Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) V Semester (Artificial Intelligence & Data Science)

w.e.f. Juy 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	AI51	PEC	Professional Elective Course-I	70	20	10	-	-	100	3	1	-	4
2	AI52	PCC	Deep Learning	70	20	10	30	20	150	3	-	2	4
3	AI53	PCC	Data Science	70	20	10	30	20	150	3	-	2	4
4	AI54	PCC	Digital & Wireless Communication	70	20	10	30	20	150	3	-	2	4
5	BT51	HSMC	Professional Ethics	70	20	10	-	-	100	3	1	-	4
Total				**350**	**100**	**50**	**90**	**60**	**650**	**15**	2	**6**	**20**
6	AI56	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
7	AI57	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code AI56 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four optional subjects those are available in MOOC as well for PEC.

02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.

Professional Elective Course-I		
S.No.	**Subject Code**	**Subject Name**
1	AI51A	Probability and Random Process
2	AI51B	Theory of Computation
3	AI51C	Information Theory & Coding

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, PCC: Professional Core Course, HSMC: Humanities and Social Sciences including Management Course, DLC: Distance Learning Course, MC: Mandatory Course,

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COURSE CONTENTS **w. e. f. July 2023**

Subject Code	Subject Name & Title	Maximum Marks Allotted						Hours/ Week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI51A	Probability and Random Process	70	20	10	-	-	100	3	1	-	4

Module-I: Probability Axioms of probability conditional
Probability Bay's theorem discrete and continuous random variables, Moments, Moment generating functions Binomial, Poisson Geometric, uniform, Exponential and neural distribution, Counting (permutation and combinations), probability axioms, Sample space, events, independent events, mutually exclusive events, Bernoulli Distribution.

Module-II: Two-dimensional Random. Variables Joint distributions, Marginal and conditional distributions Covariance correlation and linear regression, Transformation of random variables, central limit theorem (for independence and identically distributed random variables)

Module-III: Random Processes
Classification stationary process Markov process, Markov chain Poisson process, Random telegraph process. Correlation and spectral densities-Autocorrelation functions , cross correlation functions and properties, power spectral density, cross spectral density properties.

Module-IV: Linear system with Random Inputs
Linear time invariant system, system transfer function, linear systems with random inputs, auto correlation and cross correlation function of input and output. System stability.

Module-V: Statistics
Conditional expectation and variance, mean, median, mode and standard deviation,t-distribution, chi-squared distributions, cumulative distribution function, Conditional PDF, confidence interval, z-test, t-test, chi-squared test.

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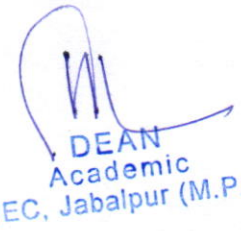
Reference Books:

1. Probability and Random Processes By S. Palaniammal, Prentice Hall, 2011
2. Probability theory and Random Processes By K. Mergu CBS Publisher.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Basic understanding of probabilities and various type of distributions.
CO2	Understanding of conditional & point probability, various, stationary process, markov process.
CO3	Developing concept of spectral density and system transfer function



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		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI51B	Theory of Computation	70	20	10	-	-	100	3	1	-	4

Module-I Introduction of Automata Theory

Examples of automata machines, Finite Automata as a language acceptor and translator, Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, Equivalence of NDFA and DFA, minimization of automata machines, 2 way DFA. Moore mealy machines , composite machine, Conversion from Mealy to Moore and vice versa.

Module-II: Regular Expressions and Languages:

Arden's theorem.Finite Automata and Regular Expressions, From DFA's to Regular Expressions, Converting DFA's to Regular Expressions. Properties of Regular Languages, The Pumping Lemma for Regular Languages, Applications of the Pumping Lemma Closure Properties of Regular Languages, Decision Properties of Regular Language.

Module -III: Grammars:

Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, Eliminating null and unit productions. Chomsky normal form and Greibach normal form.

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Module-IV: **Push** down **Automata:**
example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petri net model.

Module-V: Turing Machine
Techniques for construction. Universal Turing machine Multi-tape , multi-head and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable & undecidable languages , Halting problem of Turing machine & the post correspondence problem.

Reference Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory Languages and Computation", Pearson Education, India.

2. K. L. P Mishra, N. Chandrashekaran "Theory of Computer Science-Automata Languages and Computation", Prentice Hall of India.

3. Harry R. Lewis & Christos H. Papadimitriou,,"Element of the Theory computation ", Pearson.

4. Cohen, D.I. and Cohen, D.I., "Introduction to computer theory", Wiley.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Illustrate conceptual knowledge of switching and finite automata theory & languages.
CO2	Develop concept of abstract models of computing such as NFA, DFA, PDA. Turing machine and to check their power to recognize the languages
CO3	Interpret rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO4	Classify types of grammars, simplification and normal form and P. NP problems.

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Subject Code	Subject Name & Title	Maximum Marks Allotted						Hours/ Week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI51C	Information Theory And Coding	70	20	10	-	-	100	3	1	-	4

Module –I Source Coding:

A logarithmic measure of information, Average mutual information and entropy, Information measures for continuous random variables, Noiseless coding theorem, Coding for discrete memory-less sources, Discrete stationary sources, The Lampel-Ziv algorithm, Coding for analog sources, rate distortion function.

Module –II Channel Capacity and Coding:

The converse to the coding theorem, Channel models, Channel capacity, Achieving channel capacity with orthogonal Signals, Channel reliability functions, Random coding based on M-ary Binary-coded signals, Practical Communication systems in light of Shannon's equation.

Module –III The Noisy-channel coding theorem:

Linear Block codes, The generator matrix and the parity check matrix, Some specific linear block codes, Cyclic codes, Decoding of linear block codes, bounds on minimum distance of the linear block codes.

Module –IV Convolutional Codes:

Basic properties of the convolutional codes, The transfer function of a convolutional code, Optimum decoding of convolutional codes- The Viterbi algorithm, Distance properties of binary convolutional codes, Other decoding algorithms for convolutional codes, Practical considerations in the application of convolutional codes.

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Module –V Complex codes based on combination of simple codes:
Product codes, Concatenated codes, Turbo codes, The BCJR algorithm.
Coding for Bandwidth-constraint channels: Combined coding and modulation, Trellis coded modulation.

References Books :

1. Simon Haykins: Communication Systems, 4th Edition, John Wiley.
2. J. G. Proakis: Digital Communications, McGraw Hills
3. B.P. Lathi: Modern Analog and Digital Communication System, Oxford University Press
4. R. G. Gallager: Information Theory and Reliable Communication, John Wiley and Sons
5. A. J. Viterbi and J. K. Omura: Principles of Digital Communications and Coding, McGraw Hill Series.
6. U. Madhow: Fundamentals of Digital Communication, Cambridge University Press.

Course Outcomes:
Upon successful completion of course students will be able to:

CO1	Understand various source coding algorithm.
CO2	Describe channel capacity.
CO3	Translate noise channel coding theorem.
CO4	Understand various types of the convolution codes.
CO5	Execute complex codes based on combination of simple codes.

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Subject Code	Subject Name & Title	Maximum Marks Allotted						Hours/ Week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI52	Deep Learning	70	20	10	30	20	150	3	-	2	4

Module- I

Basics of neural networks, perception algorithm feed forward and Back propagation Networks, ideaof computational units. McCulloch Pitts unit and threshold logic unit, Linear perception, perceptionlearning algorithm.

Module-II

Feed Forward network, multilayer Perception, Gradient descent, Back propagations Empirical riskminimization, regularization auto encoders.

Module-III

Convolutional networks, convolution separation, verity of basic convolution function, structured outputs, Data types, Le Net, AlexNet.

Module-IV

Recurrent Neural Networks Bidirectional RNNS deep recurrent N/W, Recursive Neural Network the long short time memory & other gated Recurrent Unit.

Module-V

Deep Generative models, Boltzmann Machines, Restricted Boltzmann machines, machines introduction to MCMC and cubbs seeping gradient N/W Deep Boltzmann machines. Deep Boltzmann machines, application of deep learning in speech recognition

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Reference Books:

(1) Deep learning MIT, Press 2016 By Ia Good fellow, Yoshna Brangio
(2) Fundamental of deep learning By Nikhil Budeima, O'Reilly Publication
(3) Make your own neural network By Tariq Pashid

Course outcomes: After completion of course, student will be able to:

CO1 Understand basic need of deep learning.
CO2 Knowledge of deep learning algorithm.
CO3 Understanding CNN RNN in real world application.
CO4 Applying Deep Learning in practical application.

List of Experiments (AI52Lab)

1. Implementation of different activation functions to train Neural Network. usingMatlab/Python.
2. Implementation of different learning Rules.
3. Implementation of Perception Networks
4. Implementation of adaline network for system Identification
5. Implementation of the Madaline networks
6. Pattern matching with different rules.
7. Project related to application of machine learning in health care
8. Project related to application of machine learning in business analytics.
9. Pin point implementation of application of deep learning in sports analytics.
10. Deep learning project in Time series analysis and fore casting.
11. Generate generic Python code for deep learning Networks ..
12. Create and Explore Data store for image classification using deep learning .

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Subject Code	Subject Name & Title	Maximum Marks Allotted						Hours/ Week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI53	DATA SCIENCE	70	20	10	30	20	150	3	-	2	4

Module I: Introduction

Introduction to Data Science - Evolution of Data Science - Data Science Roles - Stages in a Data Science Project - Applications of Data science in various fields - Data Security Issues. Data Collection and Date Pre-Processing, Data Collection strategies - Data Pre-Processing overview - Data cleaning - Data integration and Transformation - Data Reduction - Data Discretization.

Module II: Exploratory Data Analytics

Descriptive statistics - Mean, Standard Deviation, Skewness and Kurtosis - Box plots - pivot Table - Heat Map - Correlation Statistics - ANOVA. Visual data AI algorithms for data analytics.

Module III: Model Development

Simple and Multiple Regression - Model Evaluation using visualization - Residual plot Distribution Plot - Polynomial Regression and pipelines – Measures for in-sample Evaluation - Prediction and Decision Making.

Module IV: Model Evaluation

Generalization Error – Out-of-sample Evaluation Metrics - Cross Validation - overfitting - under Fitting and Model Selection - Prediction by using Ridge Regression - Testing Multiple parameters by using Grid Search.

ModuleV: Introduction to Data Mining and Data Warehousing

Data types ,Introduction to Data Mining, Understand data: Mean, median, mode, standard deviation, correlation, variance, covariance, likelihood, data, nominal, ordinal, ratio, interval, factor, levels. Data warehousing Components, Building a Data warehouse, Data Warehouse Architecture, Data transformation such as normalization, discretization, sampling, compression; data warehouse modelling: schema for multidimensional data models, concept hierarchies, measures: categorization and computations.

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Reference Books:

l. Cathy O'Neil and Rachel Schutt , ..Doing Data Science", O'Reilly, 2015.
2. David Dietrich, Barry Heller, Beibei yang, ,,Data Science and Bii data Analytics,,, EMC 2O13
3. Raj, Pethuru, "Handbook of Research on cloud Infrastructures for Big Data Amlytics',, IGI Global.
4. Introduction to Data Science by Paul G. Allen School of Computer Science & Engineering, University of Washington.
5. JojoMoolayil, "Smarter Decisions: The intersection of loT and Data Science,,, PACKT, 2016.

COURSE OUTCOMES: At the end of this course, the students will be able to:

CO 1	Demonstrate proficiency with statistical analysis of data.
CO 2	Build and assess data-based models.
CO 3	Execute statistical analyses with professional statistical software.
CO 4	Demonstrate skill in data management.
CO 5	Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.

List of Experiments:- AI53 Lab

1. Write R – Programming to plot various charts and graphs. You have to consider minimum two popular data sets and draw all the statistical observations.
2. Write a python Program to apply EDA on any two popular data sets and provided your analysis and interpretations. Use matplotlib library of python along with other libraries for the analysis and interpretation.
3. Write Python program to implement K-Means using inbuilt python Library. Also, write your own program to implement K-Means without using the inbuilt function. Compare and contrast the results.
4. Write a python program to implement a Spam Filter using Linear Regression and K-NN. Use a popular dataset.
5. Write a Python Program to Scrapping the Web using suitable API. Create a usable dataset for classification and clustering purpose.
6. Write a Python Program to implement Filter and Wrappers.
7. Write a Python Program to implement Decision Trees, Random Forests – The inbuilt functions should not be used for the implementation.
8. Write a python Program to implement Singular Value Decomposition and Principal Component Analysis. Use any popular data set.
9. Write a python Program to extract the friendship details of your face book account as Social network Graph and represent in various visual forms.
10. Write Python Program using Bokeh 2.1.1 realize the all the basic principles of data visualization.
11. Consider any popular dataset and present complex visualization principle using Bokeh 2.1.1.

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		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
AI54	Digital And Wireless Communication	70	20	10	30	20	150	3	-	2	4

Module-I: Analog & Digital Communication

Analog Modulation, Sampling Theorem, Digital Modulation, AM Modulation, FM Modulation, Phase Modulation, Demodulation techniques, PCM Basic, ADM, DM, DPCM, PPM, PAM quantization in PCM

Module-II: Communication System

Overview of communication and information theory, coding- Shannon fano and halffman, LZW coding, Communication protocols in brief, Decoders – Viterbi Decoder, Redundancy coder – decoder and advanced decoders in trends.

Module-III: Mobile Communication

Mobile communication, block diagram, protocols and channel .Introduction to mobile communication Block Diagram, Transmitter, Base Stations, Routers communication, protocols, channels, and multi path channels, path loss, Fading, etc.

Module-IV: Wireless Communication

Wireless communication, Advanced Modulator and Demodulators, Overview of TDMA, FDMA, CDMA, WCDMA and OFDMA. Different Generations of 3G/4G/5G/6G of wireless communication system and advancement in technology in mobile, radio and wireless Communication.

Module-V: Communication System & Standards

Advance Wireless System and Communication Standards Like MPEG – 4, MPEG -7, JPEG- 2000, All Audio, Speech coders, MP3, H.264, G.711, G.722, etc.

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Reference Books:

1. Fundamentals of Wireless Communication: David Tse and PramodViswanath
2. Principles of Mobile Communication : Gordon L. Stüber
3. WIRELESSCOMMUNICATIONS : AndreaGoldsmith
4. Wireless Communication Principles and Practice : T. S. Rappaport

Course outcomes:

After completion of course, student will be able to:

CO1	Understand basics concept of Digital modulation techniques
CO2	Comprehend statistical multipath channel modes and path loss.
CO3	Knowledge of capacity of various wireless channels.
CO4	Analyze the diversity in wireless channels.
CO5	Elaborate various wireless systems and standards, 4G, 5G

List of Experiment:-AI54 Lab

1. Verification of sampling theorem.

2. Generation and detection of PCM signals

3 Determine the response of of delta modulation

4. Analysis of responses of ASK

5 Analysis of responses of PSK

6. Experiment on time division multiplexing and other access techniques.

8. Study of 4G and 5G communication System

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COURSE CONTENT

(w.e.f. July 2021 Onwards)

Subject Code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem Exam	Quiz/ Assignment	End Sem	Lab Work					
BT-51	Professional Ethics	70	20	10	-	-	100	3	1	-	4

Module I. HUMAN VALUES:
Morals , values and Ethics-Integrity-Work Ethics-Service Learning-Civics virtue-respect for others- Living peacefully - Caring – Sharing - Honestly – Courage - Valuing time- Cooperation - Commitment- Empathy - Self Confidence – Character – Spirituality - Introduction to Yoga and meditation for professional excellence and stress management.

Module II: ENGINEERING ETHICS:
Sensors of Engineering Ethics- Variety of moral Issues- Types of Inquiry – Moral dilemmas- Moral autonomy- Kohiberg's theory – Gilligan's theory – Consensus and Controversy – Models of Professional roles – Theories about right action – self interest – Customs and Religion- Uses of Ethical Theories.

Module III : ENGINEERING AND SOCIAL EXPERIMENTATION:
Engineering as Experimentation – Engineering as responsible Experimenters – Codes of Ethics – A balanced Outlook on Law.

Module IV: SAFETY,RESPONSIBILITIES AND RIGHT:
Safety and Risk – Assessment of Safety and Risk – Risk Benefit analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentially – Conflict of interest –

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Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Module V: GLOBAL ISSUES:

Multinational Corporations – Environment Ethics – Computer Ethics – Weapons Development – Engineering as Managers – Consulting Engineers – Engineering as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate social Responsibility.

References Books:

1. MikeW.Martin and Roland Schinzinger, "Ethics in Engineering" Tata Mc-Graw Hill New Delhi,2003.
2.Govindaranjan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India, New Delhi,2004.
3.Charies B. Feddermann, "Engineering Ethics" Pearson Prentics Hall, New Jersey 2004
4.Charies E. Herris Michael S. Pritchard and Michael J. Rabins "Engineering Ethics – Concepts and cases" Learning, 2009.
5.John R Boatright, "Ethics and the conduct of Business" , Pearson Education New Delhi 2003.
6.Edumund G Seebauer and Robert L Barry, "Fundamental of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.
7.Laura P. Hartman and joe Desjardins, "Buisness Ethics: Decision Making for Personal Intigrity and Social Responsibility" McGraw Hill Education India Pvt Ltd, New Delhi 2013.
8.World Community Service Centre, "Value Education",Vethathiri publication, Erode 2011.

COURSE OUTCOMES:

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society .At the end of the course the student will be able to

CO1	Understand Human Values
CO2	Apply Engineering Ethics.
CO3	Apply Engineering as Social expectation.
CO4	Assess Safety and Risks.
CO5	Deep Perception of Global Issues.

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