Cybersecurity and Digital Forensics

Course Title: Cybersecurity and Digital Forensics
Course No: MIT601
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45 + 30
Pass Marks: 22.5 + 15
Credit Hrs.: 3

Course Description:
This course introduces the concepts of cybersecurity and digital forensics. The topics covered include basics of cyber security, digital forensic, forensic process, concepts of digital evidence, forensic analysis, web and e-mail forensics, mobile and cloud forensics.

Course Objectives:
The main objective of this course is to make students familiar with the concepts of cyber security focusing on digital forensics. Upon completion of this course students will be able to understand and use the cyber security practices and digital forensic tool for ensuring security and performing forensics in cyberspace.

Course Contents:

Unit	Contents	Hours
Unit 1 Cybersecurity (4 Hrs.)	Cyberspace	**0.25**
	Cybersecurity	**0.25**
	NIST Cybersecurity Framework	**0.25**
	Cybersecurity Management Process	**0.5**
	Cybersecurity Threats and Attacks	**0.5**
	Cyber Kill Chain	**0.25**
	Vulnerability Assessment	**0.5**
	Penetration Testing	**0.5**
	Ethical Hacking	**0.5**
	Cyber Law: Global and Local	**0.5**
Unit 2 Digital Forensics (10 Hrs.)	Digital Forensic	**0.5**
	Cyber Crime[Cybercrime Attack Mode, Examples of cybercrime: Malware Distribution, Ransomware Distribution, CryptoJacking, Hacking, SQL Injections, Pharming, Phishing, E-mail Bombing and Spamming, Identity Theft, Cyberstalking, DDoS Attacks, Social Engineering, Software Piracy]	**2**
	Digital Forensic Categories [Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics, Forensics Data Analysis]	**1**

	Digital Forensic Users[Law Enforcement, Civil Ligation, Intelligence and Counterintelligence]	**0.5**
	Digital Forensic Investigation Types[Public and Private],	
	Forensics Readiness [Importance, EDRM reference model]	**0.5**
	Digital Evidence[Digital Evidence Types, Machine/Network-Created Data, Locations of Electronic Evidence, Challenge of Acquiring Digital Evidence, Collecting Digital Evidence, Chain of Custody]	**2**
	Digital Forensics Examination Process [Seizure, Acquisition, Analysis, Reporting]	**0.5**
	Basic Concepts of Data Representation [Decimal, Binary, Hex]	**0.5**
	Computer Character Encoding Scheme[ASCII, Unicode]	**0.25**
	File Structure	**0.5**
	Digital File Metadata	**0.25**
	Timestamps	**0.25**
	Hash Analysis	**0.25**
	Data Storage on HDD	**0.5**
	Host Protected Area; Device Configuration Overlay	**0.25**
	File Systems: NTFS, FAT	**0.75**
Unit 3 Computer Forensics Lab Requirements (4 Hrs.)	Physical Facility Requirements	**0.25**
	Environment Controls	**0.25**
	Hardware Equipment	**0.25**
	Furniture and Consumable Materials	**0.25**
	Evidence Container	**0.25**
	Forensic Workstation [Basic and Commercial Ready-Made Digital Forensic Workstation]	**0.25**
	Forensic Software [Commercial Forensics Tools, Free and Open Source Forensic Tools, Linux Distribution for Digital Forensics]	**0.25**
	Validation and Verification of Forensics Hardware and Software	**0.25**
	Lab Manager	**0.25**
	Secrecy Requirement	**0.25**
	Lab Data Backup	**0.25**
	Training Requirements	**0.25**
	Policies and Procedures	**0.25**
	Documentation	**0.25**
	Lab Accreditation [Steps, Accreditation Bodies]	**0.5**
Unit 4 Forensic Process	Initial Response	**0.5**
	Search and Seizure	**0.25**
	Consent to Search	**0.25**

(5 Hrs.)	Subpoena	**0.25**
	Search Warrant	**0.5**
	First Responder Toolkit	**0.5**
	First Responder Tasks	**0.5**
	Order of Volatility	**0.5**
	Documenting the Digital Crime Scene	**0.5**
	Packaging and Transporting Electronic Devices	**0.5**
	Conducting Interview [First Responder Questions When Contacted by a Client, Witness Interview Questions, Witness Signature]	**0.75**
Unit 5 Acquiring and Analyzing Digital Evidence (8 Hrs.)	Acquiring Digital Evidence	**0.5**
	Forensic Image File Formats [Raw Format, Advanced Forensic Format (AFF), Expert Witness (EnCase)]	**1**
	Forensics Image File Validation	**0.5**
	Acquiring Volatile Memory [Live Acquisition, Virtual Memory, Challenges of Acquiring RAM Memory, Capturing RAM using Various Tools]	**1**
	Acquiring Non-Volatile Memory [Static Acquisition, Hard Drive Acquisition Methods: Physical Acquisition, Logical Acquisition, Sparse Acquisition, Using Various tools to capture hard drive, Hard Drive Imaging Risks and Challenges: Network attached storage, Encrypted Hard Drive, Corrupted or Physically Damaged Hard Drive, Cloud Data Acquisition, Network Acquisition]	**3**
	Analyzing Hard Drive Forensic Image[Analyzing Hard Drive Forensic Image using Various Tools]	**1**
	Analyzing RAM Forensic Image[Analyzing RAM Forensic Image using Various Tools]	**1**
Unit 6 Forensics Analysis (6 Hrs.)	Timeline Analysis [Creating Timeline and Generating Timeline Report using Various Tools]	**1**
	File Recovery [Undeleting Files, Recycle Bin Forensics, Data Carving]	**0.5**
	Registry Analysis [Architecture of Windows Registry, Acquiring Windows Registry, Registry Examination, Automatic Startup Locations , USB Device Forensics, Most Recently Used List, Network Analysis, Windows Shutdown Time, User Assist Forensics, Printer Registry Information, Deleted Registry Key Recovery]	**2**
	File Format Identification	**0.5**
	Windows Features Forensics Analysis [Windows Prefetch Analysis, Windows Thumbnail Forensics, Jump Lists Forensics,	**2**

	LNK File Forensics, Event Log Analysis, Hidden Hard Drive Partition Analysis, Windows Minidump File Forensics, Windows Volume Shadow Copies Forensics]	
Unit 7 Web Browser and E-mail Forensics (4 Hrs.)	Web Browser Forensics [Web Browser Forensics for Edge, Firefox, Chrome]	**2**
	E-mail Forensics [E-mail Header Examination, Analyzing E-mail Headers, Determining a Sender's Geographic Location, Investigating E-mail Clients, Webmail Forensics, E-mail Investigations Challenge]	**2**
Unit 8 Mobile and Cloud Forensics (4 Hrs.)	Mobile Device Forensics	**0.25**
	Acquisition Procedure for Mobile Devices	**0.25**
	Mobile Forensic Equipment	**0.25**
	Mobile Forensics Tools	**0.25**
	Cloud Forensics	**0.25**
	Legal Challenges in Cloud Forensics [Service Level Agreements, Jurisdiction Issues, Accessing Evidence in the Cloud]	**0.5**
	Technical Challenges in Cloud Forensics [Architecture, Data collection, Analysis of cloud forensic data, Anti-forensics, Incident first responders, Role management, Legal issues, Standards and training]	**1**
	Acquisitions in Cloud	**0.25**
	Cloud Investigation	**0.5**
	Tools for Cloud Forensics	**0.5**

Laboratory Works:

Laboratory works include implementing and simulating tools and techniques for ensuring cyber security and performing digital forensics. The laboratory should include case studies of cyber-attacks and digital forensics.

References:

1. Nihad A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS, Apress, 2019
2. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide To Computer Forensics and Investigations, Cengage Learning, 6th edition, 2018
3. William Stallings, Effective Cyber Security, Addion-Wesley, 2019
4. Joanna F. DeFranco, Bob Maley, What Every Engineer Should Know About Cyber Security and Digital Forensics, CRC Press, 2nd Edition, 2023
5. Joakim Kävrestad, Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications, Springer, 2nd Edition, 2020

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Model Question

Master Level/ Second Year/ Third Semester **Full Marks: 45**
Information Technology (MIT601) **Pass Marks: 22.5**
(Cybersecurity and Digital Forensics) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. What is digital forensics? Discuss different categories of digital forensics. List the steps of digital forensics examination process. [2+5+3]
2. Discuss the various Forensic Image File Formats. Describe how hard drive forensic image analysis is done? [5+5]
3. Define timeline analysis. What is registry analysis? How Printer Registry Information, Deleted Registry Key Recovery is done? [3+2+5]

Section B

Attempt any five questions. [5 x 5 =25]

4. Describe NIST cyber security framework [5]
5. Differentiate between pharming, phishing and social engineering. [5]
6. Discuss the duties of lab manager. [5]
7. Explain the challenges of acquiring digital evidence from RAM Memory. [5]
8. How E-mail forensics is done? Explain. [5]
9. What is cloud forensics? How analysis of cloud forensic data is done? [1+4]

Data Analytics and Visualization

Course Title: Data Analytics and Visualization
Course No: MIT602
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45+30
Pass Marks: 22.5+15
Credit Hrs.: 3

Course Description:
This course covers time series forecasting, machine learning and deep learning models for regression and classification, and text analytics with python.

Course Objectives:
The main objective of this course is to enable student to write python programs related to data analytics and visualization.

Course contents:

Unit	Contents	Hour
Unit 1 Data Visualization (6 Hrs.)	**Direct Plotting:** Concept, Line Chart, Bar Chart, Pie Chart, Scatter Plot, Box Plot, Histogram Plot	**1.5**
	Plotting with Matplotlib: Line Chart, Bar Chart, Histogram Plots, Scatter Plots, Stack Plot, Pie Chart, Heatmap, Using text() and annotate() methods to add text in the charts, Creating multiple charts in same Plot	**3**
	Plotting with Seaborn: Strip Plot, Box Plot, Swarm Plot, Joint Plot.	**1.5**
Unit 2 Time Series Forecasting (9 Hrs.)	**Introduction:** Concept and Components of Time Series, Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF), Correlogram**,** Plotting ACF and PACF	**1.5**
	Univariate Time Series Forecasting: Autoregression (AR), Moving Average (MA), Autoregressive Moving Average (ARMA), Autoregressive Integrated Moving Average (ARIMA), Seasonal Autoregressive Integrated Moving Average (SARIMA), Seasonal Autoregressive Integrated Moving-Average with Exogenous Regressors (SARIMAX), Programs for Time Series Forecasting using each Model and Visualizing Result	**3**
	Multivariate Time Series Forecasting: Vector Autoregression Moving Average, Vector Autoregression Moving-Average with Exogenous Regressors, Programs	**3**

	for Time Series Forecasting using each Model and Visualizing Result	
	Smoothing: Simple Exponential Smoothing, Holt Winter's Exponential Smoothing, Programs for Time Series Forecasting using each Model and Visualizing Result.	**1.5**
Unit 3 **Data Analytics with Machine Learning** **(12 Hrs.)**	**Introduction:** Scales of Measurement, Feature Engineering, Exploratory Data Analysis (EDA), Performance Metrics for Regression (MSE, RMSE, MAE, R^2) and Classification Algorithms (Confusion Metrics, Accuracy, Recall, Precision, F1-Score, Specificity)	**3**
	Regression and Classification: Regression and classification using KNN, Concept of Decision Tree, Concept of Attribute Selection Criterion, ID3 vs. C4.5 vs. CART Decision Trees, Random Forest (Bagging and Boosting), Concept of linear and Non-linear SVM, classification using SVC, Regression Using SVR, Gradient Boosting using XGBoost and LightGBM, Programs for classification and Regression using each Model	**7**
	Dimensionality Reduction: Principle Component (PCA) and Independent Component Analysis (ICA), Programs for PCA and ICA	**2**
Unit 4 **Data Analytics with Deep Learning** **(9 Hrs.)**	**Multilayer Perceptron:** Regression and Classification using Multiplayer Perceptron, Gradient Descent Optimizers (Momentum, RMSProp, Aadam), Programs for Regression and Classification Using MLP	**2**
	Recurrent Neural Networks: MLP vs. RNN, Recurrent Neural Networks (RNN), Vanishing and Exploding Gradient Problem, Long Short-term Memory (LSTM), Gated Recurrent Unit Networks (GRU), Programs for Regression and Classification Using LSTM and GRU	**5**
	Transformer and Generative Learning: Concept of Transformer, Auto-Encoder, Generative Adversarial Networks	**2**
Unit 5 **Text Analytics** **(9 Hrs.)**	**Text Preprocessing and Representation:** Review of Text Preprocessing (Tokenization, Lower Casing, Stop Word Removal, Stemming and Lemmatization) One Hot Encoding, Count Vectorization, TF-IDF Vectorization, Word Embeddings, Generating N-Grams, Hash Vectorization, Programs using NLTK	**3**

	Text Analysis: Finding Text Similarity, POS Tagging, Entity Extraction, Topic Extraction, Programs to Demonstrate each Topic	**3**
	Text Classification: Spam-Ham Classification, Sentiment Analysis, Transformer in NLP, Programs to Demonstrate each Topic	**3**

Laboratory Works:

Students need to write python programs to demonstrate time series forecasting, machine learning and deep learning algorithms for solving classification and regression problems, text preprocessing, text classification and sentiment analysis.

References:

1. Dr. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, First Edition, 2018
2. Sayan Mukhopadhyay, Advanced Data Analytics Using Python: With Machine Learning, Deep Learning and NLP Examples, Apress, Fisrt Edition, 2018.
3. Jesus Rogel-Salazar, Data Science and Analytics with Python, Chapman and Hall/CRC, First Edition, 2017.
4. Terence C. Mills, Applied Time Series Analysis: A Practical Guide to Modeling and Forecasting, First Edition, 2019.
5. Manohar Swamynathan, Mastering Machine Learning with Python in Six Steps: A Practical Implementation Guide to Predictive Data Analytics Using Python, Apress, First Edition, 2017.
6. Taweh Beysolow II, Applied Natural Language Processing with Python: Implementing Machine Learning and Deep Learning Algorithms for Natural Language Processing, Apress, First Edition, 2018.
7. Akshay Kulkarni and Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, First Edition, 2019.
8. Dipanjan Sarkar, Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data, Apress, First Edition, 2016.

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Model Question

Master Level/ Second Year/ Third Semester **Full Marks: 45**
Information Technology (MIT602) **Pass Marks: 22.5**
(Data Analytics and Visualization) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. How univariate time series forecasting differs from multivariate time series forecasting? Explain the concept behind various smoothing techniques used in time series forecasting. Demonstrate two of them with suitable python programs. [2+3+5]
2. Discuss the working of linear and non-linear SVM. Consider the dataset "course.csv" that contains attributes "NumberOfCourses", StudyTime and "Score", where Score is output attribute. Write a python program that divides dataset into train-test datasets in 8:1 ratio and then predicts score of the test data using SVR. Finally, compute and display RMSE and MAE of the predicted scores. [2+8]
3. When MLPs are suitable than machine learning approaches? Discuss loss functions used in MLPs for regression and classification problems briefly. Demonstrate classification using MLP with suitable python program. [2+3+5]

Section B

Attempt any five questions. [5 x 5 =25]

4. How can we add text and text with arrowhead in charts? Explain with examples. [1+4]
5. How ACF differs from PACF? Discuss time series forecasting using AR model with suitable python program. [1.5+3.5]
6. Why PCA is used? Discuss its working with suitable python program. [1+4]
7. When RNNs are favored over MLPs? Discuss vanishing gradient descent problems. Demonstrate use of RNN with suitable example. [1+1+3]
8. How can we use count vectorizer and TF-IDF vectorizer? Explain with examples. [2+3]
9. Write a python program that identifies spam and ham emails. Assume dataset of your own interest. [5]

Digital Governance

Course Title: Digital Governance
Course No: MIT603
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45 + 30
Pass Marks: 22.5 + 15
Credit Hrs.: 3

Course Description:
This course addresses the inefficiencies and risks associated with digital technology, emphasizing strategic investment and utilization. It covers fundamental principles like leadership, accountability, and transparency, providing insights to develop and implement digital strategies.

Course Objectives:
The main objective of this course is to make students familiar with different concepts of digital governance, understanding the principles and best practices of digital governance its security

Course Contents:

Unit	Contents	Hour
Unit 1 Introduction and Digital Governance Strategy (5 Hrs.)	A Digital Governance Manifesto	**0.5**
	The Scope of Digital Governance, The Role of the Governing Body	**1.5**
	Digital Governance Strategy: A Strategy for Digital Technology: Agreeing on the current situation, Developing a vision, How will we get there?	**1**
	A Pragmatic Approach to Digital Governance: Strategic principles	**0.5**
	Achieving Good Governance, Strategic Governance Principles: Principle 1 – Principle 12, Delivering Strategic Change	**1.5**
Unit 2 Managing rapid change in a digital world (3 Hrs.)	The Digital Opportunity, The Pace of Change: The problem with technology, Managing technology, Managing rapid change	**1**
	Getting Started: Watching out for the risks, Managing technology risks successfully, Understand your business environment, Provide active leadership	**1**

	Getting Digitisation Right: Have the right objectives, Plan for change, Promote the right structure, Avoid short-termism, Take account of people, Encourage innovation, Reach for excellence, Monitor success; Projects or Programmes?	**1**
Unit 3 Digitising Internal Operations (4 Hrs.)	Introduction, Understanding digitization: Technology drivers, Digitising processes, Moving to the cloud	**1**
	Making the case for process digitization: Efficiency and waste reduction, Efficiency and productivity, Data and information, Advantages beyond efficiency and data	**1.5**
	Issues with digitization: When not to digitize, Starting from scratch, Watching out for the risks, Managing the digital estate, Owning vs. renting assets Recording the digital estate	**1.5**
Unit 4 Transforming Products and Services (4 Hrs.)	Models of digital transformation, Digitally enhanced products: Adapting to digital services, Customisation as the norm, Personalisation, Providing information, Informationalisation, Being digital, Sticky ecosystems	**2**
	Digitised products: From atoms to pixels, Reusing infrastructure, Reusing data, Extrapolating data, New business models: The sharing economy, Usage-based pricing, Limited free services, New obligations, Make the customers do the work	**2**
Unit 5 Digital Marketing and Sales (6 Hrs.)	Introduction, Understanding Consumers (Digital Marketing Myth 1), Talking to Consumers (Digital Marketing Myth 2)	**1**
	Governance of Marketing Assets: Websites, Online advertising campaigns, Social media (Digital Marketing Myth 3), Reputation management	**3**
	Making the Sale (Digital Marketing Myth 4), Sales technology (Digital Marketing Myth 5), Finding the Right People	**2**
Unit 6 Thinking Digital in Mergers, Acquisitions and Venturing (3 Hrs.)	Introduction, Acquiring services rather than organisations, Assessing the fit	**0.5**
	Making it happen: Maintaining a focus on digital, Corporate venturing and start-ups, Data disclosure and data rooms, Due diligence, Deal provisions, The deal is done, so now what?, Cultural evolution, Technology strategy, Post-implementation review	**2.5**
Unit 7 Assuring Digital Compliance	Introduction, Why Care About Compliance?, Sources of Compliance Obligations	**0.5**
	Becoming Compliant: Scanning and tracking expectations, Engagement not denial, Obligation or option: what's reasonable?	**1**

(5 Hrs.)	The Role of Standards: The standards universe, Emerging Compliance Obligations	**1**
	Rationalisation of Compliance: Challenges of digital technology compliance, Doing what you said you'd do, Assessments, audits, KPIs and reporting, Assuring the assurers, The benefits of assured compliance, The rise of RegTech	**2.5**
Unit 8 Information and Cyber Security (5 Hrs.)	Introduction, What is All This About?: What's in a name?, Looking at the problem holistically, Developing a strategy	**0.5**
	Cyber Risk Management: Major cyber risks, Advanced persistent threats, Ransomware, Performing careful risk assessment, Risks in the supply chain	**1**
	Layered Protection: People, Process and Technology: Controls for layered protection, Efficiency vs. security, Managing assets that you don't control, Personal sof tware ,	**1**
	Protection Through People: Setting the rules, Training and awareness, Cultural change Protection through Process: Policies, Standards and best practices, Operational processes and management systems Protection through Technology	**1.5**
	Role of the Board in Security: Having realistic expectations, How are we doing?, Working with the Chief Information Security Officer, Getting help and contributing to increased professionalism, Delivering a culture of no regrets	**1**
Unit 9 Delivering Digital Privacy and Digital Resilience (6 Hrs.)	Introduction, Privacy: An Urgent Priority: Increasing volumes of increasingly intrusive data, GDPR: new rights and responsibilities, Increased penalties, Other consequences of privacy breaches, Privacy authorities	**1**
	Privacy Compliance: Privacy oversight, Processing data, Privacy: a trade-off between principle and pragmatism, Subject Access Requests	**1**
	Getting it Right: Questions of ethics and policy, Cultural dilemmas, limitations and exclusions, Other required processes	**1**
	Employers' Vicarious Liability, Embedding Privacy and Minimising Risk	**0.5**

	A Grandiose Name for Business Continuity?: Resilience: a few definitions, The scope of resilience, Foundations for resilience, Situational awareness and responding to the risks, Thinking outcomes, not triggers, Devolved but coordinated resilience planning, Balancing tactical decisions with strategic goals (A capability to adapt, Avoid over-dependence)	**2**
	Resilience Challenges: Testing and rehearsal, Managing stress, Importance of effective communications, Lesson learning and review	**0.5**
Unit 10 Emerging digital technologies (4 Hrs.)	Introduction, Big Data: Using Big Data, Robotic Process Automation and Autonomous Systems	**1.5**
	Artificial Intelligence, Internet of Things, Wearables, 3D Printing, Distributed Ledgers and Blockchain	**1.5**
	Virtual Reality and Augmented Reality: The mixed reality spectrum, Implants and Brain-Computer Interfaces	**1**

Laboratory Works:

1. Familiarize students with appropriate digital governance tools
2. Students should prepare a case based digital governance report

References:

1. Jeremy Swinfen Green and Stephen Daniels, Digital Governance: Leading and Thriving in a World of Fast-Changing Technologies, 2nd Edition, 2019
2. Michael E. Milakovich, Digital Governance: Applying Advanced Technologies to Improve Public Service, 2019
3. Data Governance for Managers: The Driver of Value Stream Optimization and a Pacemaker for Digital Transformation, Lars Michael Bollweg, Springer, 2022

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Model Question

Master Level/ Second Year/ Third Semester **Full Marks: 45**
Information Technology (MIT603) **Pass Marks: 22.5**
(Digital Governance) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. How can organization achieve good governance? Describe strategic governance principles. [3+7]
2. What is digital transformation? Illustrate models of digital transformation with suitable examples. [2+8]
3. Elaborate on governance of marketing assets with reference to websites, online advertisement campaigns and social media. [10]

Section B

Attempt any five questions. [5 x 5 =25]

4. Explain how cyber risk management can be carried out. [5]
5. "Managing rapid change in digital technology is very challenging". Justify the statement with suitable examples. [5]
6. Explain business process digitalization with respect to efficiency and data. [5]
7. Describe resilience management framework with suitable diagram. [5]
8. How can technology strategies and cultural evolution play significant role in the success of mergers and acquisitions of organizations? [5]
9. Write short notes: [2x2.5=5]
    a) Augmented Reality
    b) Scope of digital governance

Digital Economy

Course Title: Digital Economy
Course No: MIT605
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45 + 30
Pass Marks: 22.5 + 15
Credit Hrs.: 3

Course Description:
This course provides a comprehensive understanding of the digital economy, focusing on digital assets such as crypto currencies, blockchain technology, digital tokens, and decentralized finance (DeFi). Through a blend of theoretical foundations and practical applications, students will explore the evolution of digital money, the mechanics of digital market platforms, the intricacies of block chain technology, and the revolutionary potential of DeFi.

Course Objectives:
This objective of the course is to make students understand the history and evolution of physical and digital money, analyze the functioning and economic impact of digital market platforms. It also emphasizes on providing in-depth knowledge of crypto currencies, their ecosystems, and smart contracts, various types of digital tokens and their transactions. It also comprehends the purpose, types, and applications of blockchain technology. It also explores decentralized finance's concepts, origin, and components (DeFi) and the future of block chain and Web 3.0

Course Contents:

Unit	Contents	Hours	References
Unit 1 Introduction to Digital Economy (7 Hrs.)	Physical and Digital Money: History, Different Forms, Currency Pegs, Banks and e-money Wallets	2	Lewis, A. – Chapter 1
	Digital Market Platforms as Economic Practice	1	Jordan, T. – Chapter 1
	Search Engines	1	Jordan, T. – Chapter 2
	Social media	1	Jordan, T. – Chapter 3
	e-commerce Platforms	1	Jordan, T. – Chapter 4
	Online Games	1	Jordan, T. – Chapter 6
Unit 2 Blockchain Technology (15 Hrs.)	Introduction of Blockchain {History, Basics of: Public Key Cryptography; Hash; Digital Signature, Block Structure, Characteristic of Blockchain, Benefits of Blockchain, Basic Working Mechanism of Blockchain}	3	Mei, L. – Chapter 1

	Types of Blockchain: Distributed, Centralized vs. Decentralized Computing, Permissioned vs. Permissionless Blockchain	3	Mei, L. – Chapter 1
	Prolification of Blockchain Technology, Initial Coin Offering	2	Mei, L. – Chapter 1
	Consensus Mechanism: PoW, PoS, Hybrid, dBFT, and Proof of Concept	3	Mei, L. – Chapter 4
	Blockchain Application: Insurance, Health Management, Defense, Healthcare, Food, Credit Rating, Data management, Internet Security, Logistics and Supply Chain	4	Mei, L. – Chapter 8
Unit 3 Digital Assets (10 Hrs.)	Bitcoin {Introduction}, Bitcoin Mining, Working Mechanism, Bitcoin Wallets, Bitcoin Address	3	Mei, L. – Chapter 2
	Bitcoin Issues: Block Size, Split, Transaction Fees, Bitcoin Supply and its Future	2	Mei, L. – Chapter 3
	Ethereum {Introduction, History, Comparison with Bitcoin}, Actors in the Ethereum Ecosystem, Smart Contracts	2	Lewis, A. – Chapter 4
	Digital Tokens {Introduction}, Types of Tokens {Native, Asset-backed, Contract, and Utility}, and Transactions	3	Lewis, A. – Chapter 5
Unit 4 Decentralized Finance (DeFi) (10 Hrs.)	Introduction, History, Key Issues in DeFi, and Advantages over Traditional Approach	2	Harvey, C.R., Ramachandran, A., & Santoro, J. – Chapter 1 & 2
	Blockchain as DeFi Infrastructure: Blockchain, Cryptocurrency, The Smart Contract Platform, Oracles, Stablecoins, Decentralized Applications	2	Harvey, C.R., Ramachandran, A., & Santoro, J. – Chapter 3
	DeFi Primitives: Transactions, Fungible and Non-fungible Tokens, Custody, Supply Adjustment, Swap, Collateralized and Uncollateralized Loans	4	Harvey, C.R., Ramachandran, A., & Santoro, J. – Chapter 4

	DeFi Applications: Credit/Lending, Decentralized Access, Derivatives, Tokenization	2	Harvey, C.R., Ramachandran, A., & Santoro, J. – Chapter 6
Unit 5 Future of Blockchain and Web 3.0 (3 Hrs.)	Introduction	1	Lacity, M.C., & Lupien S.C. – Chapter 12
	Combinatorial Innovations, Metaverses, and Beyond	1	Lacity, M.C., & Lupien S.C. – Chapter 12
	Web 3.0 Aspirations for Decentralization and Inclusivity	1	Lacity, M.C., & Lupien S.C. – Chapter 12

Laboratory Works:

Lab 1: Implement SHA-256 to understand the concept of PoW in blockchain technology.
Lab 2: Implement the concept of Merkle Tree and Merkle root concepts in blockchain technology.
Lab 3: Build the fundamental structure of a blockchain.
Lab 4: Implement mining within a blockchain environment.
Case Study I – Central Bank Digital Currency (CBDC): identifying appropriate policy goals and design for Nepal (A Concept Report)
Case Study II – Neobank: An application of a Blockchain Technology

References:

1. Lewis, A., The Basics of Bitcoins and Blockchains. Mango, 2018
2. Mei, L., Blockchain, Bitcoin, and the Digital Economy. Mercury Learning and Information, 2022
3. Jordan, T., The Digital Economy, Polity, 2020
4. Harvey, C. R., Ramachandran, A., & Santoro, J., DeFi and the Future of Finance. John Wiley & Sons, 2021
5. Lacity, M. C., & Lupien, S. C., Blockchain Fundamentals for Web 3.0. University of Arkansas Press, 2022

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Master Level/ Second Year/ Third Semester **Full Marks: 45**
Information Technology (MIT 605) **Pass Marks: 22.5**
(Digital Economy) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. How does a proof-of-stake (PoS) consensus mechanism differ from a proof-of- work (PoW) consensus mechanism in blockchain networks? [10]
2. What are the primary differences between native tokens, asset-backed tokens, contract tokens, and utility tokens in the context of blockchain technology, and how do these differences influence their use cases? [8+2]
3. How do fungible tokens differ from non-fungible tokens (NFTs) in DeFi, and what are their respective use cases within the ecosystem? [4+6]

Section B

Attempt any five questions. [5 x 5 =25]

4. What are the various forms of money that have been used throughout history, and how have they evolved over time? [3+2]
5. What is an Initial Coin Offering (ICO), and how does it differ from a traditional Initial Public Offering (IPO) in terms of fundraising and regulatory oversight? [2+3]
6. How can blockchain technology improve transparency and efficiency in the insurance industry, and what are some real-world examples of its implementation? [2+3]
7. What are the key components of Bitcoin mining, and how does the mining process contribute to the security and functionality of the Bitcoin network? [2+3]
8. How do decentralized lending platforms operate in the DeFi ecosystem, and what are the advantages and risks associated with borrowing and lending through these platforms? [2+3]
9. What role do metaverses play in the broader context of Web 3.0, and how might they influence future interactions and economies within decentralized environments? [2+3]

Course Title: Human Computer Interaction
Course No: MIT 607
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45 + 30
Pass Marks: 22.5 + 15
Credit Hrs.: 3

Course Description:

This course covers different fundamental theories and concepts of human computer interaction. HCI is an interdisciplinary field that integrates theories and methodologies across many domains including cognitive psychology, neurocognitive engineering, computer science, human factors, and engineering design.

Course Objectives:

The main objective of this course is to provide fundamental knowledge on the basic physiological, perceptual, and cognitive components of human learning and memory and to develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.

Course Contents

Unit	Contents	Hour
Unit 1 Foundations (7 Hrs.)	**Introduction:** Cognitive Psychology and Computer Science, Capabilities of HCI, Goals and Roles of HCI, Architecture of HCI System, Ubiquitous Computing and Ambient intelligence	1
	The Human: Input - Output Channels, Human Memory, Thinking: Reasoning and Problem Solving, Human error and false memory, Emotion, Individual Differences, Psychology and the design of Interactive systems	3
	The Computer: Text Entry Devices, Positioning, Pointing and Drawing, Display Devices, Devices for Virtual Reality, Physical Control, Printing and Scanning, Memory, Processing and Networks	2
	The Interaction: Models of Interaction, Frameworks and HCI, Ergonomics, Interaction Styles, Interactivity, The Context of the Interaction, Experience, Engagement and Fun	1
Unit 2 Design Process (15 Hrs.)	**Interaction Design Basics**: Design, Process of design, User focus, Scenarios, Navigation Design (beware the big button trap, mode), Screen design and Layout, Iteration and Prototyping (Alignment and layout matter)	4
	HCI in Software Process: Software Life Cycle, Usability Engineering, Design Rationale	1

	Design Rules: HCI and usability engineering, Principles to support usability, Standards, Guidelines, Golden Rules and Heuristics, HCI Patterns	2
	Evaluation Techniques: Goals of Evaluation, Evaluation through expert analysis and user participation, choosing an Evaluation method	4
	Universal Design: Universal Design Principles, Multi Modal Interaction, Designing for Diversity	2
	User Support: Requirement of user support, Approaches to user support, Adaptive Help systems, designing user support systems	2
Unit 3 Models and Theories (20 Hrs.)	**Cognitive Models**: Goal and Task hierarchies, Linguistic models, Challenges of display based system, Physical and device models, Cognitive architectures	4
	Communication and Collaborative models: Face to face communication (GOMS saves money), Conversation, Text based communication, Group working	3
	Dialog notations and design: Dialog design notation, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design	2
	Spoken Dialogue System: General architecture of spoken dialogue system, Voice activity detection, Automatic speech recognition, Natural language understanding, Natural language generation, Text to speech synthesis	4
	Computational Models for Dialogue Management: Finite state based approach, Frame based approach, Agent based approach	2
	Statistical Approaches to Dialogue Management: Reinforcement learning, Dialogue as Markov decision process	2
	Models of the systems: Standard formalisms, Interaction models, Continuous behaviors	1
	Modeling rich interaction: Status event analysis, Rich contexts, Low intention and sensor based interaction (Designing a car courtesy light)	1
	Ubiquitous computing and Augmented Reality: Virtual and Augmented reality, Information and data visualizations	1
Unit 4 Ambient Intelligence (3 Hrs.)	AmI vision, AmI Contributing Technologies, Context aware systems and HCI, Middleware, Attentive computing. Immersive Interaction	3

Laboratory Works:

Students should implement different concepts of HCI models studied in each unit of the course during lab time and should submit a small model at the end of the course.

References:

1. Human – Computer Interaction, Third Edition, Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, Pearson , 2004
2. Human – Computer Interaction, K. Meena, R. Sivakumar, PHI, 2015

Tribhuvan University
Institute of Science and Technology
Model Question

Master Level/ Second Year/ Third Semester **Full Marks: 45**
Human Computer Interaction (MIT607) **Pass Marks: 22.5**
(Human Computer Interaction) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. Explain the Human-Computer Interaction (HCI) System architecture and its role in the context of ubiquitous computing and ambient intelligence. [10]
2. Describe the different models and theories of HCI related to cognitive models and communication models. How do these models contribute to the design of effective interactive systems? [7+3]
3. Evaluate the principles and techniques involved in the HCI design process including interaction design, design rules, and evaluation techniques. How do these contribute to creating user-friendly and efficient software? [7+3]

Section B

Attempt any five questions. [5 x 5 =25]

4. What are the capabilities and goals of HCI, and how do they influence the development of interactive systems? [5]
5. Describe the different input-output channels of the human user and their relevance to HCI. [5]
6. What are the different types of devices used for positioning, pointing, and drawing in HCI, and what are their uses? [5]
7. Explain the concept of 'Universal Design' in HCI and its importance in designing interactive systems. [5]
8. What is a spoken dialogue system, and what are its key components? [5]
9. Outline the significance of middleware in ambient intelligence and its impact on HCI**.** [5]

Database Administration

Course Title: Database Administration
Course No: MIT608
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 45 + 30
Pass Marks: 22.5 + 15
Credit Hrs.: 3

Course Description:

This course provides a comprehensive introduction to Database Administration (DBA) principles and practices using Oracle Database. Students will gain a foundational understanding of Oracle architecture, user and security management, database object manipulation, backup and recovery strategies, performance tuning techniques, and basic automation with the scheduler. The course integrates theoretical knowledge with hands-on labs, equipping students with practical skills for managing and maintaining organizational databases.

Course Objectives:

The main objective of this course is to make students:

- To explain the role and responsibilities of a Database Administrator.
- To describe the core components of Oracle Database architecture and install and configure an Oracle database instance.
- To utilize essential administrative tools like SQL*Plus, SQL Developer, and Enterprise Manager.
- To implement user accounts, privileges, and roles for secure access control.
- To create and manage various database objects including tables, indexes, views, and PLSQL Procedure and Functions.
- To develop backup and recovery strategies for data protection and disaster preparedness.
- To identify and apply performance tuning techniques to optimize database operations.
- To automate routine database tasks using the scheduler.

Course Contents:

Unit	Contents	Hours
Unit1 Introduction (6 Hrs.)	Introduction of Oracle Database, Tasks of a Database Administrator (Roles and Responsibilities of DBA)	**1**
	Oracle Database Architecture (Oracle Memory Structure (PGA, SGA, SGA components), Oracle Storage Structure (logical structure, Physical structure, Different physical files), Oracle Process Structure (user process, Server	**2**

	process, Oracle background Processes), Oracle Database Instance)	
	Oracle Multitenant Architecture (Container database concept, Pluggable database, Creating Pluggable Databases (PDBs) within a CDB, Benefits of the Multitenant Architecture)	**1**
	Installing and connecting database (Install, creating a database with DBCA, connecting database)	**1**
	Administrative Tools (SQL *Plus, SQL Developer, Enterprise Manager (EM))	**0.5**
	SQL Loader Overview (Input datafile, Control file, Log file, Bad file, Discard file)	**0.5**
Unit 2 **Oracle instance Configuration and Storage Management** **(6 Hrs.)**		
	Oracle instance configuration using parameter file (Understanding different parameters in parameter file, Configure different parameter and starting the instance)	**0.5**
	Online Redo log file, Control file and multiplexing (Control file, contents of control file and its importance, Online redo log files and their importance, Multiplexing the control file and online redo log files)	**1.5**
	Database archiving (Importance of Database archiving and archived redo logs, Steps of database archiving, Managing archive logs at different locations)	**1**
	Tablespaces and datafile management (Data Files and Tablespaces, Importance of tablespace in oracle database, Understanding the default tablespaces, creating new tablespace, renaming and drop tablespace, Adding datafiles in existing tablespace and resizing)	**1**
	Starting and shutdown modes (Startup options, Shutdown options and their differences)	**0.5**
	Undo Management	**0.5**

	(Undo Data Overview, Configure Undo Retention, Size the Undo Tablespace)	
	Oracle Network Configuration and Management (Overview of Network Configuration, Oracle Net Naming Methods, Oracle Net Service Components, Configure using Net Configuration Assistant, Start and Stop the Oracle Listener, Use TNSPING to Test Oracle Net Connectivity, Connect to the Database)	**1**
Unit 3 **Security and User Management** **(7 Hrs.)**	Database Security and Auditing (Overview of Database Security, Security Guidelines, Overview of Database Auditing, Standard Auditing, Fine-grained auditing, Unified Auditing)	**1.5**
	Database Authentication and Authorization Methods (Understanding Authentication and Authorization, User Authentication methods, administrative user accounts, Authorization Methods)	**1.5**
	Managing user accounts in CDB and PDB (Common and local user accounts concepts and scope, Creating common and local user and connecting the database, Monitoring user information)	**1**
	Privilege Management (System level security and object level security using privilege management, System and object level privileges, Granting and revoking system and object level privileges)	**1**
	Role management (Creating role, assigning privileges to the role and assign role to the user, Modify and Drop roles, Predefined roles)	**1**
	Profile Management (Overview of User Profiles, Profile Resource Parameters, Manage Passwords with Profiles, Control Resource Usage with Profiles, Create and apply the Profile, Alter and drop the profile)	**1**

Unit 4 **Managing Database Objects** **(10 Hrs.)**	Tables, constraints, sequence and Index (DDL and DML operation in table, Different types of constraints, creating and applying sequence in a table; Temporary tables; External Tables; create and drop index, Guidelines for Creating Indexes, Index Maintenance)	**2**
	Table Partitioning (Range Partitioning, List Partitioning, Hash Partitioning, Composite Partitioning)	**1**
	View, Materialized view, Synonyms (creating views and materialized views, private and public synonym)	**1**
	Introduction of PLSQL, Exception Handling (The Basic PL/SQL Block Structure, Declaring Variables, DML Statements in PL/SQL, Control statements; Predefined and user defined exceptions)	**1**
	Records, collections, Cursors (Records: Table-based, Cursor-based records, User-defined records; collections: Associative array, Varray, Nested Tables; Cursors: Implicit and Explicit cursors)	**2**
	Stored Procedure, Functions, Trigger, Package (Create procedure, passing parameter into and out of procedures; create stored function and invoke functions in SQL statements; use of before and after trigger, Statement Level Trigger, Row level Trigger, instead of trigger; Create package specification and package body)	**3**
Unit 5 **Backup, Recovery and High Availability** **(8 Hrs.)**	Oracle Backup Solutions (Oracle Secure Backup (RMAN Backup), User Managed Backup, Backup Terminology: whole and partial backup, full and incremental backup, cold and hot backup, Logical and Physical backup)	**1**
	Backup and Recovery Strategy (Database backup, Restoration and Recovery, Backup Guideline; Maintaining a Redundancy Set; RPO, RTO)	**1**
	Types of Failure	**1**

	(System failure, Statement failure, user process failure, network failure, user error, instance failure, media failure)	
	Oracle Recovery Process (Crash and Instance Recovery; Steps in Media Recovery; Complete and Incomplete Recovery)	**2**
	RMAN backup and Recovery, Data Pump (RMAN Configuration; Benefits of RMAN, RMAN backups: Full backup, partial backup, Restore and Recovery using RMAN, Data Pump Technology and its benefits, Export and import using DataPump, Backup and Recovery in multitenant Environment)	**2**
	High Availability Features (Oracle Real Application Clusters, Oracle Streams, Oracle Data Guard and standby databases, Flashback operations, Flashback Table Before Drop, Flashback database)	**1**
Unit 5 **Database Tuning** **(5 Hrs.)**	Performance Tuning Methodology (Tuning Methodology, Database Tuning Activities, Proactive Vs Reactive Tuning, Instance Tuning)	**1**
	Tuning Activities (Performance Planning , Tuning Application Design, Instance Tuning, Tuning Data Access, Tuning Data Manipulation, Reducing Network Traffic)	**1**
	Automatic Workload Repository (AWR); Automatic Database Diagnostic Monitor(ADDM)	**1**
	Tuning SQL; Execution Plans, SQL Tuning Advisor	**1**
	Performance Tuning in a Multitenant Environment	**1**
Unit 6 **Task automation with the Scheduler** **(3 Hrs.)**	Introduction to the Scheduler, Access Rights, Scheduler Components and Workflow (Job, Schedule, Program; DBMS_SCHEDULER workflow, Creating and scheduling a job, disabling, enabling and dropping a job)	**2**
	Time Based and Event-Based Schedules	**1**

Laboratory Works: Laboratory works include implementing the concepts in above mentioned chapters in oracle database.

References:

1. Oracle Database Administrator's Guide, 21c, Copyright © 1996, 2022, Oracle and/or its affiliates. Primary Authors: Mark Doran, Padmaja Potineni, Rajesh Bhatiy.
2. Benjamin Rosenzweig, E. R. (2015). Oracle PL/SQL by Example. New Yourk: Prentice Hall
3. Expert Oracle Database 11g Administration, Sam R. Alapati, Apress
4. https://docs.oracle.com/en/database/oracle/oracle-database/21/administration.html
5. Pro Oracle Database 18c Administration: Manage and Safeguard Your Organization's Data, Michelle Malcher and Darl Kuhn, Third Edition.
6. Database Administration: The Complete Guide to Practices and Procedures, Craig S. Mullins, Addison Wesley

Tribhuvan University
Institute of Science and Technology
Model Question

Master Level/ Second Year/ Third Semester **Full Marks: 45**
Information Technology (MIT 608) **Pass Marks: 22.5**
(Database Administration) **Time: 2 hours**

Section A

Attempt any two questions. [2 x 10 =20]

1. What is the importance of privileges in database security? Explain the different system privileges and object privileges in oracle database and how you can use them to secure the database with examples. Also explain the importance of roles in user authorization with example. [2+2+2+4]
2. Explain the term backup, restore and recovery in oracle database. Also explain the different backups and recovery processes with example. [3+5+2]
3. What do you mean by database management system? Mention the clear architecture of oracle database management system including different files and oracle background processes. [2+4+4]

Section B

Attempt any five questions. [5 x 5 =25]

4. What is materialized view? How does it differ from view? Explain the benefits of creating a materialized view. [2+1+2]
5. What is multiplexing? Why is it needed? Write the steps of multiplexing the redo log files with example. [1+1+3]
6. What is database archiving? Why is it needed? Write the steps to keep your database in archive log mode. [1+2+2]]
7. Explain the importance of job scheduling in oracle database. Explain time-based schedule with example. [2+3]
8. What is a package in PL/SQL? Explain the components of package with example. [1+4]
9. What is AWR and how does it help in performance tuning? Explain the key metrics captured in AWR snapshots. [1+2+2]