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Head

Annexure-III to the Minutes of Departmental Committee Meetings held on 8th April, 2026

(Item-I)

Entrance Examination Syllabus for the year 2027 and onwards for Admission to 5th Year of FYIMP in DS & AI (1-year Master's Programme in DS & AI)

Note: There shall be sixty questions, each carrying one mark. Weightage to be given to each section is indicated in parentheses. Paper setters are required to set the required number of multiple-choice questions with only one correct or most appropriate answer, separately for each section, ensuring uniform representation of the entire syllabus.

Unit I: Evolutionary Computing

(04)

Overview of Evolutionary Computing- Evolutionary Algorithms, Evolutionary Search Techniques, Principles of Genetic Algorithms, Encoding schemes and Representation. Selection, Crossover, and Mutation Operators. Evolutionary Strategies: Evolution in continuous variables. Transformations. Covariance Matrix Adaptation. Different Components of Evolutionary Algorithms- Framework, Populations, Selection operators, Genetic operators. Genetic Programming, Differential Evolution

Unit II: Probability Theory

(04)

Probability: Sample space and events – Probability – The axioms of probability – addition law of probability – Conditional probability – Bayes' theorem. Counting Techniques: Permutations and combinations, applications in probability, discrete probability: finite and countably infinite sample spaces, inclusion-exclusion principle. Random Variables: Discrete and Continuous, Probability Mass Function (PMF), Probability Density Function (PDF), and Cumulative Distribution Function (CDF)– Distribution - Binomial, poisson.

Unit III: Machine Learning

(04)

Inductive learning algorithms. Categories of inductive learning algorithms. Rule extraction with inductive learning algorithms, Decision trees, ID3 algorithm. AQ algorithm, SAFARI algorithm Applications of Inductive Learning Machine Learning: Supervised, Unsupervised and Reinforcement Learning, Applications. Introduction to Classification: Overview, types of classification problems, binary vs. multi-class classification. Linear Regression, Logistic Regression.

Introduction to Clustering: Definition, types of clustering (hard vs. soft), applications, and importance. K-Means and Variants: K-means algorithm, choosing the number of clusters (elbow method), K-means++.

Unit IV: Cloud Computing

(04)

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, Business Agility: Benefits and challenges to Cloud architecture. VIRTUALIZATION: Role of virtualization in enabling the cloud: Types of Virtual Machines, Advantages of Virtualization, Components of Virtualization.

CLOUD APPLICATIONS: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture.

Unit V: Deep Learning Essentials

(04)

Deep Learning vs. Traditional Machine Learning, Key Deep Learning Terminology, Shallow Architectures and Deep Architectures, Deep Learning Basics: Biological Neural Network, Artificial Neural Networks, Neuron as a basic building element of ANN, Activation Functions, Perceptron, learning with Perceptron, Limitations of Perceptron, Multilayer neural network, learning with Multilayer Perceptron, Training ANN using Backpropagation algorithm.

Bayesian Classifiers: Naive Bayes, assumptions, advantages, limitations, and Bayesian networks.

Support Vector Machines (SVM): SVM for linearly separable data, kernel methods for non-linearly separable data, hyperplane and margin concepts.
K-Nearest Neighbors (KNN): KNN algorithm, choice of K, distance metrics, and performance optimization. (04)

Unit VI: Digital Image Processing

Introduction to Digital Image Processing, Origins of DIP, Examples, Fundamental steps in DIP, Components of DIP. Fundamental elements of visual perception: brightness, contrast, hue, saturation, Mach-band effect; Light and the electromagnetic spectrum. Image formation and digitization concepts; Image sensing and acquisition; Image sampling and quantization. Basic relationships between pixels: Neighbor's of pixel, adjacency, connectivity, regions and boundaries, distance measures.
Image enhancement in the spatial domain: Background; Point and arithmetic/logic operations; Some basic grey-level transformations; Histogram processing: Equalization, Matching.
Mechanics of spatial filtering: Correlation, Convolution; Smoothing spatial filters; Sharpening spatial filters. (04)

Unit VII: Time Series Analysis & Forecasting

Stochastic process. Time series as a discrete stochastic process. Main characteristics of stochastic processes- Auto-covariation and Autocorrelation functions. Stationary stochastic processes. Components of time series: trend, seasonality, cyclicity, and noise. Moving average (MA), Auto regressive (AR), ARMA and AR integrated MA (ARIMA) models. Box-Jenkins models, choice of AR and MA periods. Seasonal ARIMA models. Exponential Smoothing methods: Simple, Holt's, and Holt-Winters exponential smoothing
Inheritance: Mechanism. Role of Access Modifiers. Method Overriding and Shadowing. Use of super keyword. Polymorphism Early and late binding. Abstract Class and Interface. Exception Handling: Mechanism - Exception-Object, Throwing an Exception, and Exception Handler. Types of Exception - Checked vs Unchecked, Built-in vs User defined. Catching an Exception try-catch-finally. Specifying an Exception throws.

Unit VIII: Optimization Techniques (04)

Linear Programming Problem (LPP): Formulating LPPs, Simplex Algorithm, Big-M Method, Two Phase Method, Sensitivity Problem. Duality in LPP: Duality Theorems, Dual Simplex Method.
Transportation Problems: Mathematical Formulation of Transportation problem, Methods of selecting initial basic feasible solution: Matrix minima method, North-West Corner Rule, Vogel's Approximation Method; Unbalanced Transportation Problem, Degeneracy in Transportation Problem and its resolution through MODI Method (U-V Method).

Unit IX: Deep Learning Architecture (04)

Convolutional Network Regularization: Data Augmentation, L2, Dropout, DropConnect. Batch Normalization, Transfer Learning and Fine-Tuning Pretrained Models. Advanced Convolutional Architectures: AlexNet, Visual Geometry Group, Residual Networks, Inception Networks: V1, V2, V3, V4 and Inception-Res, Applications of Convolutional Neural Network: Image classification, object detection, and image segmentation. Transfer Learning and Fine Tuning, Limitations of Convolutional Networks.
Overview of NAS: History and Motivation, significance in Deep Learning. Baseline methods and its limitations: Random and Grid search.

Unit X: Big Data Analytics (04)

Overview of Big Data: Definition, characteristics, and importance (Volume, Velocity, Variety, Veracity, and Value). Differences between traditional data management and Big Data. Challenges of Big Data. Introduction to Hadoop Ecosystem: HDFS, MapReduce. Introduction to NoSQL databases: Key-value stores, Document databases, Column-family stores.
Introduction to Hadoop: Architecture, HDFS (Hadoop Distributed File System), and MapReduce framework. Overview of Apache Spark: Architecture, RDD (Resilient Distributed Dataset), and comparison with MapReduce. Introduction to Data Warehousing: Hive, HBase. Introduction to Stream Processing: Apache Storm, Kafka.

Unit XI: Intrusion Detection Systems (04)

Overview of Intrusion detection and its importance in cybersecurity, Types of Intrusion Detection Systems. Attack trees and Correlation of Alerts, Autopsy of Worms and Botnets, Malware Detection, Obfuscation, Email/IM security issues, Viruses/ Spam, From Signatures to thumbprints to zero-day Detection, Insider Threat Issues, Masquerade and Impersonation Traitors, Decoys and Deception.
Basic concepts of Intrusion detection system and Intrusion Prevention System, Components of IDS: Sensors, analyzers, and user interfaces. Types of IDS: Host-based IDS (HIDS), Network-based IDS (NIDS), and Hybrid IDS.

Unit XII: Generative AI (04)

Introduction to Generative AI: What is Generative AI? Historical context and development. Applications of Generative AI. Generative vs. Discriminative Modeling. The rise of generative modeling, the generative modeling framework. Probability and Statistics in Generative AI, Probabilistic Generative Model. Naïve bayes. The challenges of Generative modeling.

Generative Models: Overview, Types of Generative Models (e.g., Variational Autoencoders, GANs, Boltzmann Machines). Strengths and Weaknesses of each model.

Unit XIII: Reinforcement Learning (04)

Overview of Reinforcement Learning (RL) and its applications. Differences between Supervised, Unsupervised, and Reinforcement Learning. Key concepts: Agent, Environment, Actions, Rewards, Policy, and Value Functions. The Markov Decision Process (MDP): states, actions, rewards, state transitions. Exploration vs. Exploitation dilemma.

Dynamic Programming: Policy Evaluation, Policy Iteration, and Value Iteration. Bellman Equations. Monte Carlo methods for prediction and control. Model-free vs. model-based RL. Exploration strategies: epsilon-greedy, softmax

Unit XIV: Natural Language Processing (04)

History and applications of NLP. Overview of NLP tasks and challenges. Text preprocessing: tokenization, stemming, lemmatization. Part-of-speech tagging and named entity recognition. Regular expressions and text pattern matching. Speech processing: Phonetics, speech sounds and phonetic transcription, phonological categories and pronunciation variation.

Text classification and sentiment analysis: Sequence labeling and parsing. Word embeddings. Feature Engineering for Text representation, Bag of Words model, Bag of N-Grams model, TF-IDF model. Named Entity Recognition (NER).

Unit XV: Fuzzy Systems (04)

History and evolution of fuzzy logic. Comparison between classical and fuzzy logic. Applications of fuzzy logic in various domains. Concept of fuzzy sets and membership functions. Operations on fuzzy sets: Union, Intersection, Complement. Types of membership functions: Triangular, Trapezoidal, And Gaussian. Fuzzy relations and their properties. Fuzzy logic operators: AND, OR, NOT.

Construction of fuzzy rules. Rule-based system design: Mamdani and Sugeno models. Fuzzification: Conversion of input data into fuzzy sets. Rule evaluation and aggregation. Defuzzification: Conversion of fuzzy outputs into crisp values. Design and implementation of fuzzy controllers.