VISVESVARAYATECHNOLOGICALUNIVERSITYBELAGAVI

SchemeofTeachingandExaminationsandSyllabus
M.Techin Artificial Intelligence and Data Science (SAD)
(EffectivefromAcademicyear2021-22)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2021 - 22
M.Tech in Artificial Intelligence and Data Science (SDS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER

SL. No.	Course	CourseCode	CourseTitle	TeachingHours/Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development	Durations in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SAD11	MathematicalFoundations ofComputerScience	03	--	02	03	40	60	100	4
2	PCC	20SAD12	Data Science	03	--	02	03	40	60	100	4
3	PCC	20SAD13	Artificial Intelligence	03	--	02	03	40	60	100	4
4	PCC	20SAD14	Predictive Analytics	03	--	02	03	40	60	100	4
5	PCC	20SAD15	Data acquisition and Productization	03	--	02	03	40	60	100	4
6	PCC	20SADL16	Artificial Intelligence and DataScienceLaboratory	--	04	--	03	40	60	100	2
7	PCC	21RMI17	ResearchMethodologyandIPR	01	--	02	03	40	60	100	2
			TOTAL	**16**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Profession Core, PEC

1. **Note: PCC: Profession Core**

Skilldevelopmentactivities:

Studentsandcourseinstructor/stoinvolveeitherindividuallyorin groupstointeracttogethertoenhancethelearningand applicationskills.Thestudentsshould interact withindustry (small,mediumandlarge),understand theirproblems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative andinnovative methodsto solvetheidentified problem.Thestudentsshall

GainconfidenceinModeling ofsystemsandalgorithms.

Work on different software/s (tools) to Simulate, analyze and authenticate theoutput to interpret andconclude. Operate the simulated system under changed parameter conditions to study the system withrespect to thermalstudy,transientandsteadystateoperations,etc.

Handleadvancedinstrumentstoenhancetechnicaltalent.

Involveincasestudiesandfieldvisits/fieldwork.

Accustomwiththeuseofstandards/codesetc.,tonarrowthegapbetweenacademiaandindustry.

Allactivitiesshouldenhancestudent'sabilitiestoemploymentand/orself-employmentopportunities,managementskills,Statisticalanalysis,fiscalexpertise,etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and IIsemesters and /or II and III semesters. A University examination shall be conducted during III semester and theprescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shallbe considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail ininternshipcourseandhavetocompletethesameduringthesubsequentUniversityexaminationaftersatisfyingthe internshiprequirements.

Note:

(i)Fourcreditcoursesaredesignedfor50hoursTeaching–Learningprocess.

(ii)Threecreditcoursesaredesignedfor40hoursTeaching–Learningprocess.

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Scheme of Teaching and Examinations – 2021 – 22
M.Tech in Artificial Intelligence and Data Science (SAD)
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II SEMESTER

SL. No.	Course	CourseCode	CourseTitle	Teaching Hours/ Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Durations in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SAD21	Advanced Artificial Intelligence	03	--	02	03	40	60	100	4
2	PCC	20SAD22	Information Retrieval	03	--	02	03	40	60	100	4
3	PCC	20SAD23	Data Visualization	03	--	02	03	40	60	100	4
4	PEC	20SAD24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20SAD25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20SADL26	Visualization of Data and Mini Project Lab	--	04	--	03	40	60	100	2
7	PCC	20SAD27	Technical Seminar	--	02	--	--	100	--	100	2
			TOTAL	**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Profession Core, PEC: Professional Elective Course

Professional Elective-1		Professional Elective-2	
Course Code 20SAD24X	CourseTitle	Course Code 20SAD25X	CourseTitle
20SAD241	Managing Big Data	20SAD251	Data Security and Privacy
20SAD242	Natural Language Processing	20SAD252	Time Series Analysis and Forecasting
20SAD243	Soft and Evolutionary Computing	20SAD253	Applied Social Network Analysis
20SAD244	Pattern Recognition	20SAD254	Image and Video Analytics

Note:

1. **Technical Seminar:** CIE marks shall be awarded by a committee comprising of HoD as Chairman,

Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of theprogramshallbemandatory.The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, PresentationskillandperformanceinQuestion-and-Answer sessionintheratio50:25:25.

2. **Internship:** All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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Scheme of Teaching and Examinations – 2021 - 22
M.Tech in Artificial Intelligence and Data Science (SAD)
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IIISEMESTER

SL. No.	Course	Course Code	CourseTitle	TeachingHours/Week			Examination				Credits
				Theory	Practical/Seminar	SkillDevelopmentActivity	Duration inHours	CIEMarks	SEEMarks	TotalMarks	
1	PCC	20SAD31	Deep Learning	03	--	02	03	40	60	100	4
2	PEC	20SAD32X	Professionalelective3	04	--	--	03	40	60	100	3
3	PEC	20SAD33X	Professionalelective4	04	--	--	03	40	60	100	3
4	Project	20SAD34	Projectworkphase-1	--	02	--	--	100	--	100	2
5	PCC	20SAD35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20SADI36	Internship	(Completed during the intervening vacation of I and II semesters and / or II and III semesters)			03	40	60	100	6
			TOTAL	11	04	02	12	360	240	600	20

Note:PCC:ProfessionCore,PEC:ProfessionalElectiveCourse

ProfessionalElective-3		ProfessionalElective-4	
Course Code20SDS33X	CourseTitle	Course Code20SDS34X	CourseTitle
20SAD321	Business Analytics	20SAD331	Blockchain Technology
20SAD322	Cyber security and Cyber Law	20SAD332	Supply Chain Management
20SAD323	Cloud Computing for Data Analysis	20SAD333	Spatial Data Analysis
20SAD324	Data Stream Mining	20SAD334	Health Care Data Analytics

Note:

1. **Project Work Phase-1:** Students in consultation with the guide/co-guide if any, shall pursue literature survey andcomplete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory projectdocumentand presenta seminar.CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior facultyof the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report,ProjectPresentationskillandQuestionandAnswersessionintheratio50:25:25.SEE(Universityexamination)shallbeasper the University norms.

2. **Internship:** Those, who have not pursued /completed the internship shall be declared as fail in internship course andhavetocompletethesameduringsubsequentUniversityexaminationsaftersatisfyingtheinternshiprequirements. InternshipSEE(Universityexamination)shallbeaspertheUniversitynorms.

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IVSEMESTER

SL. No.	Course	CourseCode	CourseTitle	Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	Credits
				Teaching Hours/ Week			Examination				
1	Project	20SAD41	Projectworkphase2	--	04	03	03	40	60	100	20
	TOTAL			**--**	**04**	**03**	**03**	**40**	**60**	**100**	**20**

Note:

ProjectWorkPhase-2:

CIEmarksshallbeawardedbyacommitteecomprisingofHoDasChairman,Guide/co-guide,ifany,andaSeniorfacultyof the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Reportsubjectedtoplagiarismcheck,ProjectPresentationskillandQuestionandAnswersessionintheratio50:25:25.

SEEshallbeattheendofIVsemester.Projectworkevaluationand Viva-Voceexamination(SEE),aftersatisfyingtheplagiarismcheck,shallbeas pertheUniversitynorms.

SEMESTER–I			

MATHEMATICALFOUNDATIONOFCOMPUTERSCIENCE			
CourseCode	**20SAD11**,20SDS11,20LNI11,20SCS11,20SCE11,20SFC11,20SCN11,20SSE11,20SIT11,20SAM11,20SIS11	CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

VectorSpaces: Vectorspaces;subspacesLinearlyindependentanddependentvectorsBasisanddimension;coordinatevectors-Illustrativeexamples.Lineartransformations,Representationoftransformationsbymatrices;

(RBTLevels:**L1&L2)**(Textbook:1)

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonalbases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems,applicationstolinearmodels(leastsquarelinesandleastsquarefittingofothercurves).

(RBTLevels:**L2&L3)**(Textbook:1)

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, TheSingular value decomposition.Applications to image processing and statistics, Principal ComponentAnalysis

(RBTLevels:**L2&L3)**(Textbook:1)

Module-4

StatisticalInference:Introductiontomultivariatestatisticalmodels:CorrelationandRegressionanalysis,Curvefitting(Linear andNon-linear)

(RBTLevels:**L2&L3)**(Textbook:3)

Module-5

ProbabilityTheory: Randomvariable(discreteandcontinuous),Probabilitymassfunction(pmf),Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by t-test,3^2-test.

(RBTLevels:**L1&L2)**(Textbook:3)

CourseOutcomes:

Oncompletionofthiscourse,studentsareableto:

1. Understandthenumericalmethodstosolveandfindtherootsoftheequations.
2. Applythetechniqueofsingularvaluedecompositionfordatacompression,leastsquareapproximationinsolvinginconsistentlinearsystems
3. Understandvectorspacesandrelatedtopicsarisinginmagnificationandrotationofimages.

4. Utilizethestatisticaltoolsinmultivariabledistributions.
5. UseprobabilityformulationsfornewpredictionswithdiscreteandcontinuousRV's.

QuestionPaperPattern:
- TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60
.
- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionconsistingof20marks
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbooks:

Sl. No	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	LinearAlgebraanditsApplications	DavidC.Lay,StevenR.LayandJ.J.McDonald	Pearson EducationLtd	5th Edition2015.
2	NumericalmethodsforScientificandEngineeringComputation	MKJain,S.R.K Iyengar,RK.Jain	NewAge International	6th Edition2014
3	Probability,StatisticsandRandomProcess	T.Veerarajan	TataMc-GrawHill Co	3rd Edition2016

Reference Books

1	Optimization:Theory& ApplicationsTechniques	Rao.S.S	WileyEasternLtd NewDelhi.	
2	Signals,Systems,andInference	AlanV.Oppenheim and George C.Verghese	Spring	2010
3	FoundationMathematicsfor ComputerScience	JohnVince	Springer International	

M.TECHINARTIFICIAL INTELLIGENCE AND DATA SCIENCE (SAD)
ChoiceBasedCreditSystem(CBCS)andOutcomeBasedEducation(OBE)

SEMESTER–I			
DATASCIENCE			
CourseCode	**20SAD12,**20SDS12,20SCS21,20SAM14, 20SIS22	CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Whynow? – Datafication, Current landscape of perspectives, Skill sets. NeededStatistical Inference:Populationsandsamples,Statisticalmodelling,probabilitydistributions,fittingamodel,-IntroductiontoR.

Text Book 1: Chapter 1

Module-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summarystatistics)ofEDA,PhilosophyofEDA,TheDataScienceProcess,CaseStudy:RealDirect(onlinerealestatefirm).ThreeBasicMachineLearningAlgorithms:LinearRegression,k-NearestNeighbours(k-NN),k-means.

Text Book 1: Chapter 2

Module-3

OneMoreMachineLearningAlgorithmandUsageinApplications:Motivatingapplication:FilteringSpam,WhyLinearRegressionandk-NNarepoorchoicesforFilteringSpam,NaiveBayesandwhyitworksforFilteringSpam,DataWrangling:APIsandothertoolsforscrappingtheWeb.

Text Book 1: Chapter 7

Module-4

FeatureGenerationandFeatureSelection(ExtractingMeaningfromData):Motivatingapplication:user(customer) retention. Feature Generation (brainstorming, role of domain expertise, and place forimagination),FeatureSelectionalgorithms.Filters;Wrappers;DecisionTrees;RandomForests.RecommendationSystems:BuildingaUser-FacingDataProduct,AlgorithmicingredientsofaRecommendationEngine,DimensionalityReduction,SingularValueDecomposition,Principal ComponentAnalysis,Exercise:buildyourownrecommendationsystem.

Text Book 2: Chapter 6

Module-5

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery ofcommunitiesingraphs,Partitioningofgraphs,Neighbourhoodpropertiesingraphs,DataVisualization:Basicprinciples,ideasandtoolsfordatavisualization.DataScienceandEthicalIssues,Discussionsonprivacy,security,ethics,Next-generationdatascientists.

Text Book 1: Chapter 8

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Definedatascienceanditsfundamentals
- Demonstratetheprocessindatascience
- Explainmachinelearningalgorithmsnecessaryfordatasciences
- Illustratetheprocessoffeatureselectionandanalysisofdataanalysisalgorithms
- Visualizethedataandfollowofethics

Questionpaperpattern:

TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	DoingDataScience	CathyO'Neiland RachelSchutt	O'Reilly Media, Inc	2013
2	MiningofMassiveDatasets.	AnandRajaraman andJeffreyD. Ullman	CambridgeUniversityPress	2010

Reference Books

1	MachineLearning:AProbabilisticPerspective	KevinP.Murphy	MIT Press	2013
2	Data Mining:ConceptsandTechniques	JiaweiHan,MichelineKamberandJian Pei	Elsevier	2011.
3	PracticalStatisticsforDataScientists	PeterBruceand AndrewBruce	O'Reilly Media, Inc	2017

SEMESTER–I				
ARTIFICIAL INTELLIGENCE				
CourseCode	**20SAD13**		CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2		SEEMarks	60
Credits	04		ExamHours	03

Module-1

What is artificial intelligence?, Intelligent agents, solving problems by searching, Beyond classical search

TB1: chapter 1,2,3,4

Module-2

Adversarial search, Constraint satisfaction Problem

TB1: chapter 5,6

Module-3

Logical Agents, First Order Logic,

TB1: chapter 7,8

Module-4

Inference in first Order Logic, Classical Planning

TB1: chapter 9, 10

Module-5

Planning and acting in the real world, Knowledge representation

TB1: chapter 11 ,12

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Use AI principals to solve real world problems

- Understand representation of knowledge in different techniques

Questionpaperpattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.

- Each full question is for 20 marks.

- There will be two full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub question covering all the topics under a module.

- The students will have to answer five full questions, selecting one full question from each module

Text Books

Sl.No	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Artificial Intelligence: A Modern Approach	Stuart Rusell, Peter Norving	Pearson Education	3rd ed

ReferenceBooks

1	Artificial Intelligence	Elaine Rich, Kevin K and S B Nair	McGraw Hill Education	3rded, 2017

SEMESTER –I			
PREDICTIVE ANALYTICS			
CourseCode	**20SAD14,** 20SDS14	CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

Overview of Supervised Learning: Introduction, Variable Types and Terminology, Two Simple Approaches to Prediction:

Linear Methods for Regression and Classification: Introduction, Linear regression models and least squares, , Subset selection , Shrinkage Methods, A Comparison of the Selection and Shrinkage Methods, Linear Discriminant Analysis, Logistic regression.

Text Book 1:Chapters 2.1 – 2.3, 3.1 – 3.4, 3.6, 4.1, 4.3 – 4.4

Module-2

Model Assessment and Selection: Bias, Variance, and model complexity, The Bias-variance Decomposition, Optimism of the training error rate, Estimate of In-sample prediction error, The Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, Conditional or Expected Test Error.

Text Book 1:Chapters 7.1 – 7.7, 7.10 – 7.12

Module-3

Additive Models, Trees, and Related Methods: Generalized additive models, Tree-Based Methods,

Boosting and Additive Trees: Boosting Methods, Exponential Loss and AdaBoost, Example: Spam Data, Numerical Optimization via Gradient Boosting , Illustrations (California Housing , New Zealand Fish, Demographic Data)

Text Book 1: Chapters 9.1 – 9.2, 10.4, 10.8, 10.10, 10.13

Module-4

Neural Networks: Introduction, Fitting Neural Networks, Some Issues in Training Neural Networks

Support Vector Machines: Introduction, The Support Vector Classifier, Support Vector Machines and Kernels

Unsupervised Learning and Random forests: Association rules, Cluster analysis, Details of Random Forests, Random forests and analysis.

Text Book 1: Chapters 11.1, 11.3 – 11.5, 12.1 – 12.3, 14.1 – 14.3, 15.1 – 15.4

Module-5

Assessing Performance of a classification Algorithm (t-test, McNemar's test, Paired t-test, F-test), Analysis of Variance, Creating data for analytics through designed experiments.

Text Book 2: Chapter 19

Course outcomes:

At the end of the course the student will be able to:

- Apply Regression and classification models to solve real world problems
- Identify and analyze different analytical models
- Identify and apply Additive models to different data science related problems
- Apply Supervised and Unsupervised learning techniques
- Choose appropriate assessment evaluation criterion for different analytical methods

Question paper pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	The Elements of Statistical Learning-Data Mining, Inference, and Prediction	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	2009
2	Introduction to Machine Learning	E. Alpaydin	PHI	2010

ReferenceBooks

1	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	2007
2	All of statistics	L.Wasserman	Springer	2004
3	An Introduction to statistical learning with applications in R	G. James, D. Witten, T. Hastie, R. Tibshirani	Springer	2017

SEMESTER–I			
DATA ACQUISITION AND PRODUCTIZATION			
CourseCode	**20SAD15,** 20SDS15	CIEMarks	40
TeachingHours/ Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

Introduction to Data Warehouse- OLTP and OLAP concepts, Introduction to Data Mining- Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Exploratory Data analysis, Measuring Data Similarity and Dissimilarity, Graphical representation of data.

Text Book 1: Chapter 4

Text Book 2: Chapter 1

Module-2

Introduction to Data Acquisition, Applications, Process, Data Extraction, Data Cleaning and Annotation, Data Integration, Data Reduction, Data Transformation, Data Discretization and Concept Hierarchy Generation.

Text Book 1: Chapter 3

Module-3

Visualization-Introduction, Terminology, Basic Charts and Plots- Multivariate Data Visualization, Data Visualization Techniques, Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations, Data Visualization Tools, Rank Analysis Tools, Trend Analysis Tools, Multivariate Analysis Tools, Distribution Analysis Tools, Correlation Analysis Tools, Geographical Analysis Tools.

Text Book 1: Chapter 2

Module-4

IoT Overview, IoT Design methodology, Semantic Web Infrastructure, Intelligence Applications, Programming Framework for IoT, Distributed Data Analysis for IoT, Security and Privacy in IoT, Applied IoT, Cloud Based Smart Facilities Management.

Text Book 3: Chapter 2, 5

Module-5

Virtualization on Embedded Boards IoT, Stream Processing in IoT, Internet of Vehicles and Applications, Case study on Data Acquisition using Dashboards, Android and iOS apps.

Text Book 3: Chapter 8, 9

Courseoutcomes: Attheendofthecoursethestudentwillbeableto:

- Apply of data pre-processing, extraction, cleaning, annotation, integration on data.
- Apply the suitable visualization techniques to output analytical results.

- Explore on applications using Internet of things.

Questionpaperpattern: TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestion isfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

Sl.No.	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Data mining: concepts and techniques	Jiawei Han, Jian PeiMichelineKamber	Elsevier	3rdEdition, 2011.
2	Data Mining: Introductory and Advanced Topics	Margaret H. Dunham	Pearson Education	2012
3	Internet of Things -A hands-on approach	ArshdeepBahga, Vijay Madisetti	Universities Press	2015

Reference Books

1	Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for Linux Programmers	Manoel Carlos Ramon	Apress	2014
2	Learning Qlikview Data Visualization	Karl Pover	Packt	2013
3	Internet of Things: Principles and Paradigms	RajkumarBuyya, Amir VahidDastjerdi	Elsevier	2016

SEMESTER – I			
ARTIFICIAL INTELLIGENCE AND DATASCIENCELAB			
Course Code	**20SADL16**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

The purpose of this laboratory is to get you acquainted with Python/R and use them in implementing Data Science and Algorithms.

- **Citybik.es**

Citybik.es is a website that offers an Application Programming Interface (or API, for short) for the usage of bike-sharing services throughout the world. Among the others, data for one of Turin's bike sharing system is available. The information available is at a "station" granularity. This means that all the data available regards the bike stations: some of the useful information available is the station name, its position (in terms of latitude and longitude), the number of available bikes and the number of free docks. The data is offered in near real-time (i.e. it is updated every 15-30 minutes).

The API endpoint to request the data about for the Bike service is the following: http://api.citybik.es/v2/networks/to-bike. This dataset is in the JSON (JavaScript Object Notation) format.

- **MNIST**

The MNIST dataset is another particularly famous dataset as CSV file. It contains several thousands of hand-written digits (0 to 9). Each hand-written digit is contained in a 28×28 8-bit grayscale image. This means that each digit has 784 (28^2) pixels, and each pixel has a value that ranges from 0 (black) to 255 (white). The dataset can be downloaded from the following URL: https://raw.githubusercontent.com/dbdmg/data-science-lab/master/datasets/mnist_test.csv. Each row of the MNIST datasets represents a digit. For the sake of simplicity, this dataset contains only a small fraction (10,000 digits out of 70,000) of the real MNIST dataset, which is known as the MNIST test set. For each digit, 785 values are available.

Exercises

1. Implement A* Search algorithm.

2. Implement AO* Search algorithm.

3. **Citybik.es dataset**

Load the Citybik.es dataset as a Python dictionary. Use of the json module. Count and print the number of active stations (a station is active if its extra.status field is "online"). Count and print the total number of bikes available (field free_bikes) and the number of free docks (field empty_slots) throughout all stations. Given the coordinates (latitude, longitude) of a point (e.g. 45.074512, 7.694419), identify the closest bike station to it that has available bikes. For computing the distance among two points (given their coordinates), you can use the function distance_coords() defined in the code snippet below (which is an implementation of the great-circle distance):

from math import cos, acos, sin defdistance_coords(lat1, lng1, lat2, lng2):

"""Compute the distance among two points.""" deg2rad = lambda x: x * 3.141592 / 180

lat1, lng1, lat2, lng2 = map(deg2rad, [lat1, lng1, lat2, lng2])

R = 6378100 # Radius of the Earth, in meters

return R * acos(sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lng1 - lng2))

4. **MNIST dataset**

Load the MNIST dataset. Create a function that, given a position $1 \le k \le 10,000$, prints the kthdigit of the dataset (i.e. thekthrow of the csv file) as a grid of 28×28 characters. More specifically, you should map each range of pixel values to the following characters:

$[0, 64) \rightarrow$ " "

$[64, 128) \rightarrow$ "."

$[128, 192) \rightarrow$ "*"

$[192, 256) \rightarrow$ "#"

Compute the Euclidean distance between each pair of the 784-dimensional vectors of the digits at the following positions: 26th, 30th, 32nd, 35th. Based on the distances computed in the previous step and knowing that the digits listed are 7, 0, 1, 1, can you assign the correct label to each of the digits?

5. Tips dataset

Read the dataset "Tips.csv" as a dataframe "Data". Extract the columns in the following sequence - Time,TotalBill, Tips. Plot a histogram for the variable 'TotalBill' to check which range has the highest frequency. Draw bar chart for the variable "Day". Identify the category with the maximum count. Demonstrate the datadistributions using box, scatter plot, histogram, and bar chart on iris dataset. Demonstrate the correlation plot oniris dataset and perform exploratory visualization giving an overview of relationships   among data   withcovarianceanalysis.

6. Split the Iris dataset into two the datasets - IrisTest_TrainData.csv, IrisTest_TestData.csv.Read them as two separate data frames named Train_Data and Test_Data respectively.

Answer the following questions:

   a) How many missing values are there in Train_Data?
   b) What is the proportion of Setosa types in the Test_Data?
   c) What is the accuracy score of the K-Nearest Neighbor model (model_1) with 2/3 neighbors using Train_Data and Test_Data?
   d) Identify the list of indices of misclassified samples from the 'model_1'.
   e) Build a logistic regression model (model_2) keeping the modelling steps constant. Find the accuracy of the model_2

6. Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining.

7. For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable „mpg" (Miles per gallon)

8. Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine-learning-databases/iris/ or the inbuilt iris dataset) using sklearn.Train the model with the following hyperparameter C = 1e4 and report the best classification accuracy.

9. Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBF-kernel, gamma=0.5, onevs-rest classifier, no-feature-normalization. Also try C=0.01,1,10C=0.01,1,10. For the above set of hyperparameters,

find the best classification accuracy along with total number of support vectors on the test data.

10. Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:

K – means Clustering

Single – link Hierarchical Clustering

Complete link hierarchical clustering. Also visualize the dataset and which algorithm willbe able to recover the true clusters.

Courseoutcomes:

Attheendofthiscoursethestudentswillbeableto:

- Demonstrate proficiency with statistical analysis of data.
- Illustrate the ability to build and assess data-based models.
- Optimize the data using Classifiers.
- Apply clustering algorithms and logistic regressions on data sets.
- Apply kernel techniques on datasets.

ConductionofPracticalExamination:

- Alllaboratoryexperiments(nos)aretobeincludedforpracticalexamination.

Evaluation:

- Studentsareallowedtopickoneexperimentfromthelist.
- Strictlyfollowtheinstructionsasprintedonthecoverpageofanswerscriptforbreakupofmarks
- Changeofexperimentisallowedonlyonceandmarksallottedtotheprocedureparttobemade Zero.

SEMESTER–I

RESEARCHMETHODOLOGYANDIPR (ProfessionalCoreCourse)and(CommontoallM.TechProgrammes)			
Course Code	**21RMI17**	CIEMarks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEEMarks	60
Credits	02	Exam Hours	03

Courseobjectives:

- Togiveanoverviewoftheresearchmethodologyandexplainthetechniqueofdefiningaresearchproblem
- Toexplainthe functionsoftheliteraturereviewinresearch.
- To explain carrying out a literature search, its review, developing theoretical and conceptual

frameworksandwritinga review.

- Toexplainvariousresearchdesignsandtheircharacteristics.
- Toexplainthedetailsofsamplingdesigns,andalsodifferentmethodsofdatacollections.
- Toexplaintheartofinterpretationandtheartofwritingresearchreports.
- Toexplainvariousformsoftheintellectualproperty,itsrelevanceandbusinessimpactinthechangingglobalbusines senvironment.
- TodiscussleadingInternationalInstrumentsconcerningIntellectualPropertyRights.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation inResearch, Types of Research, Research Approaches, Significance of Research, Research Methodsversus Methodology, Research and Scientific Method, Importance of Knowing How Research isDone,ResearchProcess,CriteriaofGoodResearch,andProblemsEncounteredbyResearchersinIndia.

Text Book 1: Chapter 1

Module-2

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of DefiningtheProblem, TechniqueInvolvedinDefininga Problem,AnIllustration.

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus toyour research problem, Improving research methodology, Broadening knowledge base in researcharea, Enabling contextual findings,How to review the literature, searching the existing literature,reviewing the selectedliterature, Developing a theoretical framework, Developing a conceptualframework, Writingabouttheliterature reviewed.

Text Book 1: Chapter 2

Text Book 2: Chapter 3

Module-3

Research Design: Meaning of Research Design, Need for Research Design, Features of a GoodDesign,ImportantConceptsRelatingtoResearchDesign,DifferentResearchDesigns,BasicPrinciplesofExperiment al Designs, ImportantExperimentalDesigns.

Design ofSampleSurveys: Introduction,SampleDesign,SamplingandNon-samplingErrors,SampleSurveyversusCensusSurvey, TypesofSamplingDesigns.

Text Book 1: Chapter 3, 4

Module-4

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of SecondaryData, Selectionof AppropriateMethod for Data Collection,CaseStudyMethod. **InterpretationandReportWriting:**MeaningofInterpretation,TechniqueofInterpretation,Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report,Layout. **InterpretationandReportWriting(continued):**oftheResearchReport,TypesofReports,OralPresentation,Mechanics ofWritingaResearchReport,PrecautionsforWritingResearchReports.

Text Book 1: Chapter 6, 14

Module-5

IntellectualProperty: TheConcept,IntellectualPropertySysteminIndia,DevelopmentofTRIPS CompliedRegimeinIndia,PatentsAct,1970,TradeMarkAct,1999,TheDesignsAct,2000,TheGeographicalIndicationsof Goods(RegistrationandProtection)Act1999,CopyrightAct,1957,TheProtectionofPlantVarietiesandFarmers'RightsAct,2001,TheSemi-ConductorIntegratedCircuits LayoutDesignAct,2000,TradeSecrets,UtilityModels,IPRandBiodiversity,TheConventionon BiologicalDiversity(CBD)1992, CompetingRationalesforProtectionofIPRs,Leading InternationalInstrumentsConcerningIPR,WorldIntellectualPropertyOrganisation(WIPO),WIPO andWTO,ParisConventionfortheProtectionofIndustrialProperty,NationalTreatment,Rightof Priority,CommonRules,Patents,Marks,IndustrialDesigns,TradeNames,IndicationsofSource, UnfairCompetition,PatentCooperationTreaty(PCT), Advantages ofPCTFiling,BerneConventionfortheProtectionofLiteraryandArtisticWorks,BasicPrinciples,DurationofProtection,Trade RelatedAspectsofIntellectualPropertyRights(TRIPS)Agreement,CoveredunderTRIPS Agreement,FeaturesoftheAgreement,ProtectionofIntellectualProperty underTRIPS,Copyright andRelatedRights,Trademarks,Geographicalindications,IndustrialDesigns, Patents,Patentable SubjectMatter,RightsConferred,Exceptions,Term ofprotection,ConditionsonPatentApplicants, ProcessPatents,OtherUsewithoutAuthorizationoftheRightHolder Layout-Designsof IntegratedCircuits,ProtectionofUndisclosedInformation,EnforcementofIntellectualPropertyRights,UNSECO.

Courseoutcomes:

Attheendofthecoursethestudent willbeableto:

- Discussresearchmethodologyandthetechniqueofdefiningaresearchproblem
- Explainthefunctionsoftheliteraturereviewinresearch,carryingoutaliteraturesearch,developingtheoreticalandconceptualframeworksandwritingareview.
- Explainvariousresearchdesignsandtheircharacteristics.
- Explaintheartofinterpretationandtheartofwritingresearchreports

Questionpaperpattern:

Examinationwillbeconductedfor100markswithquestionpapercontaining10fullquestions,each of20 marks.

- Eachfullquestion canhaveamaximumof4subquestions.
- Therewillbe2fullquestionsfromeach module coveringallthetopicsofthemodule
- Studentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule
- Thetotalmarkswill beproportionallyreduced to60marksas SEEmarksis60

Text Books

Sl.No.	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Research Methodology: Methods and Techniques,	C.R. Kothari, Gaurav Garg	New Age International	4th Edition, 2018
2	Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2),	RanjitKumar,	SagePublications	3rd Edition, 2011
3	Study Material (For the topic Intellectual Property under	Professional Programme Intellectual	The Institute of Company Secretaries of	2013

	module 5)	Property Rights, Law and Practice,	India, Statutory Body Under an Act of Parliament,	
Reference Books				
1	ResearchMethods:theconciseknowledgebase	Trochim	AtomicDogPublishing	2005
2	Conducting Research Literature Reviews:Fromthe Internet to Paper.	FinkA	SagePublications	2009

SEMESTER–II			
ADVANCED ARTIFICIAL INTELLIGENCE			
CourseCode	**20SAD21**	CIEMarks	40
TeachingHours/Week (L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

Uncertain Knowledge and reasoning

Quantifying Uncertainty, Probabilistic reasoning,

TB1: Chapter 13 , 14

Module-2

Probabilistic reasoning over time, Making simple decision, Making complex decision

TB1 : chapter 15,16,17

Module-3

Learning from example, knowledge learning

TB1: Chapter 18, 19

Module-4

Learning probabilistic models, reinforcement Learning, Natural language processing

TB1: chapter 20,21,22

Module-5

Natural Language for communication, Perception

TB1: chapter 23, 24

CourseOutcomes:

Oncompletionofthiscourse,students should be able to:

- Design intelligent agents for problem solving, reasoning, planning, and decision making, and learning.

- Specific design and performance constraints, and when needed, design variants of existing algorithms.

- Apply AI technique on current applications.

- Problem solving, knowledge representation, reasoning, and learning.

Questionpaperpattern:

TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.

- Eachfullquestionisfor20marks.

- Therewillbetwofull questions)fromeachmodule.

- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.

- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Text Books

Sl.No.	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Artificial Intelligence: A Modern Approach	Stuart Rusell, Peter Norving	Pearson Education	3rd Edition

Reference Books

1	Principles of Artificial	Nils J. Nilsson		Elseveir	

2	Artificial Intelligence	Elaine Rich, Kevin K and S B Nair	McGraw Hill Education	3rd ed, 2017
	Intelligence			

SEMESTER–II			
INFORMATION RETRIEVAL			
Course Code	**20SAD22,** 20SSE243, 20SDS22	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Motivation, Basic concepts, Past, present, and future, The Retrieval Process.

Modeling: Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing.

Text Book 1: Chapter 1, 2

Module -2

RetrievalEvaluation: Introduction, Retrieval performance Evaluation, Reference collections.

Query Languages: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols.
Query Operations: Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.

Text Book 1: Chapter 3, 4, 5

Module – 3

Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup languages, Multimedia.
Text Operations: Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques.

Text Book 1: Chapter 6, 7

Module-4
User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting pints, Query specification, Context, Using relevance judgments, Interface support for the search process. **Searching the Web:** Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Findingthe needle in the haystack, Searching using hyperlinks.
Text Book 1: Chapter 10, 13
Module-5
Indexing and Searching: Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression.   **Parallel and Distributed IR:** Introduction, Parallel IR, Distributed IR.
Text Book 1: Chapter 8, 9
Course outcomes: At the end of the course the student will be able to:
- Upon completion of the course, the students will be ableto   - Build an Information Retrieval system using the availabletools   - Identify and design the various components of an Information Retrievalsystem   - Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval   - Analyze the Web content structure   - Design an efficient search engine
Question paper pattern: - The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.   - The question paper will have ten full questions carrying equalmarks.   - Each full question is for 20marks.   - There will be two full questions (with a maximum of four sub questions) from eachmodule.   - Each full question will have sub question covering all the topics under amodule.   - The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl.No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Modern Information Retrieval	Ricardo Baeza-Yates	Pearson	1999

Reference Books

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year

1	Information Retrieval Algorithms and Heuristics	David A. Grossman, OphirFrieder	Springer	2nd Edition 2004

SEMESTER– II

DATA VISUALIZATION			
CourseCode	**20SAD23,** 20SDS23	CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03

Module-1

What Is Visualization?, History of Visualization, Relationship between Visualization and Other Fields, The Visualization Process, Types of Data, Structure within and between Records, Data Preprocessing, Perception in Visualization, Metrics, The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables, Taxonomies.

Text Book1: Chapter 1.1 – 1.4, 2.1 – 2.3, 3.4 – 3.5, 4.1 – 4.3, 4.5

Module-2

Visualization Techniques for Spatial Data, Visualization Techniques for Geospatial Data, Visualization Techniques for Multivariate Data

Text Book1: Chapter 5.1 – 5.5, 6.1 – 6.5, 7.1 – 7.4

Module–3

Visualization Techniques for Time-Oriented Data, Visualization Techniques for Trees, Graphs, and Networks, Text and Document Visualization

Text Book1: Chapter 8.1 – 8.3, 9.1 – 9.6

Module-4

Interaction Concepts: Interaction Operators,Interaction Operands and Spaces,A Unified Framework,

Interaction Techniques: Screen Space, Object Space (3D Surfaces), Data Space (Multivariate Data Values), Attribute Space (Properties of Graphical Entities), Data Structure Space (Components of Data Organization), Visualization Structure Space (Components of the Data Visualization), Animating Transformations,

Designing Effective Visualizations: Steps in Designing Visualizations, Problems in Designing Effective Visualizations.

Text Book1: Chapter 10.1 – 10.3, 11.1 – 11.7, 12.1 – 12.2

Module-5

Comparing and Evaluating Visualization Techniques, Visualization Systems, Research Directions in Visualization

Text Book1: Chapter 13.1 – 13.7, 14.1 – 14.5, 15.1 – 15.6

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- ExplainthecompletelifecycleofBI/Analyticaldevelopment
- IllustratetechnologyandprocessesassociatedwithBusinessIntelligenceframework
- Demonstrate a businessscenario,identify the metrics, indicatorsandmake recommendationstoachievethebusinessgoal.

Questionpaperpattern:

TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeach module.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Interactive Data Visualization: Foundations, Techniques, and Applications	Matthew O. Ward, Georges Grinstein, Daniel Keim	CRC Press	2015

ReferenceBooks

1	The Visual Display of Quantitative Information	Edward Tufte	Graphics Press	2001

SEMESTER – II
MANAGING BIG DATA

Course Code	**20SAD241**, 20SSE322, 20SIT31, 20LNI251, 20SEE21, 20SFC331, 20SDS241	CIE Marks	40
Teaching Hours/Week (L:P:S)	4 : 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03

Module 1

Meet Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals **MapReduce:** A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed

MapReduce Job, Hadoop Streaming

The Hadoop Distributed File system The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, HadoopFilesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Text Book 1: Chapter 1, 2, and 3

Module 2

YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness.

Hadoop I/O Data Integrity, Data Integrity in HDFS, Local FileSystem, Checksum File System, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: SequenceFile

Text Book 1: Chapter 4

Module 3

Developing a MapReduce Application The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie

How MapReduce Works Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers.

Text Book 1: Chapter 5, 6

Module 4

MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Records, Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output,

FlumeInstalling Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog

Text Book 1: Chapter 7 and Reference Book 2

Module 5

Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas,

Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.

Spark An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN

Text Book 1: Chapter 11 and Reference Book 1

Course outcomes:

At the end of the course the student will be able to:

- Understand managing big data using Hadoop and SPARK technologies
- Explain HDFS and MapReduce concepts
- Install, configure, and run Hadoop and HDFS.
- Perform map-reduce analytics using Hadoop and related tools
- Explain SPARK concepts

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

SlNo	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Hadoop: The Definitive Guide	Tom White	O'Reilley	3rd Edition, 2012

Reference Books

1	SPARK: The Definitive Guide	Bill Chambers MateiZaharia	O'Reilley	2018
2	Apache Flume: Distributed Log Collection for Hadoop	D'Souza and SteveHoffman	O'Reilley	2014

SEMESTER – II				
NATURAL LANGUAGE PROCESSING				
Course Code	**20SAD242,** 20SCS242, 20SCE243, 20SAM23, 20SDS242		CIE Marks	40
Teaching Hours / Week (L:P:S)	4 : 0 : 0		SEE Marks	60

Credits	04		Exam Hours	03

Module 1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar-based Language Models-Statistical Language Model.

Text Book1: Chapter 1, 2

Module 2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes- Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing- Probabilistic Parsing.

Text Book1: Chapter 3, 2

Module 3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Module 4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module 5

Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, non classical, and Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Course outcomes:

At the end of the course the student will be able to:

- Analyze the natural language text.
- Generate the natural language.
- Demonstrate Text mining.

	Apply information retrieval techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl. No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary	Oxford University Press	2008
2	Natural Language Processing and Text Mining	Anne Kao and Stephen R. Potee	Springer	2007

Reference Books

Sl. No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Speech and LanguageProcessing: An introduction toNatural Language Processing,ComputationalLinguisticsand Speech Recognition	Daniel Jurafskyand JamesHMartin	PHI	2ndEdition, 2008
2	NaturalLanguageUnderstanding	JamesAllen	Benjamin / Cummings publishingcompany	2nd Edition,1995
3	Information Storage andRetrievalsystems	Gerald J.Kowalski andMark T Maybury	Kluwer academic	2000.
4	NaturalLanguage ProcessingwithPython	Steven Bird,Ewan Klein, Edward Loper	O'Reilly	2009
5	Foundations of Statistical Natural Language Processing	Christopher D. Manning andHinrichSchutze	MIT Press	1999

SEMESTER – II			
SOFTANDEVOLUTIONARYCOMPUTING			
Course Code	**20SAD243,** 20SCS323, 20SSE31, 20SAM22, 20SDS243	CIE Marks	40
Teaching Hours/Week (L:P:S)	4 : 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03

Module 1

IntroductiontoSoftcomputing:Neuralnetworks,Fuzzylogic,Geneticalgorithms,Hybridsystemsanditsapplications. Introductiontoclassicalsetsandfuzzysets:Classicalrelationsandfuzzyrelations,Membershipfunctions.

Text Book 1: Chapter 1, 7, 8.1 – 8.4, 9

Module 2

Defuzzification, Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Base and Approximate Reasoning, Fuzzy Decision Making, Architecture and Operation of FLC Systemandapplications.

Text Book 1: Chapter 10, 11, 12, 13and 14.3 – 14.4

Module 3

Genetic algorithms:Introduction,Basic operations, Traditional algorithms, Simple GA General Genetic Algorithm, Operators in Genetic Algorithm, Stopping Condition for Genetic Algorithm Flow, Constraints in Genetic Algorithm, Problem Solving Using Genetic Algorithm, The schema theorem, Genetic programming,applications.

Text Book 1: Chapter 15.1 – 15.13, 15.16

Module 4

Swarm Intelligence System: Introduction, backgroundofSI,AntcolonysystemWorkingofantcolonyoptimization,antcolonyforTSP.

Text Book 2: Chapter 8

Module 5

Unit commitment problem, particle Swarm Intelligencesystem Artificialbeecolonysystem,Cuckoosearchsystem.

Text Book 2:

Course outcomes:

At the end of the course the student will be able to:

- Implementmachinelearningthroughneuralnetworks.
- DesignGeneticAlgorithmtosolvetheoptimizationproblem.
- DevelopaFuzzyexpertsystem.

	● ModelNeuroFuzzysystemforclusteringandclassification

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	PrinciplesofSoftcomputing	Shivanandam,DeepaS.N	Wiley	2011
2	SoftComputing with MATLAB Programming	N.P.Padhy, S. P.Simon	Oxford	2015

Reference Books

1	Neuro-fuzzyandsoftcomputing	J.S.R.Jang,C.T.Sun, E.Mizutani	PHI	2012
2	Soft Computing: Fundamentals, Techniques and Applications	SarojKaushik,SunitaTiwari	McGraw Hill	2018

SEMESTER – II				
PATTERNRECOGNITION				
Course Code	**20SAD244,** 20SCS244, 20SCE242, 20SAM253, 20SDS244	CIE Marks	40
Teaching Hours/Week (L:P:S)	4 : 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03

Module 1

Introduction:DefinitionofPR,Applications,DatasetsforPR,DifferentparadigmsforPR,Introductionto probability,events,randomvariables,Jointdistributionsanddensities,moments.Estimationminimumriskestimators,problems

Text Book 1: Chapter 1

Text Book 2: Chapter 1

Module 2

Representation: DatastructuresforPR,Representationofclusters,proximitymeasures, sizeofpatterns AbstractionofDataset,Featureextraction,Featureselection,Evaluation of Classifiers and Clustering

Text Book 1: Chapter 2

Module 3

Nearest Neighbour based classifiers & Bayes classifier: Nearest NeighbourAlgorithm, Variants of NN Algorithm, Use of NN for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection, Bayes theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with NNC, Naive Bayes classifier, Bayesian belief network.

Text Book 1: Chapter 3 and 4

Module 4

Hidden Markov models: Markov Models for Classification, Hidden Markov Models and Classification Using HMMS.

Decision Trees: Introduction, Decision Trees for Pattern Recognition, Construction of Decision Trees, Splitting at the Nodes, Over fitting & Pruning, Example of Decision Tree Induction.

Text Book 1: Chapter 5 and 6

Module 5

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), Clustering Large Data Sets, examples, An application: Handwritten Digit recognition

Text Book 1: Chapter 9

Course outcomes:

At the end of the course the student will be able to:

- Explainpatternrecognitionprincipals
- DevelopalgorithmsforPatternRecognition.
- Developandanalysedecisiontress.
- Designthenearestneighbourclassifier.
- ApplyDecisiontreeandclusteringtechniquestovariousapplications

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Pattern Recognition	VSusheelaDevi, M NarsimhaMurthy	UniversitiesPress	2011
2	Pattern Recognition and Image Analysis	EarlGose,RichardJohnsonbaugh,SteveJost	PHI	1996

Reference Books				
1	PatternClassification	DudaR.O.,P.E. Hart, and D.G.Stork	Wiley	2000.

SEMESTER –II

DATA SECURITY AND PRIVACY			
CourseCode	**20SAD251,** 20SDS251	CIEMarks	40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks	60
Credits	04	ExamHours	03

Module-1

Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad.

Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.

Text Book1: Chapter 3, Chapter 4

Module-2

Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public- key cryptosystems. Applications for public-key cryptosystems, requirements for public key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.

Other Public-Key Cryptosystems: Diffiehellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on a asymmetric cipher

Text book 1: Chapter 9, Chapter 10

Module-3

Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, Public Key infrastructure.

Text Book 1: Chapter 14

Module-4

An Introduction to privacy preserving data mining: Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization.
Text Book 2: Chapter 1 -1.1, 1.2 , Chapter 2 - 2.2, 2.3

Module-5

Distributed Privacy-Preserving Data Mining, Privacy-Preservation of Application Results, Limitations of Privacy: The Curse of Dimensionality, Applications of Privacy- Preserving Data Mining
Text Book 2: Chapter 2 - 2.4, 2.5, 2.6, 2.7

Course outcomes:
At the end of the course the student will be able to:

- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical.
- Describe importance of data privacy, limitations and applications

Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Cryptography and Network Security,	William Stallings	Pearson	7th Edition 2017
2	Privacy Preserving Data Mining: Models and Algorithms	Charu C. Aggarwal, Philip S Yu,	Kluwer Academic	2008

ReferenceBooks

1	Cryptography and Network Security	AtulKahate	McGraw Hill	2019
2	Cryptography and Information Security,	Pachghare V K	PHI	2019

SEMESTER – II			
TIME SERIES ANALYSIS AND FORECASTING			
Course Code	**20SAD252**, 20SDS252	CIE Marks	40
Teaching Hours/Week (L:P:S)	4: 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03

Module 1

An Introduction to Forecasting: Forecasting and Data. Forecasting Methods. Errors in Forecasting. Choosing a Forecasting Technique. An Overview of Quantitative Forecasting Techniques. REGRESSION ANALYSIS: The Simple Linear Regression Model. The Least Squares Point Estimates. Point Estimates and Point Predictions. Model Assumptions and the Standard Error. Testing the Significance of the Slope and y Intercept. Confidence and Prediction Intervals. Simple Coefficients of Determination and Correlation. An F Test for the Model.

Text book 1: Chapter 1 & 2 (Part-I)

Module 2

Multiple Linear Regressions: The Linear Regression Model. The Least Squares Estimates, and Point Estimation and Prediction. The Mean Square Error and the Standard Error. Model Utility: R2, Adjusted R2, and the Overall F Test. Model Building and Residual Analysis: Model Building and the Effects of Multicollinearity. Residual Analysis in Simple Regression. Residual Analysis in Multiple Regressions. Diagnostics for Detecting Outlying and Influential Observations.

Text book 1: Chapter 3, 4 & 5 (Part-II)

Module 3

Time Series Regression: Modeling Trend by Using Polynomial Functions. Detecting Autocorrelation. Types of Seasonal Variation. Modeling Seasonal Variation by Using Dummy Variables and Trigonometric Functions. Growth Curves. Handling First-Order Autocorrelation. Decomposition Methods: Multiplicative Decomposition. Additive Decomposition. The X-12-ARIMA Seasonal Adjustment Method. Exercises. Exponential Smoothing: Simple Exponential Smoothing. Tracking Signals. Holt's Trend Corrected Exponential Smoothing. Holt-Winters Methods. Damped Trends and Other Exponential.

Text book 1: Chapter 6, 7 & 8 (Part- III)

Module 4

Non-seasonal Box-Jenkins Modeling and Their Tentative Identification: Stationary and Non-stationary Time Series. The Sample Autocorrelation and Partial Autocorrelation Functions: The SAC and SPAC. An Introduction to Non-seasonal Modeling and Forecasting. Tentative Identification of Non-seasonal Box-Jenkins Models. Estimation, Diagnostic Checking, and Forecasting for Non-seasonal Box-Jenkins Models: Estimation. Diagnostic Checking. Forecasting. A Case Study. Box-Jenkins Implementation of Exponential Smoothing.

Text book 1: Chapter 9 & 10 (Part- IV)

Module 5

Box-Jenkins Seasonal Modeling: Transforming a Seasonal Time Series into a Stationary Time Series. Examples of Seasonal Modeling and Forecasting. Box-Jenkins Error Term Models in Time Series Regression. Advanced Box-Jenkins Modeling: The General Seasonal Model and Guidelines for Tentative Identification. Intervention Models. A Procedure for Building a Transfer Function Model Causality in time series: Granger causality. Hypothesis testing on rational expectations. Hypothesis testing on market efficiency.

Text book 1: Chapter 11 & 12 (Part- IV)

Course outcomes:

At the end of the course the student will be able to:

- Describe the fundamental advantage and necessity of forecasting in various situations.
- Identify how to choose an appropriate forecasting method in a particular environment.
- Apply various forecasting methods, which include obtaining the relevant data and carrying out the necessary computation using suitable statistical software.
- Improve forecast with better statistical models based on statistical analysis.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and Year
1	Forecasting, Time Series, and Regression	Bruce L. Bowerman, Richard O'Connell, Anne Koehler	CengageLearning	2004

Reference Books

1	The Econometric Modelling of Financial Time Series	Terence C. Mills, Raphael N. Markellos	Cambridge University Press,	2008
2	Time Series Models	Andrew C. Harvey	MIT	1993
3	Introduction to Time Series and Forecasting. (http://home.iitj.ac.in/~parmod/ document/introduction %20time%20series.pdf)	P. J. Brockwell, R. A. Davis	Springer	1996
4	Time series analysis : with applications in R	Jonathan D Cryer, Kung-sikChan	Springer	2008
5	Applied Econometric Time Series	W Enders	Wiley	1995

SEMESTER – II			
APPLIED SOCIAL NETWORK ANALYSIS			
Course Code	**20SAD253,** 20SDS253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4: 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03

Module 1

What is a Network?- Basic Network Concepts, Adjacency Matrices, Graphs, and Notation, Nodes and Links, Good Will Hunting Problem, Formal and Informal Networks, summary.**Centrality measures**- What is "Centrality" and Why do we Study It?, calculating Nodal Centrality Measures, Directed Networks and Centrality Measures, Location in the Network. Graph Level Measures- Density , Diameter , Centralization , Average Centralities, Network Topology

Textbook 1: Chapter 1, 2, 3

Module 2

Social Theory: **Social Links-** Individual Actors, Social Exchange Theory, Social Forces, Graph Structure, Agent Optimization Strategies in Networks, Hierarchy of Social Link Motivation, Summary. **Subgroup Analysis:** Subgroups, Organizational Theory, Random Groups, Heuristics for Subgroup Identification, Analysis Methods, Summary. **Diffusion and Influence:** Applications for Social Diffusion, Strain Theory, Social Context, Group Impacts on Diffusion, Network Structure and Diffusion, Group Influence Strategies and Bases of Power.

Textbook 1: Chapter 4, 5, 6

Module 3

 Meta-Networks and Relational Algebra: Modes of Data, Source, Target, Direction, Multimode Networks, Bridging a Meta-Network, Strength of Ties. **Sources of Data:** Network Sampling, Measuring Links, Data Quality, Additional Ethnographic Data Collection Methods, Anonymity Issues.

Textbook 1: Chapter 7, 8

Module 4

Information Networks and the World Wide Web: The Structure of the web, Link Analysis and Web Search, Sponsored Search Markets.

Textbook 2: Chapter 13, 14, 15

Module 5

 Network Dynamics: Structural Models, The Small-World Phenomenon, Epidemics .

Textbook 2: Chapter 19, 20, 21

Course outcomes:

At the end of the course the student will be able to:

- Definenotationandterminologyusedinnetworkscience.
- Demonstrate,summarizeandcomparenetworks.
- Explainbasicprinciplesbehindnetworkanalysisalgorithms.
- Analyzingrealworldnetwork

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and Year
1	Social Network Analysis with Applications	Ian McCulloh, Helen Armstrong and Anthony Johnson	Wiley	2013
2	Networks, Crowds, and Markets:Reasoning About a HighlyConnectedWorld	David Easley and JohnKleinberg	Cambridge University Press	2010

Reference Books

1	Social and Economic Networks	Matthew O. Jackson	Princeton University Press	2008

SEMESTER – II			
IMAGE AND VIDEO ANALYTICS			
Course Code	**20SAD254,**20SDS254	CIE Marks	40
Teaching Hours/Week (L:P:S)	4: 0 : 0	SEE Marks	60
Credits	04	Exam Hours	03
Module 1			

Digital image representation- Visual Perception- Sampling and Quantization- Basic Relations between Pixels-Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matrix Operations-Image Transforms (DFT, DCT, DWT, Hadamard).

Text Book 1: Chapter 1, 2.1 – 2.6

Module 2

Fundamentals of spatial filtering: spatial correlation and convolution-smoothing blurring- sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring- sharpening--Histograms and basic statistical models of image.

Text Book 1: Chapter 3.1 – 3.6

Module 3

Detection of Objects of Interest, Tracking of Objects of Interest in a Sequence of Images, Tracking Objects of Interest Through a Camera Network.

Text Book 2: Chapter 7, 8, 9

Module 4

Biometric Techniques Applied to Video Surveillance, Vehicle Recognition in Video Surveillance, Activity Recognition.

Text Book 2: Chapter 10, 11, 12

Module 5

Unsupervised Methods for Activity Analysis and Detection of Abnormal Events, Analysis of Crowded Scenes in Video, Detection of Visual Context, Example of an Operational Evaluation Platform: PPSL

Text Book 2: Chapter 13, 15, 16, 17

Course outcomes:

At the end of the course the student will be able to:

- Apply preprocessing techniques for better understanding of images
- Apply spatial filtering to images for the preprocessing purposes
- Apply color transformations to image and video data
- Make use of detection and classification methods for image and video data
- Apply and analyze the techniques through case studies

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book / Text Books

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year

1	Digital Image Processing	R.C. Gonzalez and R.E. Woods	Pearson	2009
2	Intelligent Video Surveillance Systems	Jean-Yves Dufour	Wiley	2013
Reference Books				
1	Computer Vision: Algorithms and Applications	Rick Szelisk	Springer	2011
2	Nonparametric and Semi parametric Models	HärdleW, MüllerM, SperlichS, Werwatz, A.	Springer	2004

SEMESTER – II			
VISUALIZATION of DATA AND MINI PROJECT LAB			
Subject Code	20SADL26	**CIE Marks**	40
Number of Contact Hours/Week (L:P:S)	0:4:0	**SEE Marks**	60
Credits	02	**Exam Hours**	3

Course Learning Objectives: This course will enable students to:

- Make use of Data sets in implementing the data visualizationtechniques
- Implement the data visualizationtechniques
- Integrate machine learning libraries and mathematical and statistical tools that are suitable for the Data Science applications underconsideration.

Descriptions (if any):

PART A:

- Write the programs using Python/R/equivalent ProgrammingLanguage.
- Execute the programs in either Visual Studio Code or PyCharm Community/equivalentEdition.
- Use appropriate libraries as needed to execute theprograms.
- Data sets can be downloaded from standard repositories

    (https://archive.ics.uci.edu/ml/datasets.html) or constructed by thestudents

PART B:

- Data Science applications is to be developed with suitable Graphical UserInterface.

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal.

PART A:	
1	Load the specified dataset a) Using numpy and compute mean, median, variance and Standard deviation and illustrate Indexing, Slicing, Splitting, Iterating, Filtering, Sorting, Combining, and Reshaping b) Using pandas and compute mean, median, variance and Standard deviation and illustrate Indexing, Slicing, Iterating, Filtering, Sorting andReshaping
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the (Note: Import Matplotlib) a) Visualizing through a LinePlot b) Creating a BarPlot c) Creating a Stacked Bar Plot to Visualize a specifiedparameter d) Comparing specific parameters using Stacked AreaChart
3	For a given set of training data examples stored in a .CSV file, implement and demonstrate the (Note: Import Matplotlib)
4	a) Histogram and a Box Plot to Visualize the givenparameter b) Scatter Plot to VisualizeCorrelation c) Scatter Plot with MarginalHistograms d) Plotting Multiple Images in aGrid
5	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6	Write a program to parse HTML using Beutifulsoup/equivalent Library support

PART B

Mini Project

- Use Java, C#, PHP, Python, or any other similar front-end tool. Developed mini projects must be demonstrated on desktop/laptop as a stand-alone or web basedapplication

- Installation procedure of the required software must be demonstrated, carried out ingroups and documented in thejournal.

- Indicative areas include: health care, education, agriculture, banking, library, agentbased systems, registration systems, industry, reservation systems, facility management, super market etc., Similar to but not limitedto:

    Handwritten Digit Recognition

    Prediction of Cardiac Arrhythmia type using Clustering and Regression Approach

    Hybrid Regression Technique for House Prices Prediction

    An Iris Recognition Algorithm for Identity Authentication

    An Approach to Maintain Attendance using Image Processing Techniques

    Unconstrained Face Recognition

    Vehicle Number Plate Detection System

Detection of Fake News
Stock Prediction using Linear Regression
Prediction of Weather Report
Analyzing Bike Sharing Trends
Sentiment Analysis for Movie Reviews
Analyzing and Recommendations of Music Trends
Forecasting Stock and Commodity Prices
Diabetes Prediction Speech Recognition
Spam Detection using neural Networks in Python
Combining satellite imagery and to predict poverty

Conduct of Practical Examination:

- Experiment distribution
    - ✓ For laboratories having only one part: Students are allowed to pick one experiment fromthe lot with equalopportunity.
    - ✓ For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equalopportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.

- Marks Distribution (Subjected to change in accordance with university regulations)
    - a) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
    - b) For laboratories having PART A and PARTB
        - i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40Marks
        - ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60Marks

TECHNICAL SEMINAR			
Course Code	20SAD27	**CIE Marks**	100
Number of contact Hours/week (L:P:SDA)	0:2:0	**SEE Marks**	--
Credits	02	**Exam Hours**	--

Courseobjectives:

Theobjectiveoftheseminaristoinculcateself-learning,faceaudienceconfidently,enhancecommunicationskill, involvein group discussion andpresent andexchangeideas.

Eachstudent,undertheguidanceofaFaculty,isrequiredto

- Choose,preferablythroughpeerreviewedjournals,arecenttopicofhis/herinterestrelevanttotheCourseofSpecialization.
- Carryoutliteraturesurvey,organizetheCoursetopicsinasystematicorder.
- Preparethereportwithownsentences.
- Typethemattertoacquaintwiththeuse ofMicro-softequationanddrawingtoolsoranysuchfacilities.
- Presenttheseminartopicorallyand/orthroughpowerpointslides.
- Answerthequeriesandinvolveindebate/discussion.
- Submittwocopiesofthetypedreportwithalistofreferences.

The participants shall take part in discussion to foster friendly and stimulating environment in which thestudentsaremotivatedtoreachhighstandardsandbecomeself-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill,participation in the question and answer session and quality of report) by the committee constituted for thepurpose by the Head of the Department. The committee shall consist of three faculties from the departmentwiththesenior most actingastheChairperson.

MarksdistributionforCIEofthecourse21XXX27seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

QuestionandAnswer:20marks

SEMESTER–III			
DEEPLEARNING			
CourseCode	**20SAD31,** 20SCS31, 20SAM31, 20SIS334, 20SDS31	CIEMarks	40
TeachingHours/Week(L:P:S)	3:0:2	SEEMarks	60
Credits	04	ExamHours	03
Module-1			
MachineLearningBasics: LearningAlgorithms,Capacity,OverfittingandUnderfitting,Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation,BayesianStatistics,SupervisedLearningAlgorithms,UnsupervisedLearningAlgorithms,Stochastic			

GradientDecent,BuildingaMachineLearningAlgorithm,ChallengesMotivatingDeepLearning.

Text Book 1: Chapter 5

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation.

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization,RegularizationandUnder-ConstrainedProblems,DatasetAugmentation,NoiseRobustness,Semi-SupervisedLearning,Multi-TaskLearning,EarlyStopping,ParameterTyingandParameterSharing, SparseRepresentations,Bagging,Dropout.

Text Book 1: Chapter 6.2 – 6.5 and 7.1 – 7.11

Module-3

OptimizationforTrainingDeepModels: HowLearningDiffersfromPureOptimization,ChallengesinNeural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms withAdaptive Learning Rates.

Convolutional Networks: The Convolution Operation, Motivation, Pooling,ConvolutionandPoolingasanInfinitelyStrongPrior,VariantsoftheBasicConvolutionFunction, StructuredOutputs,DataTypes,EfficientConvolutionAlgorithms,RandomorUnsupervisedFeatures.

Text Book 1: Chapter 8.1 – 8.5 and 9.1 – 9.9

Module-4

SequenceModelling: RecurrentandRecursiveNets:UnfoldingComputationalGraphs,RecurrentNeural Networks,BidirectionalRNNs,Encoder-DecoderSequence-to-SequenceArchitectures,DeepRecurrentNetworks,RecursiveNeuralNetworks.Longshort-termmemory

Text Book 1: Chapter 10.1 – 10.6 and 10.10

Module-5

PracticalMethodology: PerformanceMetrics,DefaultBaselineModels,DeterminingWhethertoGather MoreData,SelectingHyperparameters,DebuggingStrategies,Example:Multi-DigitNumberRecognition.**Applications:** Vision,NLP,Speech.

Text Book 1: Chapter 11 and 12

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Identifythedeeplearningalgorithmswhicharemoreappropriateforvarioustypesoflearningtasksinvariousdomains.
- Implementdeeplearningalgorithmsandsolvereal-worldproblems.
- ExecuteperformancemetricsofDeepLearningTechniques.

Questionpaperpattern:

TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	DeepLearning	IanGoodfellowYoshuaBengio, and Aaron Courville	MITPress https://www.deeplearningbook.org/	2016

Reference Books

1	NeuralNetworks:AsystematicIntroduction	Raul Rojas	Springer	1996
2	PatternRecognitionandMachineLearning	ChirstopherBishop	Springer	2006

SEMESTER–III				
BUSINESSANALYTICS				
CourseCode	**20SAD321,** 20SDS321	CIEMarks		40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks		60
Credits	03	ExamHours		03

Module-1

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, ParallelDevelopment Tracks, BI Project Team Structure, Business Justification, Business Divers, BusinessAnalysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, RolesInvolvedinTheseActivities,Risks ofNotPerformingStep,Hardware,Middleware,DBMSPlatform, Non-TechnicalInfrastructureEvaluation.

Textbook 1: Chapter: 0, 1, 2

Module-2

ManagingTheBIProject,DefiningandPlanningTheBIProject,ProjectPlanningActivities,Roles and RisksInvolvedInTheseActivities,GeneralBusinessRequirement,ProjectSpecificRequirements,InterviewingProcess.
Textbook 1: Chapter: 3, 4
Module–3
DifferencesinDatabaseDesignPhilosophies,LogicalDatabaseDesign,PhysicalDatabaseDesign, Activities,RolesAndRisksInvolvedInTheseActivities,IncrementalRollout,SecurityManagement,DatabaseBackupAndRecovery.
Textbook 1: Chapter: 8
Module-4
Descriptive Analytics: Visualizing and Exploring data, Descriptive Statistical Measures, Sampling and Estimation, Statistical Inference
Textbook 2: Chapter: 3, 4, 6, 7
Module-5
Predictive Analytics: Trendlines and Regression Analysis, Forecasting Techniques, Spreadsheet Modeling and Analysis, Basic concepts on Prescriptive Analytics
Textbook 2: Chapter: 8, 9, 11, and Part 4
Courseoutcomes: Attheendofthecoursethestudentwillbeableto:
- ExplainthecompletelifecycleofBI/Analyticaldevelopment   - IllustratetechnologyandprocessesassociatedwithBusinessIntelligenceframework   - Demonstrateabusinessscenario,identifythemetrics,indicatorsandmakerecommendationstoachievethebusinessgoal.
Questionpaperpattern: TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.   - Thequestionpaperwillhavetenfullquestionscarryingequalmarks.   - Eachfullquestionisfor20marks.   - Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.   - Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.   Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.
Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear

1	BusinessIntelligenceRoadmap:TheCompleteProjectLifecycleforDecisionSupportApplications	LarissaTMossandShakuAtre	AddisonWesleyInformationTechnologySeries	2003.
2	Business Analytics	James Evans	Pearson	2nd Edition 2016
ReferenceBooks				
1	BusinessIntelligence:TheSavvy Manager'sGuide	DavidLoshin	MorganKaufmann	2003
2	DeliveringBusinessIntelligence withMicrosoftSQLServer2005	BrianLarson	McGrawHill	2006
3	FoundationsofSQLServer2008 BusinessIntelligence	LynnLangit	Apress	2011
4	Fundamentals of Business Analytics	R N Prasad, Seema Acharya	WileyIndia	2011.

SEMESTER – III			
CYBER SECURITY AND CYBER LAW			
Course Code	**20SAD322,**20SCR15, 20LNI242, 20SCE244, 20SIT244, 20SAM244, 20SDS322	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Module-1			
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.			
Textbook 1: Chapter 1, 2			
Module -2			

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges PosedbyMobileDevices,RegistrySettingsforMobileDevices,AuthenticationServiceSecurity,Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational MeasuresforHandlingMobile,OrganizationalSecurityPoliciesandMeasuresinMobileComputingEra, Laptops.

Textbook 1: Chapter 3

Module – 3

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography,DoSandDDoSAttacks,SQLInjection,BufferOverflow,AttacksonWirelessNetworks.   Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Textbook 1: Chapter 4, 5

Module-4

Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: UnderstandingtheRequirements,ComputerForensicsandSteganography,RelevanceoftheOSI7Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, ComputerForensicsfromCompliancePerspective,ChallengesinComputerForensics,SpecialToolsandTechniques, Forensics Auditing, Anti forensics.

Textbook 1: Chapter 7

Module-5

IntroductiontoSecurityPoliciesandCyber   Laws:NeedforAnInformationSecurityPolicy,Information SecurityStandards–Iso,IntroducingVariousSecurityPoliciesandTheirReviewProcess,Introductionto IndianCyberLaw,ObjectiveandScopeoftheitAct,2000,IntellectualPropertyIssues,Overviewof Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.

Textbook 2: Chapter 4

Course outcomes:

At the end of the course the student will be able to:

- Define cyber security, cyber law and their roles
- Demonstrate cyber security cybercrime and forensics.
- Infer legal issues in cybercrime,
- Demonstrate tools and methods used in cybercrime and security.
- Illustrate evidence collection and legal challenges

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And LegalPerspectives	NinaGodbole and SunitBelapure	Wiley India Pvt Ltd	2013
2	Introduction to information security and cyberlaws	Surya Prakash Tripathi, RitendraGoyal, PraveenKumarShukla	Dreamtech Press	2015

Reference Books

1	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions	Thomas J. Mowbray	Wiley	2013
2	Cyber Security Essentials	James Graham, Ryan Olson, and Rick Howard	Auerbach Publications	2010

SEMESTER–III	
CLOUDCOMPUTING FOR DATA ANALYSIS	

CourseCode	**20SAD323,** 20SCS243,20LNI15,20SCE14,20SIT22,20SSE251,20SCN31,20SIS12, 20SDS323	CIEMarks	40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks	60
Credits	03	ExamHours	03

Module-1

Introduction,CloudInfrastructure: Cloudcomputing,Cloudcomputingdeliverymodelsandservices,Ethicalissues,Cloudvulnerabilities,CloudcomputingatAmazon,CloudcomputingtheGoogleperspective,   Microsoft

Windows Azure and online services, Open-source software platforms for privateclouds,Cloudstoragediversityandvendorlock-in,Energyuseandecologicalimpact,Servicelevelagreements,Userexperienceandsoftwarelicensing.Exercisesandproblems.
Text Book 1: Chapter 1: 1.3 – 1.6, Chapter 3: 3.1 – 3.5, 3.7 – 3.8, 3.10 – 3.11, 3.14
Module2
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles ofcloudcomputing,Workflows:Coordinationofmultipleactivities,Coordinationbasedonastatemachinemodel:TheZookeeper,TheMapReduceprogrammingmodel,Acasestudy:TheGreTheWebapplication,Cloudforscienceandengineering,High-performance computingona cloud,Cloud computingforBiologyresearch,Socialcomputing,digitalcontentandcloudcomputing.
Text Book 1: Chapter 4
Module3
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors,VirtualMachines,PerformanceandSecurityIsolation,Fullvirtualizationandparavirtualization,Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization ofnetworkvirtualization,vBlades,Performancecomparisonofvirtualmachines,Thedarksideof virtualization,Exercisesandproblems.
Text Book 1: Chapter 5.1 – 5.12, 5.16
Module4
Cloud Resource Management andScheduling: Policies and mechanisms for resource management,Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocationarchitecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomicperformance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing,Start-timefairqueuing,Borrowedvirtualtime,Cloudschedulingsubjecttodeadlines,SchedulingMapReduceapplicationssubjecttodeadlines,Resourcemanagementanddynamicscaling,Exercisesandproblems.
Text Book 1: Chapter 6
Module5
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern forcloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machineSecurity, Security of virtualization, Security risks posed by shared images, Security risks posed by amanagement OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connectingclientstocloudinstancesthroughfirewalls,SecurityrulesforapplicationandtransportlayerprotocolsinEC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-basedsimulationofadistributedtrustalgorithm,Atrustmanagementservice,Acloudserviceforadaptivedatastreaming,CloudbasedoptimalFPGAsynthesis. Exercisesandproblems.
Text Book 1: Chapter 9.1 –9.9, 9.11, and11.1 – 11.5, 11.10 – 11.14

Courseoutcomes:
Attheendofthecoursethestudentwillbeableto:
- Comparethestrengthsandlimitationsofcloudcomputing
- Identifythearchitecture,infrastructureanddeliverymodelsofcloudcomputing - Applysuitablevirtualizationconcept. - Choosetheappropriatecloudplayer - Addressthecoreissuesofcloudcomputingsuchassecurity,privacyandinteroperability - DesignCloudServices - Setaprivatecloud

Questionpaperpattern:

TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	CloudComputing Theory andPractice	DanCMarinescu	Elsevier	2013.

ReferenceBooks

1	Computing Principles andParadigms	RajkumarBuyya,JamesBroberg,AndrzejGoscinski	Willey	2014
2	CloudComputingImplementation,ManagementandSecurity	JohnWRittinghouse, JamesFRansome	CRCPress	2013

SEMESTER–III			
DATA STREAM MINING			
CourseCode	**20SAD324,** 20SDS324	CIEMarks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEEMarks	60
Credits	03	ExamHours	03
Module-1			

Introduction to Data Streams: Data stream models, basic streaming methods, data synopsis, sampling, histograms, Wavelets, Discrete Fourier Transform
Text Book 1: Chapter 2.1 – 2.2
Module2
Clustering from Data Streams: Basic concepts, Leader Algorithm, partitioning clustering, hierarchical clustering, grid clustering
Text Book 1: Chapter 6.1 – 6.2
Module3
Frequent Pattern Mining from Data Streams: Search space, landmark windows, mining recent frequent item sets, sequence pattern mining, reservoir sampling for sequential pattern mining.
Text Book 1: Chapter 7
Module4
Decision Trees from Data Streams: Introduction, The very fast decision tree Algorithm, Extensions to the Basic Algorithm. Novelty Detection in Data Streams: introduction, Learning and Novelty, Novelty detection as a one class classification problem.
Text Book 1: Chapter 8.1 – 8.3, 9.1 – 9.3
Module5
Time Series Data Streams: Introduction to Time Series analysis, Time Series prediction, Similarity between time series, Symbolic Approximation-SAX. Ubiquitous Data Mining: Intoduction to Ubiquitous Data Mining, Distributed Data Stream Monitoring, Distributed Clustering.
Text Book 1: Chapter 11.1 – 11.4, 12.1 – 12.3
Courseoutcomes: Attheendofthecoursethestudentwillbeableto:
- Understand the concept of data stream models   - Apply the basic clustering techniques for data streams.   - Understand the difference between FPM in data streams and traditional DM techniques   - Identify the classification techniques for data streams   - Understand the change detection concept in data stream mining
Questionpaperpattern: TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.   - Thequestionpaperwillhavetenfullquestionscarryingequalmarks.   - Eachfullquestionisfor20marks.   - Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.   - Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks				
SlNo	Titleofthebook	NameoftheAuthor/s	PublisherName	EditionandYear
1	Knowledge Discovery from Data Streams	Joao Gama	CRC	1st Edition 2010
ReferenceBooks				
1	Data Streams: Models and Algorithms	Charu C Aggarwal	Springer	2007
2	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach, and Vipin Kumar	Pearson.	2011
3	Stream Data Mining: Algorithms and Their Probabilistic Properties	LeszekRutkowski, MaciejJaworski, PiotrDuda	Springer	1st Edition 2020

SEMESTER–III				
BLOCK CHAIN TECHNOLOGY				
CourseCode	**20SAD331**, 20SCR244, 20SCN15, 20SCS23, 20SAM254, 20SDS331	CIEMarks		40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks		60
Credits	03	ExamHours		03

Module-1

Blockchain 101: Distributed systems, History of Blockchain, Introduction to Blockchain, Types of Blockchain, CAP theorem and Blockchain, Benefits and limitations of Blockchain.

Text Book 1: Chapter 1

Module-2

Decentralization and Cryptography: Decentralization using Blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys.

Text Book 1: Chapter 2.1 – 2.2, 2.5, 3.1 – 3.3

Module-3

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash.

Text Book 1: Chapter 4, 5

Module-4

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101:Introduction, EthereumBlockchain, Elements of the EthereumBlockchain, Precompiled contracts.

Text Book 1: Chapter 6, 7.1 – 7.3

Module-5

Alternative Blockchains: BlockchainsBlockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media.

Text Book 1: Chapter 10, 11

Courseoutcomes: Attheendofthecoursethestudentwillbeableto:

- Understand the types, benefits and limitation of Blockchain.
- Explore the Blockchain decentralization and cryptography concepts.
- Enumerate the Bitcoin features and its alternative options.
- Describe and deploy the smart contracts
- Summarize the Blockchain features outside of currencies.

Questionpaperpattern: TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto60.

- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfullquestionisfor20marks.
- Therewillbetwofullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

Sl.No.	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Mastering BlockchainDistributed ledgers, decentralization and smart contracts explained.	Imran Bashir	Packet Publishing Ltd	Second Edition, 2017

Reference Books

Sl.No.	Titleofthebook	NameoftheAuthor/s	PublisherName	Editionandyear
1	Bitcoin and Cryptocurrency Technologies	Arvind Narayanan, JosephBonneau, Edward Felten, Andrew Miller, Steven Goldfeder	Princeton University	2016
2	Blockchain Basics: A Non-Technical Introduction in 25 Steps	Daniel Drescher	Apress	1st Edition, 2017

3	Mastering Bitcoin: Unlocking Digital Cryptocurrencies	Andreas M. Antonopoulos	O'Reilly Media,	1stEdition, 2014

SEMESTER-III

SUPPLYCHAINMANAGEMENT			
Course Code	**20SAD332,** 20SSE324,20SIT321, 20SDS332	CIEMarks	40
Teaching Hours/Week(L:T:P)	4:0:0	SEEMarks	60
Credits	03	ExamHours	03

Module-1

IntroductiontoSupplyChain Management: Supplychain–objectives– importance –decisionphases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers –obstacles – framework–facilities–inventory–transportation –information–sourcing–pricing.

Text Book 1: Chapter 1, 2, 3

Module-2

Designing the supply chain network: Designing the distribution network – role of distribution – factorsinfluencing distribution – design options – e-business and its impact – distribution networks in practice – network design in the supply chain – role of network – factors affecting the network design decisions – modelingfor supplychain.

Text Book 1: Chapter 4, 5

Module–3

DesigningandPlanningTransportationNetworks.: Roleoftransportation-modesandtheirperformance - transportation infrastructure and policies - design options and their trade-offs - Tailoredtransportation.

Text Book 1: Chapter 14

Module-4

Sourcing and Pricing: Sourcing – In-house or Outsource – 3rd and 4th PLs – supplier scoring andassessment, selection – design collaboration – procurement process – sourcing planning and analysis.Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk andspotcontracts.

Text Book 1: Chapter 15, 16

Module-5

Information Technology in the supply chain: IT Framework – customer relationship management –internal supply chain management – supplier relationship management –transaction management – futureof IT.**Text**

Book 1: Chapter 17

Courseoutcomes:
At theendofthecoursethestudent will beableto:
- DiscussSCMModels,   - FormulateofQRM,CPFR.   - ImplementvariousInventoryModelsandthird-partylogistics.

Questionpaperpattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to60.
- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.   - Eachfull questionisfor20marks.   - Therewill betwofull questions(withamaximumoffoursubquestions)fromeachmodule.   - Eachfullquestionwillhavesub questioncoveringallthetopicsunderamodule.   - Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

Textbook/Textbooks

Sl.No.	Titleofthebook	Nameoftheauthor/s	PublisherName	Editionandyear
1	Supply Chain Management – Strategy,PlanningandOperation	SunilChopra and PeterMeindl	Pearson	6thEdition,2015

ReferenceBooks

1	SupplyChainLogistics Management	DonaldJBowersox,Dand J Closs, MBixbyColuper	McGraw Hill	5thEdition,2020
2	PrinciplesofSupplyChainManagementABalanced Approach	G. Leong, K C Tan, Joel Wisner	South-Western College	2015
3	DesigningandManagingthe SupplyChain-*Concepts, Strategies, and Case Studies*	David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Ravi Shankar	McGraw Hill	2008
4	The management of Business Logistics – A supply Chain Perspective	Coyle, Bardi, Longley	South-Western College	2002
5	SupplyChainManagement	Janat Shah	Pearson	2009

SPATIAL DATA ANALYSIS

CourseCode	**20SAD333,** 20SDS333	CIEMarks	40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks	60
Credits	03	ExamHours	03

Module-1

The context for spatial data analysis: Spatial data analysis - scientific and policy context, Spatial data analysis in science, Place and space in specific areas of scientific explanation. The nature of spatial data: The spatial data matrix - conceptualization and representation issues, The spatial data matrix: its form, The spatial data matrix: its quality, Quantifying spatial dependence.

Text Book 1: Chapter 1.1 – 1.2, 2.1 – 2.4

Module-2

Spatial data: obtaining data and quality issues: Obtaining spatial data through sampling - Sources of spatial data, Spatial sampling. Data quality: implications for spatial data analysis - Errors in data and spatial data analysis, Data resolution and spatial data analysis, Data consistency and spatial data analysis, Data completeness and spatial data analysis.

Text Book 1: Chapter: 3.1 – 3.2, Chapter 4

Module-3

The exploratory analysis of spatial data: Exploratory spatial data analysis: conceptual models - EDA and ESDA, Conceptual models of spatial variation. Exploratory spatial data analysis: visualization methods - Data visualization and exploratory data analysis, Visualizing spatial data. Exploratory spatial data analysis: numerical methods - Smoothing methods, The exploratory identification of global map properties: overall clustering.

Text Book 1: Chapter 5, 6, 7.1, 7.2

Module-4

Hypothesis testing and spatial autocorrelation: Hypothesis testing in the presence of spatial dependence - Spatial autocorrelation and testing the mean of a spatial data set, Spatial autocorrelation and tests of bivariate association.

Modelling spatial data: Models for the statistical analysis of spatial data - Descriptive models, Explanatory models

Text Book 1: Chapter 8, 9

Module-5

Modelling spatial data: Statistical modelling of spatial variation: descriptive modelling - Models for representing spatial variation, Some general problems in modelling spatial variation, Hierarchical Bayesian models. Statistical

modelling of spatial variation: explanatory modelling - Methodologies for spatial data modelling, Some applications of linear modelling of spatial data.

Text Book 1: Chapter 10, 11

Courseoutcomes:

Attheend ofthecoursethe studentwillbeableto:

- Analyze techniques and models for spatial data.
- Applyanalyticsforimplications of spatial data.
- Analyze the conceptual models and visualization methods for spatial data.

Question paper pattern:

- The SEE question paper will be set for 100 marks and the marks scored will beproportionatelyreduced to60.
- Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
- Eachfull questionisfor20marks.
- Therewill betwo full questions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesub questioncoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswerfive fullquestions,selectingone fullquestionfromeachmodule.

Textbook/Textbooks

SlNo	Titleofthebook	Nameofthe Author/s	PublisherName	Editionand year
1	Spatial Data Analysis: Theory and Practice	Robert Haining	Cambridge University Press	2003

Reference Books

1	Distance and space. A Geographical Perspective.	Anthony C Gatrell.	Oxford. University Press	1983
2	Models of spatial Processes	Arthur Getis, Barry Boots	Cambridge University Press,	2008

SEMESTER–III

HEALTHCAREDATAANALYTICS

CourseCode	**20SAD334,** 20SDS334	CIEMarks	40
TeachingHours/Week(L:P:S)	4:0:0	SEEMarks	60
Credits	03	ExamHours	03

Module-1
An IntroductiontoHealthcareDataAnalytics,ElectronicHealthRecords-A survey:ComponentsofHER, CodingSystems,Benefitsof HER,BarriertoAdoptingHER Challenges,PhenotypingAlgorithms **Chapter 1.1 – 1.6, 2.3 – 2.6, 2.8**
Module-2
BiomedicalImageAnalysis,MiningofSensorDatainHealthcare, BiomedicalSignalAnalysis. **Chapter 3, 4, 5**
Module-3
NaturalLanguageProcessingandDataMiningforClinicalText,MiningtheBiomedical. **Chapter 7, 8**
Module-4
Advanced Data Analytics for Healthcare: Review of Clinical Prediction Models, TemporalDataMiningforHealthcareData, VisualAnalyticsforHealthcare, Privacy, PreservingDataPublishingMethodsin Healthcare. **Chapter 10, 11, 12, 15**
Module-5
Applications and Practical Systems for Healthcare: Data Analytics for Pervasive Health- FraudDetection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems-Computer-AssistedMedical ImageAnalysisSystems. **Chapter 16, 17, 18, 19, 20**
Courseoutcomes: Attheend ofthecoursethe studentwillbeableto:
• Analyzehealthcaredatausingappropriateanalyticaltechniques.   • Applyanalyticsfordecisionmakinginhealthcareservices.   • Applydataminingtointegratehealthdatafrommultiplesourcesanddevelopefficientclinicaldecisionsupport systems.
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will beproportionatelyreduced to60.   ● Thequestionpaperwillhavetenfullquestionscarryingequalmarks.   ● Eachfull questionisfor20marks.   ● Therewill betwo full questions(withamaximumoffoursubquestions)fromeachmodule.   ● Eachfullquestionwillhavesub questioncoveringallthetopicsunderamodule.   ● Thestudentswillhavetoanswerfive fullquestions,selectingone fullquestionfromeachmodule.
Textbook/Textbooks

1	Healthcaredataanalytics	Chandan K. Reddy andCharuCAggarwal,	Taylor&Francis	1stEdition,2015
ReferenceBooks				
1	Healthcare Analytics: FromData to Knowledge toHealthcareImprovement	Hui Yang and Eva K. Lee	Wiley	2016

PROJECTWORKPHASE–1			
CourseCode	20SAD34	CIEMarks	100
NumberofcontactHours/Week	2	SEEMarks	--
Credits	02	ExamHours	--

Courseobjectives:
- Supportindependentlearning.
- Guidetoselectandutilizeadequateinformationfromvariedresourcesmaintainingethics.
- Guidetoorganizetheworkintheappropriatemannerandpresentinformation(acknowledgingthesources)clearly.
- Developinteractive,communication,organisation,timemanagement,andpresentationskills.
- Impartflexibilityandadaptability.
- Inspireindependentandteamworking.
- Expandintellectualcapacity,credibility,judgement,intuition.
- Adheretopunctuality,settingandmeetingdeadlines.
- Instilresponsibilitiestooneselfandothers.
- Train students to present the topic of project work in a seminar without any fear, face audienceconfidently,enhancecommunicationskill,involveingroupdiscussiontopresentandexchangeideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries tofinalize the topic of the Project. Subsequently, the students shall collect the material required for the selectedproject, preparesynopsisandnarratethemethodologytocarryoutthe project work.

Seminar: Eachstudent,undertheguidanceofaFaculty,isrequiredto
- Presenttheseminarontheselectedprojectorallyand/orthroughpowerpointslides.
- Answerthequeriesandinvolveindebate/discussion.
- Submittwocopiesofthetypedreportwithalistofreferences.

Theparticipantsshalltakepartindiscussiontofosterfriendlyandstimulatingenvironmentinwhichthestudentsaremotivatedto reach highstandardsandbecomeself-confident.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Demonstrateasoundtechnicalknowledgeoftheirselectedprojecttopic.
- Undertakeproblemidentification,formulation,andsolution.
- Designengineeringsolutionstocomplexproblemsutilisingasystemsapproach.
- Communicatewithengineersandthecommunityatlargeinwrittenanoralforms.
- Demonstratetheknowledge,skillsandattitudesofaprofessionalengineer.

ContinuousInternalEvaluation

CIEmarksfortheprojectreport(50marks),seminar(30marks)andquestion andanswer(20marks)shallbeawarded (based on the quality of report and presentation skill, participation in the question and answersession by the student) by the committee constituted for the purpose by the Head of the Department. ThecommitteeshallconsistofthreefacultyfromthedepartmentwiththeseniormostactingastheChairperson.

MINIPROJECT			
CourseCode	20SAD35	CIEMarks	40
NumberofcontactHours/Week	2	SEEMarks	60
Credits	02	ExamHours/Batch	03

Courseobjectives:
- Tosupportindependentlearningandinnovativeattitude.
- Toguidetoselectandutilizeadequateinformationfromvariedresourcesupholdingethics.
- Toguidetoorganizetheworkintheappropriatemannerandpresentinformation(acknowledgingthesources) clearly.
- Todevelopinteractive,communication,organisation,timemanagement,andpresentationskills.
- Toimpartflexibilityandadaptability.
- Toinspireindependentandteamworking.
- Toexpandintellectualcapacity,credibility,judgement,intuition.
- Toadheretopunctuality,settingandmeetingdeadlines.
- Toinstilresponsibilitiestooneselfandothers.
- Totrainstudentstopresentthetopicofprojectworkinaseminarwithoutanyfear,faceaudienceconfidently,enhancecommunicationskill,involveingroupdiscussiontopresentandexchangeideas.

Mini-Project: Eachstudentoftheprojectbatchshallinvolveincarryingouttheprojectworkjointlyinconstantconsultation withinternalguide,co-guide,andexternalguideandpreparetheprojectreportasperthenorms avoidingplagiarism.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Presentthemini-projectandbeabletodefendit.
- Makelinksacrossdifferentareasofknowledgeandtogenerate,developandevaluateideasandinformationso astoapply theseskillsto theproject task.
- Habituatedtocriticalthinkinganduseproblemsolvingskills.
- Communicateeffectivelyandtopresentideasclearlyandcoherentlyinboththewrittenandoralforms.
- Workinateamtoachievecommongoal.
- Learnontheirown,reflectontheirlearningandtakeappropriateactionstoimproveit.

CIEprocedureforMini-Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, ProjectPresentationskillandQuestionandAnswersessionintheratio50:25:25.ThemarksawardedforMini-Projectreport shallbethesameforallthebatchmates.

SemesterEndExamination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, PresentationskillandQuestionandAnswersessionintheratio50:25:25bytheexaminersappointedbytheUniversity.

INTERNSHIP/PROFESSIONALPRACTICE			
CourseCode	20SADI36	CIEMarks	40
NumberofcontactHours/Week	2	SEEMarks	60
Credits	06	ExamHours	03

Courseobjectives:

Internship/Professionalpracticeprovidestudentstheopportunityofhands-onexperiencethatincludepersonal training, time and stress management, interactive skills, presentations, budgeting, marketing, liabilityand risk management,paperwork, equipment ordering, maintenance, responding to emergencies etc. Theobjectivearefurther,

Toputtheoryintopractice.

Toexpandthinkingandbroadentheknowledgeandskillsacquiredthroughcourseworkinthefield.Torelatet o, interact with,andlearnfrom currentprofessionalsinthefield.

Togainagreaterunderstandingofthedutiesandresponsibilitiesofaprofessional.Tounderst andand adhere toprofessional standardsinthefield.

Togaininsighttoprofessionalcommunicationincludingmeetings,memos,reading,writing,publicspeaking,researc h, client interaction,inputofideas,andconfidentiality.

Toidentifypersonalstrengthsandweaknesses.

Todeveloptheinitiativeandmotivationtobeaself-starterandworkindependently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shalltakepartinalltheactivitiesregularlytoacquireasmuchknowledgeaspossiblewithoutcausinganyinconvenienc eat theplaceofinternship.

Seminar: Eachstudent,isrequiredto

- Presenttheseminarontheinternshiporallyand/orthroughpowerpointslides.
- Answerthequeriesandinvolveindebate/discussion.
- Submitthereportdulycertifiedbytheexternalguide.
- Theparticipantsshalltakepartindiscussiontofosterfriendlyandstimulatingenvironmentinwhichthestudents aremotivatedto reach high standardsandbecomeself-confident.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:

- Gainpracticalexperiencewithinindustryinwhichtheinternshipisdone.
- Acquireknowledgeoftheindustryinwhichtheinternshipisdone.
- Applyknowledgeandskillslearnedtoclassroomwork.
- Developagreaterunderstandingaboutcareeroptionswhilemoreclearlydefiningpersonalcareergoals.
- Experiencetheactivitiesandfunctionsofprofessionals.
- Developandrefineoralandwrittencommunicationskills.
- Identifyareasforfutureknowledgeandskilldevelopment.
- Expandintellectualcapacity,credibility,judgment,intuition.
- Acquiretheknowledgeofadministration,marketing,financeandeconomics.

ContinuousInternalEvaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question andanswersession(10marks)shallbeawarded(basedonthequalityofreportandpresentationskill,participation in the question and answer session by the student) by the committee constituted for the purposeby the Head of the Department. The committee shall consist of three faculty from the department with thesenior most actingas theChairperson.

SemesterEndExamination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10marks) shall be awarded (based on the quality of report and presentation skill, participation in the questionandanswer session)bytheexaminersappointed by theUniversity.

PROJECTWORKPHASE-2			
CourseCode	20SCS41	CIEMarks	40
NumberofcontactHours/Week	4	SEEMarks	60
Credits	20	ExamHours	03

Courseobjectives:
- Tosupportindependentlearning.
- Toguidetoselectandutilizeadequateinformationfromvariedresourcesmaintainingethics.
- Toguidetoorganizetheworkintheappropriatemannerandpresentinformation(acknowledgingthesources) clearly.
- Todevelopinteractive,communication,organisation,timemanagement,andpresentationskills.
- Toimpartflexibilityandadaptability.
- Toinspireindependentandteamworking.
- Toexpandintellectualcapacity,credibility,judgement,intuition.
- Toadheretopunctuality,settingandmeetingdeadlines.
- Toinstilresponsibilitiestooneselfandothers.
- Totrainstudentstopresentthetopicofprojectworkinaseminarwithoutanyfear,faceaudienceconfidently,enhancecommunicationskill,involveingroupdiscussiontopresentandexchangeideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project workjointlyinconstantconsultationwithinternalguide,co-guide,andexternalguideandpreparetheprojectreportas per thenorms avoidingplagiarism.

Courseoutcomes:

Attheendofthecoursethestudentwillbeableto:
- Presenttheprojectandbeabletodefendit.
- Makelinksacrossdifferentareasofknowledgeandtogenerate,developandevaluateideasandinformationso astoapply theseskillsto theproject task.
- Habituatedtocriticalthinkinganduseproblemsolvingskills
- Communicateeffectivelyandtopresentideasclearlyandcoherentlyinboththewrittenandoralforms.
- Workinateamtoachievecommongoal.
- Learnontheirown,reflectontheirlearningandtakeappropriateactionstoimproveit.

ContinuousInternalEvaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in theproject and in the preparation of project report. To be awarded by the internal guide in consultation withexternalguideifany.

ProjectPresentation:10marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constitutedforthepurposebytheHeadoftheDepartment.Thecommitteeshallconsistofthreefacultyfromthedepart mentwiththeseniormost actingastheChairperson.

QuestionandAnswer:10marks.

ThestudentshallbeevaluatedbasedontheabilityintheQuestionandAnswersessionfor10marks.

SemesterEndExamination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10

marks)shall be awarded (based on the quality of report and presentation skill, participation in the question andanswersession)bytheexaminersappointed by theUniversity.