers and the rest of us, Manning Press.
- [4] Alvin Alexander "Scala CookBook" O'Reilly publications
- [5] Chuck Lam, "Hadoop in Action", Dreamtech Press



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL72A	Image Processing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CEE72A
At the End of the course students will be able to	
Course Outcomes	CEEL72A.1 Examine image file format
	CEEL72A.2 Implement various image processing techniques
	CEEL72A.3 Develop image processing application

Exp. No.	Experiment Details	Ref.	Marks
1	To study different image file formats.	6	5
2	To perform point operations	1-3	5
3	To enhance image using histogram equalization.	1-3	5
4	To perform image filtering using smoothing and sharpening filters	1-3	5
5	To implement image segmentation using gradient Prewitt/Robert/Sobel Operators.	1-5	5
6	To perform morphological image processing using erosion and dilation	1-3	5
7	To implement compression using RLE compression algorithm on an image.	1-3	5
8	Any one application in image processing	6	5
Total Marks			40

References:

- [1] Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,
- [2] S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,
- [3] Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition



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- [4] Milan Sonka Vaclav Hlavac Roger Boyle ,” *Image Processing, Analysis, and Machine Vision*, Thomson, Second Edition,
- [5] B. Chandra and D. Dutta Majumder, “Digital Image Processing and Analysis”, Prentice Hall of India Private Ltd, 2011
- [6] On line resources



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL72B	Decision Making and Business Intelligence Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		-		40

Pre-requisite Course Codes	Data Mining(CE53), Applied Mathematics	
Course Outcomes	CEEL72B.1	Apply MADM/MCDM method for decision making.
	CEEL72B.2	Apply prediction model for decision making
	CEEL72B.3	Apply optimization techniques for decision making.
	CEEL72B.4	Design an expert system for decision making
	CEEL72B.5	Analyzing data for the purpose of helping enterprise users make better business decisions.

Exp. No.	Experiment Details	Ref.	Marks
1	To implement SAW and WPM method for a given problem.	1-5	5
2	To implement AHP method for a given problem.	1-5	5
3	To implement Business Intelligence using prediction model for a given problem.	1-5	5
4	To implement optimization technique for a given problem.	1-5	5
5	To implement an expert system for decision making using Neural Network.	1-5	5
6	To implement an expert system for decision making using Fuzzy Logic/ genetic algorithm.	1-5	5
7	Case Study/Mini Project on decision making and BI.	1-5	10
Total Marks			40

References :

- Adaptive Business Intelligence** by Zbigniew Michalewicz, Martin Schmidt, Matthew Michalewicz, Constantin Chiriac "Adaptive Business Intelligence" by Springer Publication



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2. **Decision Making in the Manufacturing Environment:** Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods by Venkata Rao ,Springer publications
3. **Computational Intelligence in Complex Decision Systems** by Da Ruan ,Atlantis Press, Amsterdam Press, World Scientific.
4. **Fuzzy sets, decision making and expert system** by Hans- Jurgen Zimmermann ,Kluwer Academic Publishers, Boston
5. **Business Intelligence: Data Mining and Optimization for Decision Making** by Carlo Vercellis ,Wiley Publications



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE81A	Human Machine Interaction(HMI)	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	CPL501 (Web Technology), Basic knowledge of designing tools and languages like HTML, Java, etc.
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At end of successful completion of this course, student will be able to

Course Outcomes	CEE81A.1	CEE81A.2	CEE81A.3	CEE81A.4	CEE81A.5
	Identify the various design principles used for interacting between human and machine.	Apply human psychology of everyday actions and UI design process for real world applications.	Implement mobile, windows and web based application	Evaluate and justify UI design	Create application for social and technical task.

Module No.	Topics	Ref.	Hrs.
1	Introduction: Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields. The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error;	1-10	06
2	Understanding Goal Directed Design: Goal directed design; Implementation models and mental models; Beginners, experts and intermediates – designing for different experience levels; Understanding users; Modeling users – personas and goals.	1-10	06
3	Design Guidelines: perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, time.	1-10	04
4	Graphical User Interface and Web Interface : The graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI, Web user Interface: Interface popularity, characteristics. Principles of user interface design.	1-10	12



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5	Interaction Styles and Communication: Interaction Styles: Menus, Windows, Device-based and Screen-based Controls. Communication: Text messages, Feedback and Guidance, Icons, Multimedia and colors.	1-10	08
6	Interface Design For Mobile Devices: Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.	1-10	06
Total			42

References :

1. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale "Human Computer Interaction", Prentice Hall.
2. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.
3. KalbandeDhananjay R,Kanade P.,Iyer S.,"Galitz's Human Machine Interaction",Wiley Publications.
4. Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.
5. Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.
6. Donald A. Normann, " Design of everyday things",Basic Books; Reprint edition 2002.
7. Donald A. Norman, "The design of everyday things", Basic books.
8. Rogers Sharp Preece,"Interaction Design:Beyond Human Computer Interaction" ,Wiley.
9. Guy A. Boy "The Handbook of Human Machine Interaction", Ashgate publishing Ltd.
10. Brian Fling, "Mobile Design and Development", First Edition , O'Reilly Media Inc., 2009.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE81B	Digital Forensic	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20	20	60	100			

Pre-requisite Course Codes	CE62 Cryptography and System Security
At the end of the course students will be able to	
Course Outcomes	CEE81B.1 Understand the fundamentals of Computer forensics
	CEE81B.2 Analyse the forensic problems and computing requirements appropriate to its solution.
	CEE81B.3 Apply appropriate forensics tools to acquire, preserve and analyze system.
	CEE81B.4 To summarize ethical, legal and security issues with social responsibilities.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		Digital Forensics Fundamentals		06
	1.1	<ul style="list-style-type: none"> Introduction to Forensics Computer – Facilitated Crimes 	1,2,3	
	1.2	<ul style="list-style-type: none"> Computer Forensics: Rules, Procedures and Legal Incident Response Methodology 	1,2,3	
2		Initial Response and forensic duplication		10
	2.1	Volatile Data Collection from Windows system <ul style="list-style-type: none"> Memory forensics Windows incident response tools 	1,2,3	
	2.2	Volatile Data Collection from Unix system <ul style="list-style-type: none"> Unix/Linux incident response tools 	1,2,3	
	2.3	Forensic duplication and Evidence Preservation <ul style="list-style-type: none"> File Systems Hard Drives Evidence Handling Challenges in evidence handling 	1,2	
3		Network Forensics and Mobile Forensics		10
	3.1	Network Forensics <ul style="list-style-type: none"> Intrusion detection and various attacks in network Analysis of network attacks Network Based Evidence- Routers Investigation, Email tracing, Internet Frauds 	1,5	
	3.2	Mobile Forensics	1,5,7	



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		<ul style="list-style-type: none"> • Components of mobile forensics • Blackberry, Android, iPhone, iPod Forensics 		
4		System investigation		08
	4.1	<ul style="list-style-type: none"> • Data Analysis Techniques • Investigating Live Systems (Windows & Unix) Investigating 	2,3	
	4.2	Hacker Tools <ul style="list-style-type: none"> • Hacker Tools • Various Hacker tools • Ethical issues 	2,3	
5		Legal Aspects		08
	5.1	Laws and privacy issues <ul style="list-style-type: none"> • Level of laws • Levels of culpability • Privacy Issues 	2,4	
	5.2	Level and burden of proof <ul style="list-style-type: none"> • Criminal versus civil cases • Vicarious liability • Laws related to computers: CFAA, DMCA, CAN Spam 	2,4	
			Total	42

References:

- [1] Kevin Mandia, Chris Prosis, "Incident Response and Computer forensics", Tata McGrawHill, 2006.
- [2] Nilakshi Jain, D. R. Kalbande, "Digital Forensic: The Fascinating World of Digital Evidences", Wiley publications, 2016.
- [3] Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999.
- [4] Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001.
- [5] Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses. Prentice Hall Professional Technical Reference. 2001.
- [6] Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000.
- [7] Soufiane Tahiri, "Mastering Mobile Forensics", Packt Publishing, 2016.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE82A	High Performance Computing	3	1	--	3	1	--	4
		Examination Scheme						
		ISE		MSE		ESE		Total
		20		20		60		100

Pre-requisite Course Codes	CE44, CE45, CE62	
At the End of the course students will be able to		
Course Outcomes	CEE82A.1	Understand the different parallel computing approaches and platforms to achieve High Performance Computing.
	CEE82A.2	Determine the communication pattern and network technology for High Performance Computing
	CEE82A.3	Design High Performance Computing System using MPI
	CEE82A.4	Design High Performance Computing System using OpenMP.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to Parallel and High Performance Computing: Motivating Parallelism, Scope of Parallel Computing	1,2	2
	1.2	Parallel Programming Platforms : Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Process-Processor Mapping and Mapping Techniques	2	6
2	2.1	Principles of Parallel Algorithm Design - Preliminaries , Decomposition Techniques, Characteristics of Tasks and Interactions	2	3
	2.2	Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	2	4
3	3.1	Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction	2,3	3
	3.2	All-Reduce and Prefix-Sum Operations, All-to-All Personalized Communication, Scatter and Gather, Circular Shift, Improving the Speed of Some Communication Operations	2	4
4	4.1	Analytical Modeling of Parallel Programs - Sources of Overhead	2	4



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		in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity on Performance		
	4.2	Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics	2	4
5	5.1	Message-Passing Paradigm – Principles of MPI, Building Blocks: Send and Receive Operations, Message Passing Interfaces, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators	2,4	6
	5.2	Shared Address Space Platforms - POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, OpenMP Programming Model	2,4	6
Total				42

References:

- [1] Kai Hwang, Naresh Jotwani, “*Advanced Computer Architecture: Parallelism, Scalability, Programmability*”, McGraw-Hill Education, SECOND Edition, 2008.
- [2] AnanthGrama, “*Introduction to Parallel Computing*”, Addison Wesley, SECOND Edition, 2003.
- [3] RajkumarBuyya, “*High Performance Cluster Computing: Architectures and Systems Volume I*”, Prentice Hall PTR, FIRST Edition, 1993.
- [4] Michael J. Quinn, “*Parallel Programming in C with MPI and OpenMP*”, McGraw Hill, FIRST Edition, 2003.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEE82B	Data Science	3	1	--	3	1	--	4
		Examination Scheme						
		ISE	MSE	ESE	Total	20	20	60

Pre-requisite Course Codes	CE53 Data Warehousing and Mining	
At the End of the course students will be able to		
Course Outcomes	CEE82B.1	Understand the foundations of the Data Science process, methods and techniques
	CEE82B.2	Apply mathematical models and tools for large-scale data analysis and reasoning
	CEE82B.3	Evaluate Data at Scale – Working with Big Data
	CEE82B.4	Exhibit the knowledge and techniques of Machine Learning and text analytics
	CEE82B.5	Visualize the information in different forms.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		Introduction to Data Science		08
	1.1	Data science process: Defining goal, retrieving data, pre-processing data, exploratory data analysis, model building and data visualization, Ethical issues in data science.	1,2	
	1.2	Probability: review of probability theory, normal distribution, Gaussian discriminant analysis: Linear discriminant analysis (LDA), Logistic regression: Bayesian logistic regression,	1,2	
2		Predictive and Descriptive Models		12
	2.1	Descriptive Modelling: Principal components analysis (PCA), singular value decomposition (SVD), probabilistic PCA, applying PCA to new data, PCA for data interpretation., EM algorithm for PCA, Independent Component Analysis (ICA), Maximum likelihood estimation using EM	2,3	
	2.2	Predictive Modeling: Predictive modeling process, supervised and unsupervised learning, parametric and nonparametric models, business intelligence, challenges in using predictive analytics	2,4	
	2.3	Introduction to time series analysis and time series mining, Introduction to spatio-temporal data, spatio-temporal model, fast dynamic time warping.	3,4,5	
3		Evaluation and Methodology of Data Science		04



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	3.1	Experimental setups, training, tuning, test data, holdout method, cross-validation, bootstrap method	1,4	
	3.2	Measuring performance of a model: Accuracy, ROC curves, precision-recall curves, loss functions for regression	1,4	
	3.3	Interpretation of results: Confidence interval for accuracy, hypothesis tests for comparing models, algorithms.	1,4	
4		Text Analytics and Machine Learning		10
	4.1	Introducing text mining, text mining techniques, Understanding Text Mining Process, Sentiment Analysis	10	
	4.2	Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application	8,9	
	4.3	Learning with Classification: Classification: Rule based classification, classification by Bayesian Belief networks, Hidden Markov Models. Support Vector Machine: Maximum Margin Linear Separators, Quadratic Programming solution to finding maximum margin separators, Kernels for learning non-linear functions	8,9	
5		Data Communication and Information Visualization		08
	5.1	Data Communication: cost Function, how to Minimize cost function, coefficients of determination.	2,4,6,7	
	5.2	Information visualization: effective information visualization, visual Encodings, perception of visual cues, data scales, visualizing time series data, data journalism, dashboards	2,4,6,7	
			Total	42

References:

- [1] Davy Cielen, Meysman, Mohamed Ali, "Introducing Data Science", Dreamtech Press
- [2] Kevin P. Murphy, "Machine Learning a Probabilistic Perspective", The MIT Press
- [3] Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
- [4] Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst", Wiley, 2014
- [5] Noel Cressie, Christopher K. Wikle, "Statistics for Spatio-Temporal Data", Wiley
- [6] Rachel Schutt and Cathy O'Neil, "Doing Data Science", O'Reilly Media
- [7] EMC Education Services, "Data Science and Big Data Analytics", Wiley
- [8] Peter Harrington "Machine Learning In Action", DreamTech Press
- [9] Ethem Alpaydm, "Introduction to Machine Learning", 3rd Edition, PHI



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[10] Jure Leskovec, AnandRajaraman, Jeffrey Ullman, "Mining Massive Datasets", Cambridge University Press, 2nd Edition.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL81A	Human Machine Interaction Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		-		-		40

Pre-requisite Course Codes	CPL501 (Web Technology), Basic knowledge of designing tools and languages like HTML, Java, etc.	
Course Outcomes	CEEL81A.1	To design user centric interfaces.
	CEEL81A.2	To design innovative and user friendly interfaces.
	CEEL81A.3	To apply HMI in their day-to-day activities.
	CEEL81A.4	To criticize existing interface designs, and improve them.
	CEEL81A.5	To Design application for social Task.
	CEEL81A.6	To Design application for Technical Tasks.

Exp. No.	Experiment Details	Ref.	Marks
1	Know your client <ol style="list-style-type: none"> Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. Design a site that can help people to sell their handmade products in metro cities. Design a site that can connect housewives and keep them engaged. 	1-10	5
2	Goal oriented design - Design an experience for passengers whose flight /train is delayed.	1-10	5
3	Design Principles - Understand principles of good UI design by heuristic evaluation. Design UI that would connect all college students to the events happening on-campus during the college festival. User should be able to browse all events sorted on time, category and place. The user should also be able to subscribe to events and get notified about their start time and also be able to send invites to friends to attend an event with them	1-10	5
4	Menus & Navigation – Redesign of a user interface (Suggest and	1-10	5



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	implement changes in Existing User Interface)		
5	Windows & Screen controls – a. Design a navigator for a student new in your Institute. b. Design a navigator for a person new in tourist city/ village. c. Motor paralysis for differently able people. d. ATM design with localization	1-10	5
6	Icons - Design appropriate icons pertaining to a given domain.(Eg. Greeting cards)	1-10	5
7	Colors – Design a personal website for an Artisan. Use statistical graphics for better visualization.	1-10	5
8	To calculate screen complexity of existing Graphical User Interface and redesign the interface to minimize the screen complexity.	1-10	5
Total Marks			40

References:

1. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale “Human Computer Interaction”, Prentice Hall.
2. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.
3. KalbandeDhananjay R,Kanade P.,Iyer S.,”Galitz’s Human Machine Interaction”,Wiley Publications.
4. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
5. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
6. Donald A. Normann, “ Design of everyday things”,Basic Books; Reprint edition 2002.
7. Donald A. Norman, “The design of everyday things”, Basic books.
8. Rogers Sharp Preece,”Interaction Design:Beyond Human Computer Interaction” ,Wiley.
9. Guy A. Boy “The Handbook of Human Machine Interaction”, Ashgate publishing Ltd.
10. Brian Fling, “Mobile Design and Development”, First Edition , O’Reilly Media Inc., 2009.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL81B	Digital Forensic Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CE62 (Cryptography and System Security) CEE81B (Digital Forensic)
At the End of the course students will be able to	
Course Outcomes	CEEL81B.1 Demonstrate current techniques, skills, and tools necessary for computing practice
	CEEL81B.2 Design and implement a computer-based system.
	CEEL81B.3 Analytics of forensic networking issues
	CEEL81B.4 Appreciate the difficulty of the task of a digital forensics analyst.

Exp. No.	Experiment Details	Ref.	Marks
1	Forensic Imaging of the evidence <ul style="list-style-type: none"> • FTK Imaging • Encase Imaging • Helix Imaging • Win hex Imaging • Write Blockers 	3,4	5
2	Forensic Analysis of the evidence <ul style="list-style-type: none"> • Configuring the tool • Analysis using FTK • Analysis using Encase • Recovering files • Bookmarking evidence • Keyword searching • Password cracking 	3,4	5
3	Steganography <ul style="list-style-type: none"> • Analysis on steganography • Tools for steganography 	1,2	5



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4	Networking <ul style="list-style-type: none">• DoS Attacks• SQL injection• Web defacement• Shell / backdoors	1,3	5
5	Email Crimes <ul style="list-style-type: none">• Email Tracing	1,3	5
6	Investigating Network & log <ul style="list-style-type: none">• IPS/IDS• Snorting• Gathering logs• Investigating logs• Investigating wireless access point• Auditing	1,3	5
7	Mobile Forensics <ul style="list-style-type: none">• Blackberry forensics• Android forensics• iPhone Forensics• iPod Forensics	7	5
8	Forensic Report Writing <ul style="list-style-type: none">• Report Samples• Report writing skills• Common mistakes in report• Report submission	6	5
Total Marks			40

References:

- [1] Kevin Mandia, Chris Prosis, "Incident Response and computer forensics", Tata McGrawHill, 2006
- [2] Nilakshi Jain, D. R. Kalbande, "Digital Forensic: The Fascinating World of Digital Evidences", Wiley publications, 2016.
- [3] Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999 [4] Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001
- [5] Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses. Prentice Hall Professional Technical Reference. 2001.
- [6] Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000
- [7] Bill Nelson, Amelia Philips and Christopher Stuart, "Guide to computer forensics investigation "Course technology, 4th edition
- [8] Soufiane Tahiri, "Mastering Mobile Forensics", Packt Publishing, 2016.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL82A	High Performance Computing Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CE44, CE45, CE62
At the End of the course students will be able to	
Course Outcomes	CEEL82A.1 Understand different parallel computing paradigms including memory passing, memory sharing, data-parallel and other approaches.
	CEEL82A.2 Understand the effects that issues of synchronization, latency and bandwidth have on the efficiency and effectiveness of parallel computing applications.
	CEEL82A.3 Develop an understanding of various basic concepts associated with parallel computing environments.

Exp. No.	Experiment Details	Ref.	Marks
1	Write a MPI Parallel Program to find all primes numbers less than N where N is large number [Use Sieve of Eratosthenes]	1	5
2	Write a MPI Parallel Program to find all shortest paths in a weighted graph with positive or negative edge weights (but with no negative cycles) [Use Floyd's Algorithm]	1	5
3	Write a MPI Parallel Program for Matrix Vector Multiplication	1,2	5
4	Write a MPI Parallel Program for Document Classification	1	5
5	Write a MPI Parallel Program for Matrix Multiplication	1	5
6	Write a MPI Parallel Program for Solving Linear Systems	1	5
7	Write a MPI Parallel Program for Finite Difference Methods	1,2	5
8	Write a MPI Parallel Program to arrange N records in descending order [Use Merge/Quick Sort Algorithm]	1	5
Total Marks			40

References:

- [1] Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw Hill, FIRST Edition, 2003
- [2] AnanthGrama, "Introduction to Parallel Computing", Addison Wesley, SECOND Edition, 2003.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEEL82B	Data Science Lab	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	CE53 (Data Warehousing and Mining)
At the End of the course students will be able to	
Course Outcomes	CEEL82B.1 Demonstrate prediction using Logistic Regression
	CEEL82B.2 Understand Dimensionality reduction techniques
	CEEL83B.3 Apply text analytics concepts on real datasets
	CEEL84B.4 Apply the concepts of sentiment analysis

Exp. No.	Experiment Details	Ref.	Marks
1	Implement Logistic Regression. Case Study: a) Estimating horse fatalities from colic- use logistic regression to try to predict if a horse with colic will live or die b) Credit Scoring- decision making process of accepting or rejecting a loan	1-7	5
2	Implement linear discriminant analysis	1-7	5
3	Implement principal component analysis	1-7	5
4	Implement Independent Component Analysis	1-7	5
5	Implementation of text analytics	1-7	5
6	Implement sentiment analysis	1-7	5
7	Mini Project	1-7	10
Total Marks			40

References:

- [1] Kevin P. Murphy, "Machine Learning a Probabilistic Perspective", The MIT Press
- [2] Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media
- [3] Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst", Wiley, 2014
- [4] Noel Cressie, Christopher K. Wikle , "Statistics for Spatio-Temporal Data, Wiley
- [5] Rachel Schutt and Cathy O'Neil, "Doing Data Science", O'Reilly Media
- [6] EMC Education Services,"Data Science and Big Data Analytics",Wiley
- [7] Peter Harrington "Machine Learning In Action", DreamTech Press



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
HSS81	Technology Entrepreneurship Lab	--	--	02	--	--	01	01
		Examination Scheme						
		ISE		MSE		ESE		Total
		40		--		--		40

Pre-requisite Course Codes	
After successful completion of the course, student will be able to,	
Course Outcomes	CO1 Identify problems worth solving
	CO2 Craft value proposition
	CO3 Prepare B-Plan
	CO4 Draft Patent
	CO5 Register virtual company

Expt. No.	Topics	Ref.	Marks
1	Opportunity Discovery 1.1 Self-discovery 1.2 Effectuation Principle 1.3 Identification of problem worth solving 1.4 Looking for solutions 1.5 Present the problem Assignment Submission : Effectuation case study	1	8
2	Value Proposition Canvas and Business Model 2.1 Craft your value proposition 2.2 Presentation of Value Proposition Canvas 2.3 Business Model and Lean Approach (Finance, Marketing, Operations) 2.4 Presentation of Lean Canvas Assignment Submission : Presentation of Value Proposition Canvas	2,3	8
3	Business Plan (4 hours) 3.1 Creation of Business Plan Assignment Submission : Presentation of Lean Canvas	4	8
4	Intellectual Property Rights 4.1 Trademark 4.2 Copyright 4.3 Design	5	8



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	4.4 Patent Assignment Submission : Patent Draft and registration form for Trademark, Copyright, Design and Patent		
5	Company Formation 5.1 Promoters, Capital, Shareholders 5.2 Directors, DIN 5.3 Company Name, Registrations 5.4 Branding Assignment Submission : Virtual Company registration	6	8
	Five Assignments Marks		40

References :

- [1] "Elements of Entrepreneurial Expertise (New Horizons in Entrepreneurship Series)" by SarasSarasvathym, Publisher : Edward Elgar Publishing.
- [2] "Business Model Generation :A Handbook for Visionaries, Game Changers, and Challengers" by Alexander Osterwalder
- [3] "Value Proposition Design: How to create Products and Services Customers Want" by Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadacos
- [4] "Writing Winning Business Plans" by Garrett Sutton. Publisher: RDA Press
- [5] "Patent Law" by P. Narayanan. Publisher :Eastern Law House, 1975.
- [6] "Company Law Procedures" by M.C. Bhandari, LexiNexis, 2018



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ABL 5: Financial Planning, Taxation Policies and Investment

Financial Planning: It is possible to manage income more effectively through financial planning. Managing income helps to understand how much money is required for tax payments, other expenditures and savings. It increases cash flows by carefully monitoring the spending patterns and expenses. Knowledge of comprehensive financial planning will help students to make right financial decisions in their life. It gives guidance in helping choose the right types of investments to fit needs, personality, and goals of their life. In this activity students need to prepare the financial plan for their life.

Taxation Policies: Taxes are levied in almost every country of the world, primarily to raise revenue for government expenditures, although they serve other purposes as well. The simple fact in economics is that there are certain common public goods and public needs that require some form of government and regulation to provide or promote. Taxation is the way to pay for these common goods. In this activity student will learn various types of taxes like Income tax, corporate tax, Capital gains, Property tax, Inheritance and Sales tax.

Investments: Investments are important because in today's world, just earning money is not enough. But that may not be adequate to lead a comfortable lifestyle or fulfil our dreams and goals. Money lying idle in the bank account is an opportunity lost. Therefore students should have a knowledge to invest money smartly to get good returns out of it. This activity will give insight to the students about investment in the form of Stocks, Mutual Funds, Fixed Deposits, Recurring Deposit, Public Provident Fund, **Employee Provident Fund and National Saving Schemes.**

Methodology: Guest lectures by professionals shall be arranged on Financial Planning, Taxation Policies and Investments. At least one session on each topic shall be taken. Assessment shall be based on performance in following activities:

1. Prepare financial plan
2. Filling of 'Income Tax Return' (Perquisite: Pan Card (if not available, student should apply for pan card))
4. Prepare investment plan



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELP81	Category I: Major Project I	--	--	10	--	--	5	5
		Examination Scheme						
		ISE		MSE	ESE		Total	
		Phase-I:40 Phase-II:40		--	20		100	

The main intention of Major Project is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem mainly addressing the issues of society, an industry or a research. These students have already undergone project assignment in their pre-final year. Therefore Major Project work may be based on the knowledge gained in the courses OR may be beyond the scope of curriculum of courses taken OR may be extension of the work done in Minor Project I and Minor Project II courses in pre-final year. The project area may be selected in which the student intend to do further education and/or may be either intending to have employment or self-employment. However thrust should be

- Learning additional skills, computational techniques.
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning till the development of final deliverable end product (Hardware/Software) OR research publication in a reputed Conference/Journal OR Patent.
- Learn the behavioral science by working in a group.

Students of final year are categorized as Category I (Internship) and Category II (Non-Internship) students. In final year these students groups will have to execute Major Projects. Execution and evaluation of Major Project will be done as Major Project I and Major Project II in respective semesters of Category I Category II students. If a Guide and a group of students of a particular Major Project wish then they can continue the work done as Major Project I and Major Project II in respective semesters as a part of Major Project. Execution and evaluation of Major Project will be done as per the BE Project Process developed at Institute level. The details of this process are available in Project Log Book.

At the end of Sem VI; students are required to finalize whether they wish to opt Category I (Internship) OR Category II (Non-Internship). Since these are separate group of students; students are required to form a BE Project Group within the category they have opted for. In order for the smooth execution and evaluation of Major Project; formation of a BE Project Group from students belonging to different categories will not be allowed at any circumstances. However in order to promote execution of interdisciplinary project; students from different departments but from the same category may execute the Major Project after the approval/agreement from respective Guides. Evaluation of these Project Groups will however be done on the basis of the work assigned to them OR their project objectives. A BE Project group of maximum three students will be allowed. Each project group will be completing a comprehensive project work based on the knowledge acquired



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from the courses studied. Each group will be assigned one faculty as a Guide as per Department policies.

The project work will be internally evaluated in Phases (Phase I and Phase II) by the Expert Groups in the Department consisting of Guide and a domain expert faculty based on Scheme of examination for ISE Marks and on the basis of rubrics defined for each Phase of evaluation as per following but not limited to:

- Scope and objectives of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment).
- Design, implementation, and analysis of the project work*.
- Results, conclusions and future scope*.
- Report in prescribed format*.

(*if Major Project I and II are separate)

In order to keep proper evaluation record of the progress of project in the department; each BE Project Group should submit soft copy of report (approved by respective Guide) in the prescribed format of the Department before each phase of evaluation for ISE marks and one hard copy of the Report duly signed by respective Guide in prescribed format for ESE marks to Project co-ordinator.

For ESE Marks; an approved external examiner will assess the Major Project during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. Each individual student should be assessed for his/her contribution, understanding and knowledge gained, the rubrics defined by department and Report in prescribed format for the awards of ISE and ESE marks.



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		L	T	P	L	T	P	Total
ELP71	Category I: Major Project II	--	--	10	--	--	5	5
		Examination Scheme						
		ISE		MSE	ESE	Total		
		Phase-III:40 Phase-IV:40		--	20	100		

The final year students have already under gone first stage of Major Project I work in their respective semesters and in this semester students are expected to continue the project work of stage I.

The project work will be internally evaluated in Phases (Phase III and Phase IV) by the Expert Groups in the Department consisting of Guide and a domain expert faculty based on Scheme of examination for ISE Marks. There will be Technical Paper Presentation (TPP) event conducted by R&D Cell and Project Exhibition (PE) event conducted by respective Departments as per the academic time table. Participation in these activities is mandatory. After evaluation Winners will be declared from TPP and PE events separately as per the rubrics, rules and regulations framed by R&D Cell and Department respectively however ISE marks are not allotted for these activities.

In order to keep proper evaluation record of the progress of project in the department; each BE Project Group should submit soft copy of report (approved by respective Guide) in the prescribed format of the Department before each phase of evaluation for ISE marks and one hard copy of the Report duly signed by respective Guide in prescribed format for ESE marks to Project co-ordinator.

The department should keep proper evaluation record of the progress of project and at the end of the semester it should be assessed for awarding ISE marks. The ISE Marks should be examined by approved internal faculty appointed by the head of Department on the basis of rubrics defined for each Phase of evaluation as per following but not limited to:

- Scope and objectives of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Design, implementation, and analysis of the project work.
- Results, conclusions and future scope.
- Report in prescribed format.

For ESE Marks; an approved external examiner will assess the Major Project during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done.

Each individual student should be assessed for his/her contribution, understanding and knowledge gained and the rubrics defined by department for awarding ISE and ESE marks.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELP71	Category II: Major Project I	--	--	10	--	--	5	5
		Examination Scheme						
		ISE		MSE		ESE		Total
		Phase-I:40 Phase-II:40		--		20		100

The main intention of Major Project is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem mainly addressing the issues of society, an industry or a research. These students have already undergone project assignment in their pre-final year in Minor Project I & Minor Project II courses. Therefore Major Project work may be based on the knowledge gained in the courses OR may be beyond the scope of curriculum of courses taken OR may be extension of the work done in Minor Project I and Minor Project II courses in pre-final year. The project area may be selected in which the student intend to do further education and/or may be either intending to have employment or self-employment. However thrust should be

- Learning additional skills, computational techniques.
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning till the development of final deliverable end product (Hardware/Software) OR research publication in a reputed Conference/Journal OR Patent.
- Learn the behavioral science by working in a group.

Students of final year are categorized as Category I (Internship) and Category II (Non-Internship) students. In final year these students groups will have to execute Major Projects. Execution and evaluation of Major Project will be done as Major Project I and Major Project II in respective semesters of Category I Category II students. If a Guide and a group of students of a particular Major Project wish then they can continue the work done as Major Project I and Major Project II in respective semesters as a part of Major Project. Execution and evaluation of Major Project will be done as per the BE Project Process developed at Institute level. The details of this process are available in Project Log Book.

At the end of Sem VI; students are required to finalize whether they wish to opt Category I (Internship) OR Category II (Non-Internship). Since these are separate group of students; students are required to form a BE Project Group within the category they have opted for. In order for the smooth execution and evaluation of Major Project; formation of a BE Project Group from students belonging to different categories will not be allowed at any circumstances. However in order to promote execution of interdisciplinary project; students from different departments but from the same category may execute the Major Project after the approval/agreement from respective Guides. Evaluation of these Project Groups will however be done on the basis of the work assigned to them OR their project objectives. A BE Project group of maximum three students will be allowed. Each project group will be completing a comprehensive project work based on the knowledge acquired



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from the courses studied. Each group will be assigned one faculty as a Guide as per Department policies.

The project work will be internally evaluated based on Scheme of examination for ISE Marks in Phases (Phase I and Phase II) by the Expert Groups in the Department consisting of Guide and a domain expert faculty.

The department should keep proper evaluation record of the progress of project and at the end of the semester it should be assessed for awarding ISE marks. The ISE Marks should be examined by approved internal faculty appointed by the head of the institute on the basis of rubrics defined for each Phase of evaluation as per following but not limited to:

- Scope and objectives of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Design, implementation, and analysis of the project work*.
- Results, conclusions and future scope*.
- Report in prescribed format*.

(*if Major Project I and II are separate)

For ESE Marks; an approved external examiner will assess the Major Project during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. Each individual student should be assessed for his/her contribution, understanding and knowledge gained and the rubrics defined by department for the awards of ISE and ESE marks.



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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ELP81	Category II: Major Project II	--	--	10	--	--	5	5
		Examination Scheme						
		ISE		MSE	ESE		Total	
		Phase-III:40 Phase-IV:40		--	20		100	

The final year students have already under gone first stage of Major Project I work in their respective semesters and in this semester students are expected to continue the project work of stage I.

The project work will be internally evaluated in Phases (Phase III and Phase IV) by the Expert Groups in the Department consisting of Guide and a domain expert faculty based on Scheme of examination for ISE Marks. There will be Technical Paper Presentation (TPP) event conducted by R&D Cell and Project Exhibition (PE) event conducted by respective Departments as per the academic time table. Participation in these activities is mandatory. After evaluation Winners will be declared from TPP and PE events separately as per the rubrics, rules and regulations framed by R&D Cell and Department respectively however ISE marks are not allotted for these activities.

In order to keep proper evaluation record of the progress of project in the department; each BE Project Group should submit soft copy of report (approved by respective Guide) in the prescribed format of the Department before each phase of evaluation for ISE marks and one hard copy of the Report duly signed by respective Guide in prescribed format for ESE marks to Project co-ordinator.

The department should keep proper evaluation record of the progress of project and at the end of the semester it should be assessed for awarding ISE marks. The ISE Marks should be examined by approved internal faculty appointed by the head of Department on the basis of rubrics defined for each Phase of evaluation as per following but not limited to:

- Scope and objectives of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Design, implementation, and analysis of the project work.
- Results, conclusions and future scope.
- Report in prescribed format.

For ESE Marks; an approved external examiner will assess the Major Project during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done.

Each individual student should be assessed for his/her contribution, understanding and knowledge gained and the rubrics defined by department for awarding ISE and ESE marks.