MA3391   **PROBABILITY AND STATISTICS**   **L T P C**
                                                                3 1 0 4

COURSE OBJECTIVES

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I   PROBABILITY AND RANDOM VARIABLES   **9 + 3**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II   TWO- DIMENSIONAL RANDOM VARIABLES   **9 + 3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III   ESTIMATION THEORY   **9 + 3**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances

UNIT IV   NON- PARAMETRIC TESTS   **9 + 3**

Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests .

UNIT V   STATISTICAL QUALITY CONTROL   **9 + 3**

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

                                                             TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:
CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO2: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
CO3: Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO4: Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
CO5: Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS
1. Johnson. R.A., Miller. I.R and Freund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.
3. John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992.

REFERENCES:
1. Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.

CO's-PO's & PSO's MAPPING

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	0	0	0	0	0	0	2	0	0	2			
CO2	3	3	0	0	0	0	0	0	2	0	0	2			
CO3	3	3	0	0	0	0	0	0	2	0	0	2			
CO4	3	3	3	2	0	0	0	0	2	0	0	2			
CO5	3	3	2	2	0	0	0	0	2	0	0	2			
AVG	3	3	1	1	0	0	0	0	2	0	0	2			

1 - low, 2 - medium, 3 - high, '-' - no correlation

AL3452	OPERATING SYSTEMS	L T P C
		3 0 2 4

COURSE OBJECTIVES:
- To understand the basics and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms and process synchronization.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To be familiar with I/O management and File systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.

UNIT I   INTRODUCTION   7

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods.

UNIT II   PROCESS MANAGEMENT   11

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The critical-section problem - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III   MEMORY MANAGEMENT   10

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames –Thrashing.

UNIT IV   STORAGE MANAGEMENT   10

Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.

UNIT V   VIRTUAL MACHINES AND MOBILE OS   7

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.

**   45 PERIODS**
PRACTICAL EXERCISES: 30 PERIODS

1. Installation of Operating system : Windows/ Linux
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exec, Getpid, Exit, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms

5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphores
7. Write a C program to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
1. Write C programs to implement the following Memory Allocation Methods
       a. First Fit   b. Worst Fit   c. Best Fit
2. Write C programs to implement the various Page Replacement Algorithms
3. Write C programs to Implement the various File Organization Techniques
4. Implement the following File Allocation Strategies using C programs
       a. Sequential   b. Indexed   c. Linked
5. Write C programs for the implementation of various disk scheduling algorithms

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Analyze various scheduling algorithms and process synchronization.
CO2 : Explain deadlock, prevention and avoidance algorithms.
CO3 : Compare and contrast various memory management schemes.
CO4 : Explain the functionality of file systems I/O systems, and Virtualization
CO5 : Compare iOS and Android Operating Systems.

TOTAL:75 PERIODS

TEXTBOOKS
1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 4th Edition, New Delhi, 2016.

REFERENCES
1. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
3. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	-	-	-	-	1	1	1	2	2	1	2
2	2	3	1	3	1	-	-	-	3	2	2	3	3	3	1
3	2	2	3	3	2	-	-	-	3	1	1	2	1	1	1
4	2	2	1	2	1	-	-	-	1	3	2	1	1	1	2
5	2	3	3	2	1	-	-	-	3	1	2	1	3	1	2
AVG	2	2	2	2	1	-	-	-	2	2	2	2	2	1	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

AL3451	MACHINE LEARNING	L T P C
		3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts of machine learning.
- To understand and build supervised learning models.
- To understand and build unsupervised learning models.
- To evaluate the algorithms based on corresponding metrics identified

UNIT I   INTRODUCTION TO MACHINE LEARNING   8
Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II   SUPERVISED LEARNING   11
Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT III   ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING   9
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT IV   NEURAL NETWORKS   9
Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

UNIT V   DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS   8
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Explain the basic concepts of machine learning.
CO2 : Construct supervised learning models.
CO3 : Construct unsupervised learning algorithms.
CO4: Evaluate and compare different models

TOTAL:45 PERIODS

TEXTBOOKS:
1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014.

REFERENCES:
1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5. Sebastain Raschka, Vahid Mirjalili , "Python Machine Learning", Packt publishing, 3rd Edition, 2019.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2	1	-	-	-	-	3	3	2	2	2	2	1
2	1	3	3	1	2	-	-	-	2	2	2	1	1	1	1
3	2	1	3	3	2	-	-	-	1	1	1	1	2	1	1
4	2	3	3	2	1	-	-	-	3	2	3	2	1	2	1
5	1	1	3	3	1	-	-	-	3	1	1	3	3	3	2
AVG	2	2	3	2	2	-	-	-	2	2	2	2	2	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

AD3491	FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS	L T P C
		3 0 0 3

COURSE OBJECTIVES:
- To understand the techniques and processes of data science
- To apply descriptive data analytics
- To visualize data for various applications
- To understand inferential data analytics
- To analysis and build predictive models from data

UNIT I   INTRODUCTION TO DATA SCIENCE   08

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II   DESCRIPTIVE ANALYTICS   10

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r^2 – multiple regression equations – regression toward the mean.

UNIT III   INFERENTIAL STATISTICS   09

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.

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UNIT IV — ANALYSIS OF VARIANCE — 09

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.

UNIT V — PREDICTIVE ANALYTICS — 09

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using StatsModels – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, the students will be able to:

CO1: Explain the data analytics pipeline
CO2: Describe and visualize data
CO3 : Perform statistical inferences from data
CO4 : Analyze the variance in the data
CO5 : Build models for predictive analytics

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I).
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCES

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
4. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	1	-	-	-	-	3	1	3	2	3	3	1
2	1	1	2	2	2	-	-	-	2	2	3	2	3	1	1
3	1	1	3	1	1	-	-	-	2	3	1	1	2	3	1
4	2	3	1	3	1	-	-	-	3	3	3	3	3	2	2
5	2	1	1	1	2	-	-	-	3	3	1	3	2	2	1
AVG	1	1	2	2	2	-	-	-	3	2	2	2	3	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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CS3591	COMPUTER NETWORKS	L T P C
		3 0 2 4

COURSE OBJECTIVES:
- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer

UNIT I   INTRODUCTION AND APPLICATION LAYER   10

Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT II   TRANSPORT LAYER   9

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III   NETWORK LAYER   7

Switching : Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP.

UNIT IV   ROUTING   7

Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.

UNIT V   DATA LINK AND PHYSICAL LAYERS   12

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets
6. Write a code simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC)

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO 1: Explain the basic layers and its functions in computer networks.

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CO 2: Understand the basics of how data flows from one node to another.
CO 3: Analyze routing algorithms.
CO 4: Describe protocols for various functions in the network.
CO 5: Analyze the working of various application layer protocols.

TOTAL:75 PERIODS

TEXT BOOKS
1. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022

REFERENCES
1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	3	-	-	-	-	1	1	3	1	3	2	1
2	3	2	1	2	2	-	-	-	2	2	2	1	3	2	3
3	2	2	3	2	1	-	-	-	3	3	1	2	1	1	3
4	1	3	1	3	1	-	-	-	1	2	1	1	1	3	1
5	3	3	1	1	2	-	-	-	2	2	2	2	2	2	2
AVG	2	2	2	2	2	-	-	-	2	2	2	1	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE3451	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L T P C
		2 0 0 2

COURSE OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

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Padeepz App

UNIT I   ENVIRONMENT AND BIODIVERSITY   6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II   ENVIRONMENTAL POLLUTION   9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III   RENEWABLE SOURCES OF ENERGY   6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV   SUSTAINABILITY AND MANAGEMENT   6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V   SUSTAINABILITY PRACTICES   6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1: To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2: To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5: To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :
1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidel 87 / 402 in Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

AD3411	DATA SCIENCE AND ANALYTICS LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES:
- To develop data analytic code in python
- To be able to use python libraries for handling data
- To develop analytical applications using python
- To perform data visualization using plots

LIST OF EXPERIMENTS
Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

Working with Numpy arrays

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1. Working with Pandas data frames
2. Basic plots using Matplotlib
3. Frequency distributions, Averages, Variability
4. Normal curves, Correlation and scatter plots, Correlation coefficient
5. Regression
6. Z-test
7. T-test
8. ANOVA
9. Building and validating linear models
10. Building and validating logistic models
11. Time series analysis

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to:
CO1. Write python programs to handle data using Numpy and Pandas
CO2. Perform descriptive analytics
CO3. Perform data exploration using Matplotlib
CO4. Perform inferential data analytics
CO5. Build models of predictive analytics

REFERENCES
1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
3. Data Analysis and Visualization Using Python, Analyze Data to Cre~ ... ... for BI Systems — Dr. Ossama Embarak

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	3	-	-	-	-	2	2	3	3	3	2	1
2	1	2	1	2	2	-	-	-	1	2	3	1	3	2	1
3	2	2	2	2	2	-	-	-	3	1	1	2	2	3	1
4	2	3	1	3	2	-	-	-	2	3	1	2	2	1	3
5	3	1	1	1	2	-	-	-	1	2	2	3	2	2	1
AVG	2	2	1	2	2	-	-	-	2	2	2	2	2	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

AD3461   **MACHINE LEARNING LABORATORY**   **L T P C**
                                                               0 0 4 2

COURSE OBJECTIVES:
- To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
- To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.
- To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
- To build the graph based learning models for standard data sets.

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Padeepz App

Padeepz App

- To compare the performance of different ML algorithms and select the suitable one based on the application.

LIST OF EXPERIMENTS:
1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples.
2. Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate data sets.
4. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets.
5. Implement **naïve Bayesian Classifier** model to classify a set of documents and measure the accuracy, precision, and recall.
6. Write a program to construct a **Bayesian network to** diagnose CORONA infection using standard WHO Data Set.
7. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means **algorithm**. Compare the results of these two algorithms.
8. Write a program to implement *k*-**Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions.
9. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data

CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	3	-	-	-	-	2	2	3	3	3	2	1
2	1	2	1	2	2	-	-	-	1	2	3	1	3	2	1
3	2	2	2	2	2	-	-	-	3	1	1	2	2	3	1
4	2	3	1	3	2	-	-	-	2	3	1	2	2	1	3
5	3	1	1	1	2	-	-	-	1	2	2	3	2	2	1
AVG	2	2	1	2	2	-	-	-	2	2	2	2	2	2	1

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AD3461	MACHINE LEARNING LABORATORY	L T P C
		0 0 4 2

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8. Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions.
9. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select an appropriate data set for your experiment and draw graphs.

List of Equipments:(30 Students per Batch)
The programs can be implemented in either Python or R.

TOTAL:60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Apply suitable algorithms for selecting the appropriate features for analysis.
CO2: Implement supervised machine learning algorithms on standard datasets and evaluate the performance.
CO3: Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance.
CO4: Build the graph based learning models for standard data sets.
CO5: Assess and compare the performance of different ML algorithms and select the suitable one based on the application.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	1	-	-	-	-	1	2	3	3	3	2	1
2	2	1	1	3	2	-	-	-	3	2	3	2	3	1	1
3	2	2	1	1	2	-	-	-	1	1	1	1	2	3	3
4	2	2	3	3	2	-	-	-	1	2	1	1	1	2	2
5	2	2	3	1	2	-	-	-	3	1	1	1	2	1	2
AVG	2	2	2	2	2	-	-	-	2	2	2	2	2	2	2

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