## B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
## REGULATION – 2020
## AUTONOMOUS SYLLABUS
## CHOICE BASED CREDIT SYSTEM
## VII TO VIII SEMESTER CURRICULUM AND SYLLABI

**VISION:**

To make the Department of Computer Science and Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

**MISSION:**

To impart highly innovative and technical knowledge to the urban and unreachable rural student folks in Computer Science and Engineering through "Total Quality Education".

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

**PEO 1:** Apply the basic engineering skills and domain knowledge for developing effective computing solutions to address various social issues.

**PEO 2:** Able to have successful career in technical / managerial roles in multi-disciplinary environment.

**PEO 3:** To confront the evolving technical challenges and problems in the areas of computing.

**PROGRAM OUTCOMES:**

After going through the four years of study, the Artificial Intelligence and Data Science graduates will have the ability to

| POs | Graduate Attribute | Programme Outcome |
|---|---|---|
| 1 | Engineering knowledge | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 2 | Problem analysis | Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| 3 | Design/evelopment of solutions | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| 4 | Conduct investigations of complex problems | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions |
| 5 | Modern tool usage | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations |
| 6 | The engineer and society | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice |

| 7 | Environment and sustainability | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
|---|---|---|
| 8 | Ethics | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| 9 | Individual and team work | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| 10 | Communication | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| 11 | Project management and finance | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| 12 | Life-long learning | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

**PSO1 :**     **Professional Skills:** To apply learned skills to build optimized solutions pertaining to Data Processing, Artificial Intelligence and Machine Learning.

**PSO2 :**     **Problem - Solving Skills:** To analyze data using domain knowledge to get insights and develop appropriate solutions.

## SEMESTER VII

| S.NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|--------------|----------|-----------------|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | AD1701 | Data Exploration and Visualization | PC | 3 | 3 | 0 | 0 | 3 |
| 2 | AD1702 | Natural Language Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | CS1636 | Full Stack Development# | PC | 4 | 2 | 0 | 2 | 3 |
| 4 | PE5 | Professional Elective – V | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | PE6 | Professional Elective – VI | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | OE2 | Open Elective – II* | OE | 3 | 3 | 0 | 0 | 3 |
| | | Online Course** | | | | | | |
| **PRACTICALS** | | | | | | | | |
| 7 | AD1711 | Data Visualization Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | AD1712 | Natural Language Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9 | AD1721 | Capstone Project | EEC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **31** | **17** | **0** | **14** | **24** |

* Course from the Curriculum of other UG programmes.

# Theory cum Laboratory Course

** Students shall complete online course in this semester. Credits earned will be added in consolidated mark statement.

## SEMESTER VIII

| S.NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|--------------|----------|-----------------|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | | Online Course – II*** | OL | 0 | 0 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 2 | AD1821 | Project Work | EEC | 16 | 0 | 0 | 16 | 8 |
| | | | **TOTAL** | **16** | **0** | **0** | **16** | **11** |

***The students shall complete the online course in this semester and credits would be added in consolidated marksheet

## PROFESSIONAL ELECTIVES (PEs)

## PROFESSIONAL ELECTIVE V (SEMESTER VII)

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | CS1635 | Augmented Reality and Virtual Reality | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | AD1731 | Business Intelligence | PE | 3 | 3 | 0 | 0 | 3 |
| 3 | CS1632 | Game Design and Development# | PE | 4 | 2 | 0 | 2 | 3 |
| 4 | CS1734 | Principles of Cyber Security | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | CS1732 | Software Project Management | PE | 3 | 3 | 0 | 0 | 3 |

# Theory cum Laboratory Course

## PROFESSIONAL ELECTIVE VI (SEMESTER VII)

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1 | CS1733 | 2D & 3D Techniques for Graphics Modeling and Simulation | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | AD1732 | Application of Robotics | PE | 3 | 3 | 0 | 0 | 3 |
| 3 | AD1733 | Enterprise Application Development# | PE | 4 | 2 | 0 | 2 | 3 |
| 4 | AD1734 | Statistical Tools for Data Science Engineers# | PE | 4 | 2 | 0 | 2 | 3 |
| 5 | CS1736 | Risk Modeling and Assessment | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | AD1735 | Virtualization and Cloud Computing# | PE | 4 | 2 | 0 | 2 | 3 |

# Theory cum Laboratory Course

## OPEN ELECTIVE – II

## OPEN ELECTIVE II (SEMESTER VII - Offered to EEE, ECE, EIE, Mech, MTR)

| S.NO. | COURSE CODE | COURSE TITLE | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | OAD171 | Artificial Intelligence and Machine Learning | OE | 3 | 0 | 0 | 3 |

| AD1701 | DATA EXPLORATION AND VISUALIZATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To enable the students to

- Explain the core skills and components involved in visualization design
- Understand the methodologies used to visualize large data sets
- Gain knowledge about the different processes involved in data visualization
- Get used with interactive data visualization
- Explore different security aspects involved in data visualization

**UNIT I         EXPLORATORY DATA ANALYSIS                          9**

Fundamentals of Exploratory Data Analysis (EDA) - Understanding Data Science - Significance of EDA - Making sense of Data - Comparing EDA with classical and Bayesian analysis - Software tools for EDA - Visual aids for EDA - Data Transformation techniques - Pivot Tables and Cross-tabulations.

**UNIT II        FUNDAMENTALS OF DATA VISUALIZATION             9**

Introduction to Visualization – Top Data Visualization Tools – Reasons to make a switch to Tableau – Positioning of Tableau - File types in Tableau – Tableau environment - Connection to various data Sources – Custom SQL.

**UNIT III       DASHBOARD AND STORIES                            9**

Filtering – Sorting – Grouping – Number functions – String functions – Logical functions – Date functions – Aggregate functions – Creating a dashboard – Dashboard actions – Creating a Story.

**UNIT IV        CHART AND MAP FORMS                              9**

Pie charts – Tree maps – Heat map – Line graph – Gantt chart – Scatter plot – Histogram – Word cloud – Waterfall charts – Bump charts – Bullet graph.

**UNIT V         STATISTICS TOOLS                                 9**

Need for Statistics - Descriptive statistics – Inferential statistics – Number summary – Spread of data – Box plot – Statistics tools in Tableau – Reference lines – Trend lines – Forecasting - Integration of tableau with R.

**OUTCOMES**

**CO1:** Illustrate the fundamentals of Data Analysis and transformation techniques used to explore the data

**CO2:** Demonstrate various File types and Data connections in the Tableau environment

**CO3:** Build meaningful Dashboards and Stories to simplify and slice the data

**CO4:** Apply different chart and map forms to visualize and insight into the data

**CO5:** Identify Statistics tools to perform advanced analysis using Tableau

**TEXT BOOKS**

1. Suresh Kumar Mukhiya & Usman Ahmed, 2020, *"Hands-On Exploratory Data Analysis with Python"*, Packt Publishing, 2020

2. Seema Acharya & Subashini Chellappan, 2017, *"Pro Tableau"*, Apress

**REFERENCE BOOKS**

1. Claus O. Wilke, 2019, *"Fundamentals of Data Visualization"*, 1st ed, O'Reilly.

2. Arshad Khan, 2016, *"Jumpstart Tableau"*, Updated edition, Apress.

3. Ben Jones, 2014, *"Communicating Data with Tableau"*, 1st ed, O'Reilly.

| AD1702 | NATURAL LANGUAGE PROCESSING | L | T | P | C |
|--------|------------------------------|---|---|---|---|
|        |                              | 3 | 0 | 0 | 3 |

## OBJECTIVES:

To enable the students to

- Learn the fundamentals of natural language processing
- Understand the use of CFG and PCFG in NLP
- Understand the role of semantics of sentences and pragmatics
- Apply the NLP techniques to IR applications

**UNIT I INTRODUCTION 9**

Origins and challenges of NLP – Processing Indian Languages – NLP applications - Language Modeling: Grammar-based LM, Statistical LM - Regular Expression basics – Corpora - Preprocessing - Text tokenization – Stemming – Lemmatization – Removing stop-words - Minimum Edit Distance - Sign language basics

**UNIT II WORD LEVEL ANALYSIS 9**

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Back off – Word Classes - Part-of-Speech Tagging - Named Entities and Named Entity Tagging - HMM Part-of-Speech Tagging - Evaluation of Named Entity Recognition

**UNIT III SYNTACTIC ANALYSIS 9**

Context-Free Grammars, Treebanks, Grammar Equivalence and Normal Form – Ambiguity - CKY parsing – Span-Based Neural Constituency Parsing - Evaluating Parsers - Dependency Relations - Transition-Based Dependency Parsing - Graph-Based Dependency Parsing – Evaluation

**UNIT IV SEMANTICS AND PRAGMATICS 9**

Word Senses - Relations between Senses – WordNet - Word Sense Disambiguation (WSD) – WSD algorithms and Tasks - Thesauruses to Improve Embedding's - Word Sense Induction - Semantic Roles - The Proposition Bank – FrameNet - Semantic Role Labeling - Selectional Restrictions

**UNIT V DISCOURSE ANALYSIS AND RESOURCES 9**

Coherence Relations - Discourse Structure Parsing - Centering and Entity-Based Coherence - Representation learning models for local coherence - Global

Coherence - Resources: Porter Stemmer – Lemmatizer - Penn Treebank - Brill's Tagger – WordNet – PropBank –    FrameNet - Brown Corpus - British National Corpus (BNC).

**TOTAL: 45 PERIODS**

**OUTCOMES**

CO1: Explain the fundamental concepts of Natural Language Processing

CO2: Illustrate the algorithms used in word level analysis

CO3: Demonstrate the use of CFG in syntactic analysis

CO4: Outline the need for semantics and pragmatics

CO5: Interpret the context of the discourse using coherence and various resources

**TEXT BOOK**

1. Daniel Jurafsky and James H Martin, 2023, "*Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*", 3rd ed, Pearson Publication.


**REFERENCE BOOKS**

1. Tanveer Siddiqui & Tiwary US, 2023, "*Natural Language Processing and Information Retrieval*", Oxford University Press Reprint.

2. Richard M Reese, 2015, "*Natural Language Processing with Java*", O'Reilly Media.

3. Nitin Indurkhya & Fred J Damerau, 2010, "*Handbook of Natural Language Processing*", 2nd ed, Chapman and Hall/CRC Press.

4. Steven Bird, Ewan Klein & Edward Loper, 2009, *"Natural Language Processing with Python*", 1st ed, O_Reilly Media.

5. Breck Baldwin, 2015, "*Language Processing with Java and LingPipe Cookbook"*, Atlantic Publisher.

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**CS1636**  **FULL STACK DEVELOPMENT**

**OBJECTIVES:**

To enable the students to

- Familiarize with the front-end design of web pages using HTML5, CSS3 and Bootstrap4.
- Implement interactive web application design using JavaScript and jQuery.
- Build simple web applications using AngularJS framework.
- Understand the basic concepts of Node.js & Express.js Framework.
- Familiarize with the different back-end design using MySQL, MongoDB.

## UNIT I  INTRODUCTION TO FRONT END DESIGN  6

Introduction to full stack development – Front-end web UI frameworks fundamentals – Basics of HTML5 & CSS3 – Responsive web design - Overview of Bootstrap4 – Containers – Grid system – Bootstrap4 CSS – Bootstrap4 Layout components – Themes – simple web application design.

## UNIT II  JAVASCRIPT AND JQUERY  6

An Introduction to JavaScript – JavaScript Objects – DOM model – functions - Event handling – jQuery overview – Selectors - Events – jQuery traversing– jQuery Effects - jQuery HTML- jQuery and AJAX

## UNIT III  ANGULARJS FRAMEWORK  6

Overview of JavaScript frameworks: MEAN stack frameworks - Introduction to Angular JS - Binding and Expression – Directives – Controllers – Filters – Modules – Services – Scopes – Tables & forms – AngularJS DOM – Animations – Simple application

## UNIT IV  EXPRESS.JS AND NODE.JS FRAMEWORK  6

Introduction to Node.js – Node.js Architecture - NPM(Node Packaging Manager) - Installing NPM module - Creating and locating modules - Creating a simple HTTP server - Overview of Express.js framework – Simple Express application – Routing – MVC in Express – middleware – templates – Error handling – Debugging – using process managers.

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## UNIT V    MYSQL, MONGODB WITH NODEJS FRAMEWORK            6

Introduction to MySQL with Node.js– Basic DDL & DML Operations, NoSQL Database -Basic CRUD Operations – Indexing –Aggregation -Data Modelling concepts - Connecting MongoDB using Mongoose

**THEORY: 30 PERIODS**

**LIST OF EXPERIMENTS:**

1.  Build responsive website to display information about your department details using HTML5, CSS3, Bootstrap4. Use Boostrap4 features like grids, jumbotron, carousel, etc.

2.  Implement simple random quote generator using JavaScript. When the user clicks on New Quote button, it will generate new quote and display it to the user randomly. There is a collection of pre-defined quotes collected and store in constant. Whenever the new quote is displayed to the user, background colour should also be changed.

3.  Create password strength checker application using jQuery.

4.  Design simple scientific calculator using AngularJS framework

5.  Develop to-do-list application using AngularJS.

6.  Develop a BMI calculator application using node.js framework.

7.  Build simple server application using node.js.

8.  Build simple library management system using node.js and MySQL/MongoDB.

**PRACTICAL: 30 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| Sl. No. | Description of Equipment | Quantity Required |
|---------|--------------------------|-------------------|
| 1. | Personal Computers (Intel Core i3, 500 GB, 8 GB RAM) | 30 |
| 2. | Printer | 1 |
| 3. | Node.js, MongoDB, Angular Framework, React Framework, MySQL | Open source |

**TOTAL: 60 PERIODS**

**OUTCOMES**

**CO1:** Develop the responsive web pages using front-end UI tools like HTML5, CSS3 and Bootstrap4.

**CO2:** Create dynamic web pages using JavaScript and jQuery.

**CO3:** Make use of AngularJS framework for developing simple web applications.

**CO4:** Construct web applications using node.js framework.

**CO5:** Make use of backend tools to build the real time web applications.

**TEXT BOOKS**

1. Brad Dayley & Brendan Dayley, 2018, *Node.js, MongoDB and Angular Web Development*, 2nd ed, Pearson Education.

2. Deitel, Deitel & Nieto, 2011, *Internet and World Wide Web - How to Program*, 5th ed, Prentice Hall.

**REFERENCE BOOKS**

1. Chris Northwood, *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*, Apress publisher.

2. Adam Bretz & Colin J Ihrig, *Full Stack JavaScript Development with MEAN*, Sitepoint publisher.

3. Vasan Subramanian, *Pro MERN Stack*: *Full Stack Web App Development with Mongo, Express, React, and Node*, Apress publisher.

| | L | T | P | C |
|---|---|---|---|---|
| **AD1711**      **DATA VISUALIZATION LABORATORY** | 0 | 0 | 4 | 2 |

**OBJECTIVES:**

To enable the students to

- Design and create data visualizations
- Analyze existing visualizations based on data visualization theory and principles
- Identify opportunities for application of data visualization in various domains
- Develop interactive visualizations for the Web applications

**LIST OF EXPERIMENTS:**

1. Build an application by Connecting various single and multiple data sources using the default data source in Tableau "Sample-Superstore".
2. Apply various filtering, sorting, grouping, and logical functions to analyze the dataset of COVID cases worldwide and give real-time numbers for various regions.
3. Create Interactive Dashboard and Stories to analyze the dataset of different stocks and derive meaningful information.
4. Analyze a data set of marketing campaigns and visualize the performance of various marketing campaigns using different forms of the chart.
5. Analyze a dataset of various crimes happening at a place and visualize the data using maps and word clouds.
6. Build an application in tableau to predict and infer the risk to the patient's health.
7. Develop an application in tableau to detect anomalies and identify fraudulent transactions.
8. Construct a meaningful dashboard in tableau for Twitter sentiment analysis and integrate it with R Studio.
9. Mini Project.

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|--------|--------------------------|-------------------|
| 1. | Personal Computers (Intel Core i3, 500 GB, 4 GB RAM) | 30 |
| 2. | Printer | 1 |
| 3. | Software: Tableau Public, R Studio | 30 |

**OUTCOMES**

**CO1:** Build applications using various File types and Data connections in the Tableau environment

**CO2:** Apply Data transformation functions to preprocess the data.

**CO3:** Construct meaningful Dashboards and Stories for data exploration and visualization

**CO4:** Choose different forms of the chart and map to visualize and insight into the data

**CO5:** Identify the Statistics tools to perform advanced data analysis using Tableau.

| | L | T | P | C |
|---|---|---|---|---|
| **AD1712** | | | | |

**NATURAL LANGUAGE PROCESSING LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**OBJECTIVES:**

To enable the students to

- Implement word analysis and word generation
- Implement morphology by the use of Add-Delete table
- Apply add-one smoothing in N-grams
- Implement syntactic and semantic elements in Natural Language Processing
- Implement word similarity and word disambiguation.

**LIST OF EXPERIMENTS:**

1. Create Regular expressions for detecting word patterns and tokenizing text
2. Getting started with Python and NLTK - Preprocessing – stop word removal and Stemming
3. Implement N-gram tagging
4. Implement N-gram smoothing
5. Implementation of part-of- speech tagging
6. Implementation of chunking
7. Implementation of word similarity
8. Implementation of Lesk Algorithm for word disambiguation
9. Mini project – Machine Translation, Documents Classification, Chatbot design with a simple dialog system

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1. | Personal Computers (Intel Core i3, 250 GB, 4 GB RAM) | 30 |
| 2. | Printer | 1 |
| 3. | Software: Python with NLTK package | 30 |

**OUTCOMES**

**CO1:** Experiment with the techniques for text-based preprocessing

**CO2:** Construct sparse N-gram table for a given sentence.

**CO3:** Model POS tagging and chunking for a given sentence.

**CO4:** Apply word similarity and word disambiguation methods

**CO5:** Build real-world applications such as machine translation, document classification and chatbot design.

| | L | T | P | C |
|---|---|---|---|---|
| **AD1821**        **PROJECT WORK** | 0 | 0 | 16 | 8 |

**OBJECTIVES:**

To enable the students to

- Develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- Train the students in preparing project reports and to face reviews and viva voce examination

The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department..

**TOTAL: 240 PERIODS**

**OUTCOMES**

**CO1:** Identify challenging engineering problems/Societal needs to propose project-based solutions

**CO2:** Build critical-thinking and analytical decision-making capabilities to find solution by formulating proper methodology

**CO3:** Analyze various algorithmic strategies using technological tools to provide software solutions

**CO4:** Develop solutions to identified problems

**CO5:** Complete an independent project, resulting in at least a publication in reputed journals or conference proceedings

| | L | T | P | C |
|---|---|---|---|---|
| **CS1635**     **AUGMENTED REALITY AND VIRTUAL REALITY** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To enable the students to

- Understand the basic concepts and framework of virtual reality
- Be familiar with the relevance of virtual reality concept, virtual reality methodology, and virtual reality environment
- Design virtual reality on the web and mobile to demonstrate engineering applications
- Understand augmented reality methodology
- Demonstrate the basic functionalities of augmented reality

**UNIT I**        **INTRODUCTION**                **9**

The three I's of virtual reality-commercial Virtual Reality technology and the five classic components of a Virtual Reality system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

**UNIT II**      **VIRTUAL REALITY DEVELOPMENT PROCESS AND CONTENT CREATION CONSIDERATIONS**      **9**

Geometric modelling - kinematics modelling- physical modelling - behaviour modelling - model Management, Methodology and terminology-user performance studies- Virtual Reality health and safety issues-Usability of virtual reality system-cyber sickness -side effects of exposures to virtual reality environment.

**UNIT III**      **VIRTUAL REALITY ON THE WEB & MOBILE**      **9**

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)-Google Virtual Reality for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio - Assessing human parameters-device development and drivers - Design Haptics.

**UNIT IV**        **INTRODUCTION TO AUGMENTED REALITY**        **9**

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

**UNIT V**        **AUGMENTED REALITY DEVLOPEMENT PROCESS**        **9**

Connecting Context and Content in AR System, Various types of contents. Associating content to context, Content Rendering in AR, POSE estimation, Obtaining RST (Rotation Scaling Translation) matrix, rendering 2D content - Images and Video, rendering 3D content - 3D models -AR Application Areas- Case study – Unity 3D and Vuforia – Deploying AR on mobiles.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:**        Explain the basic concepts and framework of virtual reality.

**CO2:**        Interpret the relevance of concept, methodology and environment of virtual reality.

**CO3:**        Develop web and mobile applications using virtual reality.

**CO4:**        Summarize augmented reality methodology.

**CO5:**        Explain the functionality of augmented reality development process.

**TEXT BOOKS**

1. Burdea C & Philippe Coiffet, 2008, *Virtual Reality Technology*, 2nd ed, Gregory, John Wiley & Sons, Inc..

2. Alan B Craig, 2013, *Understanding Augmented Reality, Concepts and Applications*, Morgan Kaufmann.

**REFERENCE BOOKS**

1. Dieter Schmalstieg & Tobias Hollerer, 2016, *Augmented Reality: Principles and Practice (Usability)*, Pearson Education (US), Addison-Wesley Educational Publishers Inc, United States.

2. Jason Jerald, 2015, *The VR Book: Human-Centred Design for Virtual Reality,* Association for Computing Machinery and Morgan & Claypool, New York, USA.

3. Steve Aukstakalnis, 2016, *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),* 1st ed, Addison-Wesley Professional.

4. Tony Parisi, 2015, *Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile*, 1st ed, O'Reilly Media.

5. Tony Parisi, 2014, *Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages*, 1st ed, O'Reilly Media.

6. Jos Dirksen, 2015, *Learning Three.js: The JavaScript 3D Library for WebGL,* 2nd ed, Packt Publishing.

7. Dieter Schmalstieg & Tobias Hollerer, 2016, *Augmented Reality: Principles & Practice*.

8. Cawood, 2008, *Augmented Reality: A Practical Guide*.

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**AD1731**                    **BUSINESS INTELLIGENCE**

**OBJECTIVES:**

To enable the students to

- Understand the fundamentals of Business Intelligence
- Learn various tools used in BI
- Familiarize with various BI models
- Work with different modelling techniques based on requirement
- Familiarize the recent trends in BI

**UNIT I          INTRODUCTION TO BUSINESS INTELLIGENCE          9**

Understand the need for Decision support system and Analytics – Evolution of Computerized Decision support to Analytics -   Framework for Business Intelligence – Overview of Analytics – Analytics applied in real world – Introduction to Big Data Analytics – Overview of Analytics Eco System.

**UNIT II          DESCRIPTIVE ANALYTICS          9**

Nature of Data – Data Pre-processing – Statistical Modelling for Business Analytics – Regression Modelling for Inferential Statistics – Business Reporting – Data Visualization – Emergence of Visual Analytics – Information Dashboard – Business Intelligence and Data Warehousing – Business Performance Measurement – Six sigma as a Performance Measurement System.

**UNIT III          PREDICTIVE ANALYTICS          11**

Data Mining Methods – Case Study to estimate the true accuracy of Classification Models – Data Mining Software Tools – Privacy Issues – Text Analytics and Text Mining overview  -  NLP – Case Study on Text Mining applications – Case Study on Sentiment Analysis – Case Study on Web Mining – Case study on social analytics.

**UNIT IV          PRESCRIPTIVE ANALYTICS          9**

Model-based Decision Making – Mathematical Models for Decision support – Decision Modelling with spread sheets -  Decision Analysis – Simulation: Types – Visual Interactive simulation – Case Study on application of Stream Analytics.

**UNIT V        FUTURE TRENDS                                                    7**

Analysis of Sensor Data – Cloud computing and Business Analytics – Location based Analytics for Organizations – Issues of Legal/Privacy/Ethics - Overview of Impact of Analytics in Organization – Data Scientist as a Profession.

**TOTAL: 45 PERIODS**

**OUTCOMES**

| | | |
|---|---|---|
| **CO1:** | Explain the fundamentals of Business intelligence. |
| **CO2:** | Illustrate various tools used in Business Intelligence |
| **CO3:** | Summarize various Business Intelligence models. |
| **CO4:** | Apply various modeling techniques to real time situations. |
| **CO5:** | Explain the future trends of Business Analytics. |

**TEXT BOOK**

1.  Ramesh Sharda, Dursun Delon & Efraim Turban, 2018, *Business Intelligence, Analytics and Data Science – A Managerial Perspective*, 4th ed, Pearson.

**REFERENCE BOOKS**

1.  Efraim Turban, Ramesh Sharda & Dursun Delon, 2013, *Decision Support and Business Intelligence Systems*, 9th ed, Pearson.
2.  Larissa T Moss & Atre S, 2003, *Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making*, Addison Wesley.
3.  Carlo Vercellis, 2009, *Business Intelligence: Data Mining and Optimization for Decision Making*, Wiley Publications.
4.  David Loshin Morgan & Kaufman, 2012, *Business Intelligence: The Savvy Manager's Guide*", 2nd ed.

| | L | T | P | C |
|---|---|---|---|---|
| | 2 | 0 | 2 | 3 |

**CS1632**          **GAME DESIGN AND DEVELOPMENT**

**OBJECTIVES:**

To enable the students to

- Understand the fundamental concepts of game design and development
- Expose concept of 2D and 3D Computer Graphics principles and algorithms for game design
- Familiarize with the processes, mechanics, issues in game design
- Understand  the architecture of game engines
- Develop and implement simple games using standard APIs

**UNIT I      INTRODUCTION                                                6**

Elements of Game Play – Artificial Intelligence – Getting Input from the Player - Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop.

**UNIT II     GRAPHICS FOR GAME PROGRAMMING                         6**

Coordinate Systems – Ray Tracing, Modeling in Game Production – Vertex Processing, Rasterization – Fragment Processing and Output Merging – Illumination and Shaders, Parametric Curves and Surfaces.

**UNIT III    GAME DESIGN PRINCIPLES                                    6**

Character Development – Story Telling – Narration – Game Balancing – Core mechanics – Principles of level design – Genres of Games – Collision Detection – Game Logic – Game AI, Path Finding – Case study : Tetris.

**UNIT IV    GAMING ENGINE DESIGN                                     6**

Renderers – Software Rendering – Hardware Rendering and Controller Based Animation – Spatial Sorting – Level of Detail – Collision Detection – Standard Objects and Physics – Case study: The Sims

**UNIT V     GAME DEVELOPMENT                                        6**

Developing 2D and 3D Interactive Games Using OpenGL – DirectX – Isometric and Tile Based Games – Puzzle Games – Single Player Games – Multi -Player Games – Case study: Mine craft.

**TOTAL: 30 PERIODS**

**OUTCOMES**

**CO1:**   Explain the essential elements of Game Design and Game Play.

**CO2:**   Demonstrate the concepts of Graphics for Game Design and Development.

**CO3:**   Illustrate the importance of Game Design Principles and process.

**CO4:**   Demonstrate the essential components of game engine for designing and developing games.

**CO5:**   Develop interactive 2D/3D Games.

**LIST OF EXPERIMENTS**

1. Design sprites with necessary animations for a 2D sidescroller game .
2. Add related physics components for a 2D sidescroller game.
3. Develop the game design documents for a 2D sidescroller game.
4. Develop simple 2D puzzle game.
5. Develop simple 3D interactive game.

**PRACTICAL : 30 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|--------|--------------------------|-------------------|
| 1. | Personal Computers (Intel Core i5/i7, 500 GB, 8 GB RAM) | 30 |
| 2. | Printer | 1 |
| 3. | Software: Unity game engine | 30 |

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. David H Eberly, 2010, *3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics*, 2nd ed, Morgan Kaufmann.

2.      Jung Hyun Han, 2011, *3D Graphics for Game Programming*, 1st ed, Chapman and Hall/CRC.

**REFERENCE BOOKS**

1.      Jonathan S Harbour, 2009, *Beginning Game Programming, Course Technology*, 3rd ed, PTR.

2.      Ernest Adams & Andrew Rollings, 2014, *Fundamentals of Game Design*, 3rd  Edition, Pearson Education.

3.      Scott Rogers, 2010, *Level Up: The Guide to Great Video Game Design*, 1st ed,  Wiley.

4.      Jim Thompson, Barna by Berbank-Green & Nic Cusworth, 2008, *Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer*", 1st ed, Wiley.

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**CS1734**         **PRINCIPLES OF CYBER SECURITY**

**OBJECTIVES:**

To enable the students to

- Understand the basics of cyber security
- Know the security aspects in OS and networks
- Familiarize with security countermeasures
- Understand the privacy aspects in cyber space
- Familiarize with various cyber laws in force

**UNIT I        INTRODUCTION TO CYBER SECURITY       9**

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authenticate Access Control and Cryptography - Web User Side - Browser Attacks - Web Attack Targeting Users - Obtaining User or Website Data - Email Attacks.

**UNIT II        SECURITY IN OPERATING SYSTEM & NETWORKS     9**

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.

**UNIT III       DEFENCES: SECURITY COUNTERMEASURES      9**

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity -SQL Injection Attacks – case study of data breaches.

**UNIT IV      PRIVACY IN CYBERSPACE            9**

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed.

**UNIT V       MANAGEMENT AND INCIDENTS          9**

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain the fundamentals of cyber security

**CO2:** Discuss the various security aspects in OS and networks

**CO3:** Summarize various security measures to safeguard resources

**CO4:** Describe the privacy aspects in cyber space

**CO5:** Explain the cyber laws in force

**TEXT BOOKS**

1. Charles P Pfleeger, Shari Lawrence Pfleeger & Jonathan Margulies, 2018, *Security in Computing*, 5th edition, Pearson Education.

2. George K Kostopoulous, 2017, *Cyber Space and Cyber Security*, 2nd edition, CRC Press.

**REFERENCE BOOKS**

1. Martti Lehto & Pekka Neittaanmäki, 2015, *Cyber Security: Analytics, Technology and Automation edited,* Springer International Publishing Switzerland.

2. Nelson Philips & Enfinger Steuart, 2009, *Computer Forensics and Investigations*, Cengage Learning, New Delhi.

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**CS1732**          **SOFTWARE PROJECT MANAGEMENT**

**OBJECTIVES:**

To enable the students to

- Familiarize with Software Project Management concepts
- Identify the appropriate techniques for the intended project life cycle and estimate the effort
- Understand the objectives of activity planning and risk management
- Explore the concepts of project management and control
- Provide the basic ideas of staffing in software projects

**UNIT I          PROJECT EVALUATION AND PROJECT PLANNING          9**

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

**UNIT II          PROJECT LIFE CYCLE AND EFFORT ESTIMATION          9**

Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern.

**UNIT III          ACTIVITY PLANNING AND RISK MANAGEMENT          9**

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

**UNIT IV          PROJECT MANAGEMENT AND CONTROL          9**

Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking –

Change control- Software Configuration Management – Managing contracts – Contract Management.

**UNIT V          STAFFING IN SOFTWARE PROJECTS                    9**

Managing people – Organizational behaviour – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:**  Explain Project Management principles while developing software

**CO2:**  Apply the appropriate techniques for software effort estimation

**CO3:**  Illustrate the activities in a project and manage risks

**CO4:**  Summarize project management and control

**CO5:**  Demonstrate staff selection process and the issues related to people management

**TEXT BOOK**

1.  Bob Hughes, Mike Cotterell & Rajib Mall, 2017, *Software Project Management*, 6th edition, Tata McGraw Hill, New Delhi.

**REFERENCE BOOKS**

1.  Robert K Wysocki, 2011, *Effective Software Project Management,* 8th edition, Wiley Publication.
2.  Walker Royce, 1998, *Software Project Management*, 6th edition, Addison-Wesley
3.  Gopalaswamy Ramesh, 2013, *Managing Global Software Projects*, McGraw Hill Education (India), 14th Reprint

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| **CS1733** | **2D & 3D TECHNIQUES FOR GRAPHICS MODELING AND SIMULATION** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To enable the students to

- Understand the basic concepts of graphics modelling and animation.

- Familiarize with different 2D modelling techniques.

- Be exposed to the techniques for modelling 3D objects.

- Learn about different 3D texturing and rendering techniques.

- Gain knowledge about the simulation techniques used for 3D object modelling.

| **UNIT I** | **INTRODUCTION TO MODELLING, ANIMATION AND MAX INTERFACE** | **10** |
|---|---|---|

Introduction to computer based animation - basic types of animation: real time, non-real-time- definition of modelling - creation of 3d objects - exploring the max interface, controlling & configuring the viewports - customizing the max interface & setting preferences - working with files - importing & exporting, selecting objects - setting object properties - duplicating objects - creating & editing standard primitive and extended primitives objects - transforming objects – pivoting – aligning.

**UNIT II          2D MODELLING          10**

Understanding 2D Splines& shape - Extrude & Bevel 2D object to 3D - Understanding Loft & terrain - Modelling simple objects with splines - Understanding morph, scatter, conform connect compound objects- blob mesh – Boolean Proboolean and procutter compound object

**UNIT III          3D MODELLING AND ANIMATION          9**

Modelling with Polygons - using the graphite - working with XRefs - Building simple scenes - Building complex scenes with XRefs using assets tracking - deforming surfaces - mesh modifiers - modelling with patches and NURBS -  Creating Keyframes - auto keyframes - move & scale keyframe on the timeline - simple controllers, animation modifiers – complex controllers -  Camera effects: function curves in the track view - motion mixer - configuring & aiming cameras - camera motion blur – camera depth of field - camera tracking - using basic lights & lighting techniques - working with advanced lighting - light tracing – radiosity.

**UNIT IV         3D TEXTURING AND RENDERING                         9**

Using material editor and the material explorer - creating and applying standard materials - adding material details with maps - creating compound materials and material modifiers - unwrapping UVs & mapping texture - using atmospheric and render effects - Rendering with V-Ray - V-ray light setup - V-ray rendering settings – HDRI Illumination - Fine-tuning shadows.

**UNIT V          3D SIMULATION                                      7**

Bind to Space Warp object - Gravity, wind, displace force object – deflectors - FFD space warp, wave, ripple, bomb - Creating particle system through parray - understanding particle flow user interface – working principle of particle flow – hair and fur modifier - cloth and garment maker modifiers.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:**    Explain the basic concepts of modelling and animation.

**CO2:**    Illustrate 2D graphics modelling techniques.

**CO3:**    Discuss different 3D modelling and animation techniques.

**CO4:**    Explain various texturing and rendering methods used for 3D graphics modelling.

**CO5:**    Illustrate the usage of 3D simulation techniques in 3D graphics modelling.

**TEXT BOOKS**

1.    Michael E Mortenson, 2010, *3D Modelling, Animation, and Rendering*, Create space publishers.

2.    Boardman Ted, 2014, *3dsmax 7 Fundamentals*, Pearson Education.

**REFERENCE BOOKS**

1.    Boris Kulagin, 2008, *3ds Max 8 from Modelling to Animation*, Bpb publishers.

2.      Michael G, 2004, 3D Modelling and Animation, Igi Publishers.

3.      Lance Flavell, 2010, Beginning Blender: Open Source 3D Modelling, Animation, and Game Design, Apress publishers.

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|---|---|---|---|
| 3 | 0 | 0 | 3 |

**AD1732**             **APPLICATION OF ROBOTICS**

**OBJECTIVES:**

To enable the students to

- Study the various parts of robots and fields of robotics.

- Study the Localization and Map Representation of robots.

- Learn about localization, planning and navigation.

- Learn about different applications of field robot.

- Study the humanoid Robots in applications.

**UNIT I          INTRODUCTION                                                9**

History of service robotics – Present status and future trends – Need for service robots – applications - examples and Specifications of service and field Robots. Non-conventional Industrial robots.

**UNIT II          LOCALIZATION                                               9**

Introduction-Challenges of Localization - Map Representation - Probabilistic Map based Localization - Monte Carlo Localization - Globally Unique Localization - Positioning Beacon Systems - Route based localization.

**UNIT III          PLANNING AND NAVIGATION                           9**

Introduction-Path planning overview - Road map path planning -Cell decomposition path planning - Potential field path planning - Obstacle avoidance - Case studies: tiered robot architectures.

**UNIT IV          FIELD ROBOT APPLICATIONS                          9**

Ariel robots -Collision avoidance - Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

**UNIT V          HUMANOIDS APPLICATIONS                            9**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of

emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

**TOTAL: 45 PERIODS**

## OUTCOMES

**CO1:** Explain the basic concepts of working of robot.

**CO2:** Summarize the Localization and Map Representation of the robot.

**CO3:** Demonstrate the knowledge for planning and navigation of a robot.

**CO4:** Summarize the use of field robots in various applications.

**CO5:** Summarize the use of humanoid Robots in various applications.

## TEXT BOOKS

1. Mittal, RK, Nagrath, IJ, 2005, *Robotics and Control*, 4th Reprint, Tata McGraw Hill, New Delhi.

2. John J Craig, 2009, *Introduction to Robotics Mechanics and Control*, 3rd ed, Pearson Education.

3. Groover, MP, Weiss, M, Nageland, RN & Odrej, NG, 1996, *Industrial Robotics*, McGraw Hill.

## REFERENCE BOOKS

1. Ashitava Ghoshal, 2010, *Robotics-Fundamental Concepts and Analysis*, Oxford University Press, Sixth impression.

2. Klafter, RD, Chimielewski, TA & Negin, M, 1994, *Robotic Engineering–An Integrated Approach*, Prentice Hall of India, New Delhi.

3. Ghosh, BK, 1998, *Control in Robotics and Automation: Sensor Based Integration*, Allied Publishers, Chennai.

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**AD1733     ENTERPRISE APPLICATION DEVELOPMENT**

**OBJECTIVES:**

To enable the students to

- Understand the architectures of Distributed systems, to compare technologies associated with J2EE and DOTNET.
- Implement lightweight enterprise-ready applications.
- Familiarize the capability in python programming and grow true web applications utilizing Django

**UNIT I     CLIENT SERVER ARCHITECTURE                                      6**

2-tier model - 3-tier model - n-tier model -J2EE architecture - DOTNET architecture - MVC architecture.

**UNIT II    SPRING                                                          6**

Web services – Consuming a restful web service – Java desktop application / JSP, building REST service with spring – Spring security architecture- Securing web applications.

**UNIT III   STRUTS                                                         6**

Struts – Introduction – MVC framework – STRUTS architecture – Business service – Parameter passing – Action class and configuration files – struts.xml tags.

**UNIT IV   HIBERNATE                                                       6**

HIBERNATE ORM – Persistence – Relational Database – The object relational impedance mismatch – Using native Hibernated APTs and hbm.xml – Using the java persistence API's.

**UNIT V    DJANGO                                                         6**

Introduction - Django model layer – View layer - Template layer – Forms —– Django security – Django web application tools.

**TOTAL: 30 PERIODS**

**OUTCOMES**

  **CO1:**    Develop an application using different client server architectures such as 2-tier model, 3-tier model, n-tier model, J2EE architecture, .NET architecture, and MVC architecture .

**CO2:** Implement a restful service using spring framework.

**CO3:** Develop a web application using the struts framework.

**CO4:** Build a simple application with hibernate and persistence.

**CO5:** Develop simple web applications using Django.

## LIST OF EXPERIMENTS

1. Create a program to connect with database and manipulate the records in the database using ADO.NET
2. Develop a car showroom inventory web application with 2-tier architecture
3. Develop a real estate web application with n-tier architecture
4. Develop a simple Spring MVC application that take user input and checks the input using standard validation annotations
5. Design a student identity management web application using struts framework. The application should be able to provide an identity such as student id, access to department assets with department id, access to lab assets with lab id.
6. Create a simple online bookstore using Django as a back end
7. Creating a Java Application using Hibernate technology.
8. Example for Basic Hibernate CRUD operations.
9. Example for Spring Dependency Injection and Types
10. Example for Simple spring JDBC program

**PRACTICAL : 30 PERIODS**

## LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

| S. No. | Description of Equipment | Quantity Required |
|--------|--------------------------|-------------------|
| 1. | Personal Computers (Intel Core i3, 500 GB, 8 GB RAM) | 30 |
| 2. | Printer | 1 |
| 3. | Software: .NET, Java Spring, Django, Hibernate, JDBC | 30 |

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Inderjeet Singh, Beth Stearns, Mark Johnson & the Enterprise Team, 2011 (Reprint) Designing Enterprise Applications with the J2EETM Platform, 2nd ed, Addison Wesley.

2. Martin Fowler, 2010, *Patterns of Enterprise Application Architecture,* 1st ed, (Addison Wesley Signature Series).

**REFERENCE BOOKS**

1. John Kanalakis, 2003, *Developing .NET Enterprise Applications*, 1st ed, Apress.

2. Yakov Fain, 2010, *Enterprise Development with Flex*, 1st ed, O'Reilly Series.

3. Jansch, VO, 2008, *PHP/Architect's Guide to Enterprise PHP Development*, Musketeers.me, LLC, 2008

4. Steven Holzner, 2007, *PHP: The Complete Reference*, 1ST ED, McGraw Hill Education.

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| **AD1734** | **STATISTICAL TOOLS FOR DATA SCIENCE ENGINEERS** | 2 | 0 | 2 | 3 |

## OBJECTIVES:

To enable the students to

- Provide students with a framework that will help them choose the appropriate descriptive statistics in various data analysis situations.
- Analyze distributions and relationships of real-time data.
- Apply estimation and testing methods to make inference and modeling techniques for decision making using various techniques including multivariate analysis.

## UNIT I    BASIC STATISTICAL TOOLS FOR ANALYSIS                6

Summary Statistics, Correlation and Regression, Concept of $R^2$ and Adjusted $R^2$ and Partial and Multiple Correlation, Fitting of simple and Multiple Linear regression, Explanation and Assumptions of Regression Diagnostics.

## UNIT II    STATISTICAL INFERENCE                6

Basic Concepts, Normal Distribution-Area properties, Steps in tests of significance – large sample tests - Z tests for Means and Proportions, Small sample tests – t-test for Means, F test for Equality of Variances, Chi-square test for independence of Attributes.

## UNIT III    FORECASTING METHODS                6

Introduction: Concept of Linear and Non Liner Forecasting model, Concepts of Trend, Exponential Smoothing, Linear and Compound Growth model, Fitting of Logistic curve and their Applications, Moving Averages, Forecasting accuracy tests.

## UNIT IV    MODELING METHODS                6

Probability models for time series: Concepts of AR, ARMA and ARIMA models.

## UNIT V    DESIGN OF EXPERIMENTS                6

Analysis of variance – one and two way classifications – Principle of design of experiments, CRD – RBD – LSD, Concepts of $2^2$ and $2^3$ factorial experiments.

**TOTAL: 30 PERIODS**

**OUTCOMES**

**CO1:** Explain the value of statistics as a discipline and its relevance for Engineering.

**CO2:** Perform large sample test and small sample test of Hypothesis as well as calculate confidence interval for a population parameter for real time data.

**CO3:** Experiment with various forecasting methods.

**CO4:** Apply various techniques of time series models, including the regression with ARMA models.

**CO5:** Interpret the outcomes of estimation and hypothesis tests in the context of a problem.

**LIST OF EXPERIMENTS**

1. Computing Summary Statistics using real time data
2. Plotting and visualizing data using Tabulation and Graphical Representations.
3. Applying simple linear and multiple linear regression models to real dataset; computing and interpreting the coefficient of determination for scale data.
4. Testing of hypothesis for large sample tests for real-time problems.
5. Testing of hypothesis for Small Sample tests for F-test
6. Testing of hypothesis for Small Sample tests for Chi-square test
7. Applying Time series analysis -Trends. Growth, Logistic, Exponential models
8. Applying Time series model AR, ARMA and ARIMA
9. Performing ANOVA (one-way and two-way), CRD, RBD and LSD for real dataset.
10. Performing $2^2$ factorial experiments with real time Applications.

**PRACTICAL : 30 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|--------|--------------------------|-------------------|
| 1. | Personal Computers (Intel Core i3, 250 GB, 8 GB RAM) | 30 |

| 2. | Printer | 1 |
|----|---------|---|
| 3. | Software R-4.0.5 or latest version (free, open source) | |

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Douglas C Montgomery George C Runger, 2016, *Applied Statistics and Probability for Engineers*, 6th ed, John Wiley & Sons.

2. Robert H Shumway, David S Stoffer, 2017, *Time Series Analysis and Its Applications with R Examples*, Springer publications.

**REFERENCE BOOKS**

1. Trevor Hastie & Robert Tibshirani, 2017, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed, Springer Series in Statistics.

2. Susan Milton & Jesse Arnold, 2017, *Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences*, Mc.Grawhill education.

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| **CS1736**　**RISK MODELING AND ASSESSMENT** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To enable the students to

- Understand the fundamentals of risk modeling and assessment
- Identify the risks through hierarchical holographic modeling and its derivatives
- Understand the objectives of risk modeling, assessment and management.
- Explore the concepts of multi objective risk impact analysis
- Learn the principles and guidelines of project risk management.

| UNIT I | **FUNDAMENTALS OF RISK MODELING AND ASSESSMENT** | 9 |
|---|---|---|

Introduction- Systems Engineering -  Risk Assessment and Management,  The Role of Modeling in the Definition and Quantification of the Risk Function: -Introduction - The Risk Assessment and Management Process: Historical Perspectives-Information, Intelligence, and Models- The Building Blocks of Mathematical Models - On the Complex Definition of Risk, Vulnerability, and Resilience: a Systems Based Approach - On the Definition of Vulnerabilities in Measuring Risks to Systems-On the Definition of Resilience in Measuring Risk to Systems-On the Complex Quantification of Risk to Systems

| UNIT II | **IDENTIFYING RISK AND RISK FILTERING** | 9 |
|---|---|---|

Identifying Risk through Hierarchical Holographic Modeling and its Derivatives: Hierarchical Aspects -Hierarchical Overlapping Coordination -HHM - HHM and the Theory of Scenario Structuring - Adaptive Multiplayer HHM Game - Water Resources System -Sustainable Development- HHM in a System Acquisition Project -Software Acquisition - Hardening the Water Supply Infrastructure- Risk Assessment and Management for Support of Operations other than War Automated Highway System – Food Poisoning Scenarios Risk Filtering, Ranking, and Management: Introduction - Past Efforts in Risk Filtering and Ranking - RFRM: A Methodological Framework - Case Study: An OOTW 220.

| UNIT III | ADVANCES IN RISK MODELING, ASSESSMENT AND MANAGEMENT - I | 9 |

Risk of Extreme Events and the Fallacy of the Expected Value: Introduction - Risk of Extreme Events- The Fallacy of the Expected Value -The PMRM -General Formulation of the PMRM -Summary of the PMRM- Illustrative Example-Analysis of Dam Failure and Extreme Flood through the PMRM – Example Problems - Multiobjective Decision Tree Analysis: Introduction -Methodological Approach-Differences between SODT and MODT- Example Problems.

| UNIT IV | ADVANCES IN RISK MODELING, ASSESSMENT AND MANAGEMENT - II | 9 |

Multiobjective Risk Impact Analysis Method: Introduction - Impact Analysis-The Multiobjective, Multistage Impact Analysis Method: An Overview - Combining the PMRM and the MMIAM - Relating Multiobjective Decision Trees to the MRIAM - Example Problems -Statistics of Extremes: Extension of the PMRM **:** A Review of the Partitioned Multiobjective Risk Method - Statistics of Extremes -Incorporating the Statistics of Extremes into the PMRM- Sensitivity Analysis of the Approximation of $f4(\cdot)$ - Generalized Quantification of Risk of Extreme Events.

| UNIT V | PRINCIPLES AND GUIDELINES FOR PROJECT RISK MANAGEMENT | 9 |

Introduction -Definitions and Principles of Project Risk Management- Project Risk Management Methods - Aircraft Development Example-Quantitative Risk Assessment and Management of Software Acquisition- Critical Factors That Affect Software Nontechnical Risk -Basis for Variances in Cost Estimation-Discrete Dynamic Modeling.

**TOTAL: 45 PERIODS**

**OUTCOMES**

**CO1:** Explain about Risk modeling principles and its assessment.

**CO2:** Summarize the activities for risk identification and filtering.

**CO3:** Interpret risk modeling and assessment.

**CO4:** Demonstrate multi objective risk impact analysis.

**CO5:** Summarize the activities for project risk management.

**TEXT BOOK**

1.      Yacov Y Haimes, *Risk Modelling, Assessment and Management,* 4th ed, Wiley Publishers.

**REFERENCE BOOK**

1.      Charles Yoe, *Principles of Risk Analysis: Decision Making Under Uncertainty,* 2nd ed,  CRC Press.

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**AD1735     VIRTUALIZATION AND CLOUD COMPUTING**

**OBJECTIVES:**

To enable the students to:

- Understand the basics of cloud computing along with virtualization.
- Demonstrate hypervisor types in server virtualization.
- Discuss virtualization solutions.
- Explain migration concepts in virtualization.
- Familiarize with cloud software environment and security in cloud

## UNIT I     INTRODUCTION TO VIRTUALIZATION                    6

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization.

## UNIT II     SERVER VIRUALIZATION                    6

Virtual machine basics, types of virtual machines, hypervisor concepts and types. Server Virtualization: Understanding Server Virtualization, types of server virtualization.

## UNIT III    VIRTUALIZATION SOLUTIONS                    6

Understanding Microsoft's Virtualization solutions: Microsoft's Infrastructure Optimization Model, Virtualization and the Infrastructure Optimization Model, Benefits of Virtualization, Achieving the Benefits of Datacenter Virtualization, Achieving the Benefits of Client Virtualization, Achieving the Benefits of Cloud Virtualization

## UNIT IV   HIBERNATE                    6

Introduction, Layers in cloud architecture, Cloud Service models, Cloud deployment model: Advantages of Cloud computing. Challenges while migrating to Cloud, Broad approaches to migrating into the cloud - why migrate -deciding on cloud migration, the Seven-step model of migration into a cloud.

**UNIT V     CLOUD TECHNOLOGIES AND SECURITY IN CLOUD                6**

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine – Amazon Web Services – Open Stack – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards

**TOTAL: 30 PERIODS**

**OUTCOMES**

**CO1:**     Summarize the basic concepts of virtualization.

**CO2:**     Explain hypervisor types in virtualization.

**CO3:**     Explain virtualization solutions.

**CO4:**     Illustrate migration concepts in virtualization.

**CO5:**     Paraphrase software environment and security in cloud.


**LIST OF EXPERIMENTS**

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8

2. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.

3.  Install a C compiler in the virtual machine created using virtual box and execute Simple Programs

4. Show the virtual machine migration based on the certain condition from one node to the other

5. Find a procedure to transfer the files from one virtual machine to another virtual machine.

6. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)

**PRACTICAL : 30 PERIODS**

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1. | Personal Computers (Intel Core i3, 250 GB, 8 GB RAM) | 30 |
| 2. | Ubuntu OS (Preferred) or CentOS | 30 |
| 3. | Printer | 1 |
| 4. | Virtual box, VMware Workstation, Cloud Environment Creation, OpenStack | 30 |

**TOTAL: 60 PERIODS**

## TEXT BOOKS

1. Marshall, David, Reynolds, Wade A McCrory, Dave, 2006, *Advanced Server Virtualization: VMware and Microsoft Platforms in the Virtual Data Center*, 1st ed, Auerbach Publications.

2. Kai Hwang, Geoffery C Fox & Jack J Dongarra, 2012, *Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet*, 1st ed, Morgan Kaufman Publisher, Elsevier.

## REFERENCE BOOKS

1. Michael Miller, 2008, *Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online*, Que Publications.

2. Rajkumar Buyya, James Broberg & Andrzej Goscinski, 2011, *Cloud Computing (Principles and Paradigms),* John Wiley & Sons, Inc.

3. Toby Velte, Anthony Velte & Robert Elsenpeter, 2010, *Cloud Computing - A Practical Approach*, Tata Mcgraw Hill.

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| **OAD171** | **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To enable the students to

- Understand the various characteristics of Intelligent agents
- Learn the different search strategies in Artificial Intelligence
- Understand the concepts of Machine Learning and Probability Theory.
- Appreciate supervised learning and their applications.
- Understand unsupervised learning like clustering and EM algorithms

**UNIT I        INTRODUCTION                                                          9**

ntroduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

**UNIT II       PROBLEM SOLVING METHODS                                    9**

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

**UNIT III      INTRODUCTION TO MACHINE LEARNING                      9**

Machine Learning –Types of Machine Learning –Supervised Learning –Unsupervised Learning –Basic Concepts in Machine Learning –Machine Learning Process –Weight Space –Testing Machine Learning Algorithms –A Brief Review of Probability Theory –Turning Data into Probabilities –The Bias-Variance Trade-off.

**UNIT IV      SUPERVISED LEARNING                                            9**

Linear Models for Regression –Linear Basis Function Models –The Bias-Variance Decomposition –Bayesian Linear Regression –Common Regression Algorithms – Simple Linear Regression –Multiple Linear Regression –Linear Models for Classification –Discriminant Functions –Probabilistic Generative Models – Probabilistic Discriminative Models –Laplace Approximation –Bayesian Logistic Regression –Common Classification.

**UNIT V          UNSUPERVISED LEARNING                                    9**

Mixture Models and EM–K-Means Clustering –Dirichlet Process Mixture Models – Spectral Clustering –Hierarchical Clustering –The Curse of Dimensionality – Dimensionality Reduction –Principal Component Analysis –Latent Variable Models(LVM) –Latent Dirichlet Allocation (LDA).

**TOTAL: 45 PERIODS**

**OUTCOMES**

CO1: Explain the various characteristics of intelligent agents.

CO2: Make use of searching strategies to solve various real time problems

CO3: Summarize the machine learning concepts.

CO4: Apply suitable classification or regression algorithm for an application.

CO5: Apply clustering algorithms for different types of applications.

**TEXT BOOKS**

1. Russell, S & Norvig, P, 2009, *Artificial Intelligence: A Modern Approach*, 3rd ed, Prentice Hall.

2. Ethem Alpaydin, 2015, *Introduction to Machine Learning*, 3rd ed, Prentice Hall of India.

**REFERENCE BOOKS**

1. Tim Jones, M, 2008, *Artificial Intelligence: A Systems Approach (Computer Science)*, 1st ed, Jones and Bartlett Publishers.

2. Nils J Nilsson, 2009, *The Quest for Artificial Intelligence*, Cambridge University Press.

3. Christopher Bishop, 2006, *Pattern Recognition and Machine Learning*, Springer.

4. Kevin P Murphy, 2012, *Machine Learning: A Probabilistic Perspective*, MIT Press.