Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI301	**Generative AI**	DSC	4	4

Course Outcome:

1. To understand generative AI deeply, including its historical development.
2. To understand the dynamics of reinforcement learning and the power of data search in Generative AI.
3. To understand potential digital transformation opportunities enabled by generative AI for your organization.
4. To understand what it will take – from both technology and culture - to make AI work in your organization.

Learning Outcome:

1. Discover how diverse domains like art, biology, emotional support, and learning apply Generative AI.
2. Comprehend and implement prompt engineering to enhance productivity.
3. Learn CNN for image translation using Generative AI.
4. Learn Auto Encoders and Generative Adversarial Network with Generative AI.

UNIT	TOPICS
UNIT - I	**Introduction to Deep Learning:** History of Deep Learning, Learning XOR, Perceptron, Gradient Based Learning, Deep Neural Network, Architecture Design of ANN and Backpropagation, Activation & Loss Functions, Drop out & Regularization **Introduction to Generative Modelling:** What is Generative Modelling, Generative vs Discriminative Modelling, The Rise of Generative Modelling and Framework, Probabilistic Generative Models, Challenges of Generative Models.
UNIT - II	**Sequence Modelling :** Recurrent Neural Network(RNN), Bidirectional RNN, Encoder- Decoder Sequence to sequence Architecture, LSTM, Gated recurrent unit, Attention Mechanism, Introduction of Transformer, What is self-attention.
UNIT - III	**Convolutional Neural Network:** CNN and visual cortex system, Convolution Operation, Pooling & padding, CNN vs ANN, Image to Image Translation, ResNET and VGG16
UNIT - IV	**Auto encoders(AE):**

	Architecture of auto encoder, Types: Under complete AE, Sparse AE, Denoising AE, Variation AE, Generating New Faces using Variational Auto encoders **Introduction to Generative Adversarial Network:** Generator, Discriminator, Training the GAN, GAN Challenges: Oscillating Loss,DCGAN, Mode Collapse, Uniormative Loss, Hyperparameter.

Reference:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville - Deep Learning (2017, MIT)

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI301P	**Generative AI**	DSC	4	2

Practical :

1. Implementation of gradient descent optimizer.
2. Implementation of drop out and regularization.
3. Implementation of generative models.
4. Design recurrent neural network.
5. Implementation of LSTM.
6. Demonstration of pre-train models.
7. Design convolutional neural network for image classification.
8. Implementation of generative adversarial network.

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI302	**Optimization Techniques**	DSC	4	4

Course Outcome:

1. Comprehend the techniques and applications of Engineering optimization.
2. Analyze characteristics of a general linear programming problem
3. Apply basic concepts of mathematics to formulate an optimization problem
4. Analyse various methods of solving the unconstrained minimization problem
5. Analyze and appreciate variety of performance measures for various optimization problems

Learning Outcome:

1. Apply operations research techniques like linear programming problems in industrial optimization problems.
2. Solve allocation problems using various OR methods.
3. Understand the characteristics of different types of decision making environments and the appropriate decision making approaches and tools to be used in each type.
4. Recognize competitive forces in the marketplace and develop appropriate reactions based on existing constraints and resources.

UNIT	TOPICS
UNIT - I	**Introduction to optimization** Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.
UNIT - II	**Linear Programming** Problem Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.
UNIT - III	**Single Variable Optimization** Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.
UNIT - IV	**Intelligent Optimization Techniques** Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming,

	terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

References

1. Reinforcement Learning: An Introduction Second edition, in progress Richard S. Sutton and Andrew G. Barto c 2014, 2015

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI302P	**Optimization Techniques**	DSC	4	2

Practical List:

1. Introduction to Optimization
2. Introduction to MATLAB
3. Classical Optimization Techniques
4. Unconstrained Optimization: Elimination Methods
5. Unconstrained Optimization: Interpolation Method
6. Unconstrained Optimization: Direct Root Methods
7. Constrained Optimization: Equality Constraints
8. Constrained Optimization: Inequality Constraints

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI303	**Advanced Data Analytics**	DSC	4	4

Course Outcome:

1. To develop skills to both design and critique visualizations.
2. To introduce visual perception and core skills for visual analysis.
3. To understand R programming and Spreadsheet for analysis.
4. To understand issues and best practices in information dashboard design.

Learning Outcome:

1. Explain principles of visual perception
2. Apply core skills for visual analysis
3. Apply visualization techniques for various data analysis tasks
4. Design information dashboard

UNIT	TOPICS
UNIT I	**Introduction To The R Language**, Data Manipulation Techniques Using R Programming: Data In R, Reading And Writing Data, R And Databases, Dates, Factors, Subscribing, Character Manipulation, Data Aggregation, Reshaping Data
UNIT II	**Statistical Applications Using R Programming: Basics**, The R Environment, Probability And Distributions, Descriptive Statistics And Graphics, One- And Two-Sample Tests, Regression And Correlation, Analysis Of Variance And The Kruskal–Wallis Test, Tabular Data, Power And The Computation Of Sample Size, Advanced Data Handling, Multiple Regression, Linear Models, Logistic Regression, Survival Analysis, Rates And Poisson Regression, Nonlinear Curve Fitting
UNIT - III	**Functionality Using Ranges:** Using Ranges, Selecting Ranges, Entering Information Into a Range, Using AutoFill **Creating Formulas:** Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum, **Advance Formulas**: Concatenate, Vlookup, Hlookup, Match, Countif, Text, Trim **Spreadsheet Charts:** Creating Charts, Different types of chart, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table
UNIT - IV	**Data Analysis:** Sorting, Filter, Text to Column, Data Validation

	PivotTables: Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, Displaying a PivotChart, Setting PivotTable Options, Adding Subtotals to PivotTables **Spreadsheet Tools:** Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding , Protecting worksheets

References

1. Jojo Moolayil, “Smarter Decisions: The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI303P	**Advanced Data Analytics**	DSC	4	2

Practical List:

1. Learn all the basics of R-Programming (Data types ,Variables Operators etc.)
2. Implement R-Loops with different examples.
3. Learn the basics of functions in R and implement them with examples.
4. Implement data frames in R. Write a program to join columns and rows in a data frame using c bind()and r bind() in R.
5. Implement different String Manipulation functions in R
6. Implement different data structures in R (Vectors, Lists, Data Frames)
7. Write a program to read a csv file and analyze the data in the file in R
8. Create pie charts and bar charts using R.
9. Create a data set and do statistical analysis on the data using R.
10. Calculate Summary Statistics in Excel
11. Generate Comparative Statistics in Excel
12. Create Graphs in Excel
13. Advanced Data Analysis using PivotTables and Pivot Charts
14. Tabulation, bar diagram, Multiple Bar diagram, Pie diagram, Measure of central tendency: Mean, median, mode, Measure of dispersion: variance, standard deviation, Coefficient of variation. Correlation, regression lines.
15. t-test , F-test, ANOVA one way classification, chi square test, independence of attributes.
16. Time series: forecasting Method of least squares, moving average method. Inference and discussion of results.

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI401	**Introduction to Reinforcement Learning**	DSC	4	4

Course Outcome

1. To understand the basics of Reinforcement Learning.
2. The student should be able to a) model a control task in the framework of MDPs.
3. To identify the model based on the model free methods.
4. To identify stability/convergence and approximation properties of RL algorithms.
5. Use deep learning methods to RL problems in practice.

Learning Outcomes

1. Define the key features of reinforcement learning
2. Given an application problem (e.g. from computer vision, robotics, etc), decide if it should be formulated as a RL problem
3. Implement in code common RL algorithms.
4. Describe (list and define) multiple criteria for analyzing RL algorithms and evaluate algorithms
5. Describe the exploration vs exploitation challenge and compare and contrast at least two approaches for addressing this challenge

UNIT	TOPICS
UNIT - I	**Introduction Reinforcement Learning:** Overview of Reinforcement Learning concepts and terminology, Difference between supervised, Semi-Supervised, unsupervised, and reinforcement learning.
UNIT - II	**Markov Decision Processes(MDPS):** Introduction to MDPs, Formal definition of an MDPs and its components, Value Functions (V-function and Q-Learning), Bellman quotations and optimality principle.
UNIT - III	**Monte-Carlo Simulation:** Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling Importance Sampling on Truncated Returns
UNIT - IV	**Eligibility Traces:** n-Step TD Prediction, The Forward View of TD(λ), The Backward View of TD(λ), Equivalences of Forward and Backward Views, Sarsa(λ), Watkins's

	Q(λ), Off-policy Eligibility Traces using Importance Sampling, Implementation Issues, Variable λ

References

Reinforcement Learning: An Introduction Second edition, in progress Richard S. Sutton and Andrew G. Barto c 2014, 2015

Course Code	Course Name	Group	Teaching Scheme	Credits
			Lectures	
RJSPGDSAI401P	**Introduction to Reinforcement Learning**	DSC	4	2

Practical List:

1. Implementation of markov decision process.
2. Perform CartPole Balancing with Q-Learning.
3. Implement Mountain CAr with Deep Q-Networks(DQN).
4. Solve grid-world navigation problem.
5. Implement a solution to the multi-armed Bandit problem.
6. Solving Atari games with advanced DNs.
7. Implementation of monte carlo simulation.
8. Implement TD(0) for value estimation.

Course Code	Course Name	Group	Teaching Scheme
			Lectures
RJSPGDSAIE401	**Introduction to Robotics**	DSC	2

Course Outcome:

The objectives of this course are Identify robots and its peripherals for satisfactory operation and control of robots for industrial and non-industrial applications.

Learning Outcome:

On completion of the course the student will be able to:
1. list and explain the basic elements of industrial robots
2. analyse robot kinematics and its control methods.
3. classify the various sensors used in robots for better performance.
4. summarize various industrial and non-industrial applications of robots.

UNIT	TOPICS
UNIT - I	Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical etc., Laws of Robotics, Robot mechanisms; Kinematics- coordinate transformations, DH parameters, Forward kinematics, Inverse Kinematics
UNIT - II	Jacobians, Statics, Trajectory Planning, Actuators (electrical)- DC motors, BLDC servo motors, Sensors , sensor integration
UNIT - III	Control – PWM, joint motion control, feedback control, Computed torque control, Perception, Localisation and mapping
Unit IV	Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches, Simultaneous Localization and Mapping

References:

1. Introduction to Robotics: Mechanics and Control (3rd Edition) by John Craig from Pearson.
2. Robotics Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciavicco, , Giuseppe Oriolo, Luigi Villani from Springer.