SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering

Program: B. Tech Data Science (Business Analytics)				Semester : IV	
Course/Module : Advanced Database Management System				Module Code: BTDS04003	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -100 in Question Paper)
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Database Management System (from SEM III)

Objectives:

- Expand the knowledge gained in Database Management Systems in several directions like Non-Relational data models, deductive (Intelligent) database systems, Distributed systems, web based systems and object oriented systems etc.

Course Outcomes:

After completion of the course, students would be able to :

- Design database using concept of extended entity relationship model.
- Implement functions and procedures using concepts of PL/SQL
- Implement object oriented concepts in database.
- Compare and contrast different types of advance database management systems.
- Describe database Administration and its management.

Detailed Syllabus:

Unit	Description	Duration
1.	**The Extended Entity Relationship Model and Object Model:** The ER model revisited, Motivation for complex data types, User defined abstract data types and structured types, subclasses, super classes, Inheritance, Specialization and Generalization, Constraints and characterisitics of specialization and generalization	**05**
2.	**Procedural Language/Structured Query language (PL/SQL):** Introduction to PL/SQL, Disadvantages of SQL and advantages of PL/SQL, PL/SQL block structure, block data types, block variable declaration, exception handling, Cursors, types of cursors, functions, procedures, triggers.	**07**
3.	**Object Oriented Databases:** Overview of object oriented concepts, object identity, object structure and type constructions, Encapsulation of operations, Method and persistence, Type hierarchies and Inheritance, Type extents and queries, Complex objects; Database schema design for OODBMS; OQL, Persistent programming language; OODBMS architecture and storage issues; Transaction and Concurrency control, example of ODBMS.	**05**
4.	**Object Relational and Extended Relational Databases:** Database design for an ORDBMS, Nested relations and collections, storage and access methods,	**04**

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	Query processing and optimization, An overview of SQL3, Implementation issues of extended type; System comparison of RDBMS, OODBMS, and ORDBMS.	
5.	**Parallel and Distributed Databases and Client-Server Architecture:** Architectures for parallel database, Parallel query evaluation, Parallelizing individual operations, Sorting, Joins, Distributed Database Concepts, Data Fragmentation, Replication, and allocation techniques for distributed database design; Query processing in distributed databases; Concurrency control and Recovery in distributed databases. An overview of Client-Server architecture.	**06**
6.	**Databases on the web and Semi-Structured Data:** Web interfaces of the web. Overview of XML; data XML applications; The semi structured data model, Implementation issues, Indexes for data.	**05**
7.	**Enhanced data models for Advanced applications:** Active database concepts, Temporal database concepts, Spatial database concepts and architecture, Deductive databases and Query processing, Mobile databases, Geographic information systems.	**07**
8.	**Introduction to Data Warehousing & Mining:** Purpose of Data Warehousing, Introduction & conceptual structure of Data Warehouse, Multidimensional schemas, OLAP, Introduction to Data Mining, of Data Warehousing & Data Mining	**06**
	Total	**45**

Text Books:

1. Elmarsi, Navathe, Fundamentals of Database Systems, 5th edition, Addison Wesley, 2006

Reference Books:

1. Stefano Ceri and Giuseppe Pelagatti, Distributed Databases Principles and Systems, McGraw Hill, 2008.
2. R.Ramakrishnan, Database Management Systems, 3rd edition, McGraw Hill, 2002
3. Hennery Korth, Abraham Silberschatz, S Sudarshan, Database System Concepts, 5th edition, McGraw Hill, 2005.
4. C.J. Date, An Introduction to Database System, 8th edition, Addison Wesley, 2006.
5. W. Kim, Modern Database System, ACM Press, Addison Wesley, 1995.
6. George Koch, Oracle 8i – The complete Reference, Tata McGraw Hill, 2001
7. Ivan Bayross, Oracle Developer 2000, BPB.
8. M. Tamer Ozsu, Patrick Valduriez, Principles of Distributed Database Systems, Pearson Education, 2nd edition, 2005.

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:

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- Minimum 10 practical experiments covering all the topics.
- Minimum two Assignments.
- Two class tests.

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Program: B. Tech. – Data Science (Business Analytics)				**Semester :IV**	
Course/Module: Operations Research				**Module Code: BTDS04004**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**0**	**0**	**3**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: Course on Linear algebra and Matrix Algebra

COURSE OBJECTIVES:

- Introduce optimization methodology as a valuable decision support tool.
- Help develop skills in building and solving optimization models for variety of engineering and Data Science related decision problems.
- Expose key mathematical concepts underlying various optimization models and algorithms.
- Provide hands-on experience with optimization software for solving and analyzing optimization models.

Outcomes:

After completion of the course, students would be able to :

- Formulate deterministic mathematical programs in various practical systems
- Understand basic optimization techniques
- Be able to interpret the results of a model and present the insights (sensitivity, duality)
- Know the limitations of different solution methodology
- Use software to solve problems

Detailed Syllabus:

Unit	Description	Duration
1	Linear Programming Problem (LPP) : Mathematical Model, Standard Form, Canonical Form, Cost Minimization & Profit Maximization Models, Graphical Polygon Corners Method, Graphical Iso-Profit/Iso-Cost Line Method, Analytical /Trial & Error Method, Simplex Method, Big-M Simplex Method, Two-Phase Simplex Method, Primal Vs Dual, Formulation of Dual from Primal, Comparison of Solutions of Primal & Dual, Economic Interpretation of Dual Variables, Shadow Pricing, Sensitivity Analysis	08

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2	Transportation Problem (TP) : Mathematical Model, Cost Minimization & Profit Maximization Models of Balanced & Unbalanced Problems, NWC/LCM/VAM Methods for IBFS, Optimality Test Criteria for OFS, MODI/uv Method for OFS.	07
3	Assignment Problem (AP) : Mathematical Model, Cost Minimization & Profit Maximization Models of Square Matrix & Non-Square Matrix Problems, Hungarian/Reduced Matrix/Flood's Techniques Method, Optimality Test Criteria for OFS.	07
4	Decision Making under Conditions of Certainty,Uncertainty & Risk : Maximax, MaxiMin, MiniMax, Hurwicz, Laplace Criteria & Methods, EMV, EOL & EVPI Calculations, Incremental/Marginal Analysis Method.	07
5	Investment Analysis : Time Value of Money & Discounted Cash Flow Techniques, Break Even Analysis; Pay Back Analysis, Discounted Pay Back Analysis, NPV Analysis & IRR Analysis.	07
6	Simulation Techniques : Concepts & Applications, Monte Carlo Method, Problems of Simulation.	03
7	Decision Making under Conditions of Conflict - Game Theory : Concepts & Applications, Simple Mathematical Models.	03
8	Integer Linear Programming & Goal Programming Problems : Concepts & Formulation of Mathematical Models.	03
Total		45

Text Books:

1. Operations Research, Authors: Prem Kumar Gupta & D S Hira, S Chand Publishers.

2 .Introduction to Mathematical Programming, by Wayne L. Winston and Munirpallam Venkataramanan (4th Edition).

Reference Books:

1. Applied Mathematical Programming by Bradley, Hax, Magnanti; http://mit.edu/15.053/www
2. David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 4th Edition.

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30
Details of Term work:

- Minimum Two class tests.
- Minimum two assignments

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Program: B. Tech. – Data Science (Business Analytics)				**Semester: IV**	
Course/Module: Cyber Security				**Module Code : BTDS04006**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**2**	**0**	**4**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: Basic syntax and semantics of programming languages, object-oriented programming

Objectives:

After completion of the course, students would be able to :

- To give an introduction to the field of cyber security. This course presents a balance of the managerial and the technical aspects of the discipline and addresses knowledge areas as specified in the CISSP (Certified Information Systems Security Professionals) certification.
- Learn about the threats to information and ways to overcome it

Outcomes:

Upon completion of this course students will be:

- Analyse threats to cyber security and understand various countermeasures.
- Describe various security technologies and policies
- Compare and contrast symmetric and asymmetric key cryptography.
- Understand various access control models
- Understand Risk Management and Business Continuity Planning
- Understand various legal and ethical issues related to cybercrime and computer forensics

Detailed Syllabus:

Unit	Description	Duration
1	**Introduction:** Basic Components of Computer security (CIA), characteristics of information vulnerabilities, threats, attacks and controls, goals of security, NSTISSC security model, security system development life cycle, computer criminals, internet standards and RFC.	05
2	**Design Principles:** Various security attacks, method of defense, design principles, security policies, and types of security policies.	04
3	**Cryptography:** Cryptography basics, transposition ciphers, substitution ciphers, AES, public key cryptography, stream and black ciphers, key management, digital signature	07

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4	**Program Security:** Secure programs, non-malicious program errors, viruses and other malicious code, types of viruses, attack mechanism of viruses, targeted malicious code, control agent program threats	04
5	**Authentication:** Authentication basics, password, challenge response, SSO, two factor authentication, biometrics	02
6	**Access Control:** Access control principles, ACL, DAC, MAC and role based access control, access control models, Kerberos	04
7	**Firewall:** Kinds of firewalls, filtering, services, DMZ, implementing policies (default allow, default deny) on proxy, IDS, types of IDS, virtual private network, SSH	05
8	**Physical and Environmental Security:** Introduction, physical security threats and measure	02
9	**Risk Management and Business Continuity planning:** Risk analysis, various terminologies associated with risk management, risk assessment techniques, managing risks, steps for risk management, Business impact analysis, various terminologies associated with BIA, different types of continuity planning, testing and revising the plan.	04
10	**Laws, investigations and Ethics:** Introduction, types of computer crimes, modus operandi, computer forensics, ethical issues in computer security.	03
11	**Contemporary issues related to Information Security**	05
Total		45

Text Books:

1 M. Whiteman, H. Mattford, "Principle of Information Security", 4th edition, Cengage Learning 2012
2 M. Bishop, S. S. Venkatramanayya, "Introduction to Computer Security", Pearson Education, 2009
3 C. Pfleeger, S. Pfleeger, "Security in Computing", 4th Edition, Pearson Education, 2009

Reference Books:

1. Kahate, "Cryptography & Network Security", 3rd Edition, TMH. 2013

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:

- Practical based on few Experiments

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- Two class tests.
- Minimum two assignments

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Program: B. Tech. – Data Science (Business Analytics)				**Semester : IV**	
Course/Module : Operating Systems				**Module Code :BTDS04007**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**2**	**0**	**4**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: Computer Programming, Data Structure and Algorithm, Computer Organization and Architecture

Objectives:

- Design techniques, process management, processor scheduling; deadlocks, memory management, secondary memory management, file management; I/O systems, Unix systems.
- Knowledge of process control, threads, concurrency, memory management scheduling, I/O and files, distributed systems, security, networking will be enhanced

Outcomes:

After completion of the course, students would be able to:

1. Design functions, structures and history of operating systems
2. Understand design issues associated with operating systems
3. Design various process management concepts including scheduling, synchronization, deadlocks
4. Be familiar with multithreading

Detailed Syllabus:

Unit	Description	Duration
1	**Operating Systems Overview:** Operating systems objectives and functions, evolution of operating systems, characteristics of modern operating systems, basic concepts of processes, files system, system calls, shell, layered structure v/s monolithic structure of OS, introduction to distributed OS, RTOS, mobile OS	**05**
2	**Process and Process Scheduling:** Process description, process control block, threads, thread management, comparison between processes and threads, process scheduling: types, study and comparison of various scheduling algorithms	**09**
3	**Process Concurrency:** Principle of concurrency: mutual exclusion – hardware approaches, mutual exclusion – software approaches, semaphore, monitors, message parsing, reader / writer problem.	**09**
4	**Deadlock:** Principle of deadlock, deadlock prevention, deadlock avoidance, Ostrich algorithm, Banker's algorithm, deadlock detection, dining philosophers' problem.	**06**

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5	**Memory Management:** Memory management requirements, memory partitioning, virtual memory management, paging, segmentation, segmented paging, design and implementation issues in lagging and segmentation.	**07**
6	**I/O Management and Disc Scheduling:** I/O devices, organization of the I/O function, operating systems design issues, I/O buffering, disk scheduling and disc schedule algorithms, RAID, disk cache.	**05**
7	**File Management:** Overview, file organization, file directories, file sharing, record blocking, secondary storage management, UNIX file system.	**04**
8	**Case Study:** Mobile Operating Systems: introduction, process & thread management, memory management, file system and I/O management, comparison with Windows and Linux operating systems functions.	
Total		**45**

Text Books:

1. William Stalling, "Operating System internals and design principles", 7th edition, Pearson education, 2011
2. Silberchatz A., Galvin P., "Operating System Principles", 7th edition, Wiley Publication, 2009
3. Flynn Ida M, Mchoes A.M, "Understanding operating systems", 6th edition, 2010

Reference Books:

1. Tannenbaum, "Modern Operating Systems", 3rg edition, PHI, 2007
2. Milan Milenkovic, "Operating systems", TMH, 2009
3. Michael J. Jipping, "Smart phone Operating System concepts with Symbian Operating System: A tutorial Guide", Wiley Publication.

Any other information: NIL

Total Marks of Internal Continuous Assessment (ICA) : 50 Marks

Distribution of ICA Marks:

Description of ICA	**Marks**
Test Marks	20
Term Work Marks	30
Total Marks :	**50**

Details of Term work:

1. Minimum: Practical based on 10 Experiments
2. Minimum Two class tests.
3. Minimum two assignments/mini project/presentation/Quiz

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Program: B. Tech. – Data Science (Business Analytics)				**Semester : IV**	
Course/Module: Internet of Things				**Module Code :BTDS04008**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**2**	**0**	**4**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: C, C++, Basics of computer network

Objectives:

- To understand fundamental of IOT architecture and protocols

Outcomes:

After completion of the course, students would be able to :

- Introduction to IOT architecture and M2M technology
- Understanding the IOT protocols
- Identify and analyse the various cloud components for IOT
- Understanding the security issues in IOT

Detailed Syllabus:

Unit	Description	Duration
1	**Introduction to IOT** IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals	**06**
2	**IOT Fundamentals** IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views, Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management	**08**
3	**IOT protocols** Networking Architectures: Star, Mesh, Tree, Networking Protocols: TCP/IP, 6LowPan, RPL, Thread, IoT Devices Application Level Protocols: MQTT, CoAP, REST	**08**

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4	**IOT and Cloud** IOT Devices and Cloud access, Cloud components, Device to Gateway –Short Range Wireless (Cell Phone as Gateway, Dedicated Wireless Access Point), Gateway to Cloud- Long Range connectivity (Wired, Cellular, Satellite, WAN), Direct Device to Cloud connectivity, IoT Device Power Constraints, Powered and Unpowered Sensors, Power Harvesting, Energy Storage Technologies	**09**
5	**IOT Security** Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT - Insufficient Authentication/Authorization - Insecure Access Control - Attacks Specific to IoT, Encryption standards-AES, DES, RSA, Hashing, Authentication	**09**
6	**Case study** Smart Cities, Smart Home Industrial Control, Smart Social Networks, Big Data Analytics	**05**
Total		**45**

Text Books:

1. Bernd Scholz-Reiter, Florian Michahelles, ―Architecting the Internet of Things‖, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-on-Approach), 1 st Edition, VPT, 2014
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ―From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014
3. Peter Waher, ―Learning Internet of Things, PACKT publishing, BIRMINGHAM – MUMBAI
4. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
5. Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:

- Minimum Two class tests.
- Minimum two assignments

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Program: B. Tech. –Data Science (Business Analytics)				**Semester : IV**	
Course/Module: Statistical Method - I				**Module Code: BTDS04009**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**2**	**0**	**4**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: Managing Uncertainty (SEM - III)

Objectives:

- To provide advanced statistical background for analysing data and drawing inferences from that analysis
- Predicative Analytics using liner and generalized liner model

Outcomes:

After completion of the course, students would be able to :

- Students will be able to learn advanced statistical technique and apply them to the analysis of real data sets from different fields.

Detailed Syllabus:

Unit	Description	Duration
1	**ANOVA/MANOVA:** Chi-Square as a test of independent, Chi-square as a Test of goodness of fit: Testing the Appropriateness of a Distribution, Analysis of Variance, Multivariate analysis of variance	3
2	**Regression Model:** a) Least squares and linear regression: Introduction; Notation; Ordinary least squares; Regression to the mean; Linear regression; Residuals; Regression inference b) Multivariable regression: Multivariate regression; Multivariate examples; Adjustment; Residual variation and diagnostics; Multiple variables , Interaction Terms, Non-linear Transformations of the Predictors, Qualitative Predictors c) Multiple Regression Analysis: The Problem of Estimation and the Problem of Inference d) Dummy Variable Regression Models e) Multi-collinearity, Heteroscedasticity, Autocorrelation f) Econometric Modelling: Model Specification and Diagnostic Testing g) Correlation and Covariance Analysis h) Canonical Analysis, Canonical Roots/variates	3 4 3 3 3 3 3 4

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3	Extension of regression analysis: Ridge Regression, The Lasso Nonlinear Regression Models: Approaches to Es**timating Nonlinear** Regression models	5 5
4	**Generalized linear models:** Logistic Regression, Binary outcomes, Count outcomes, Multiple Logistic Regression	3 3
Total		45

Text Books:

1. An Introduction to Statistical learning with application in R . Hastie T, Robert T. (2014). Springer Science Business Media: New York
2. Gujarati, D (2011). Basic Econometrics. McGraw Hill

Reference Books:

1. Statistics for Management, Seventh Edition, by Richard I. Levin, David S. Rubin, Pearson
2. An Introduction to Categorical Data Analysis. Agresti, A. (2012). John Wiley & sons
3. The Element of Statistical Learning, Data mining, Inference and Prediction. Hastie, T, Tibshirani, R, & Friedman, J. (2011). New York: Springer Series in Statistics.
4. Hair, Black, Babin, Anderson and Tatham (2009). Multivariate Data Analysis, Pearson

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:

- Practical based on 10 Experiments
- Two class tests.
- Minimum two assignments

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Program: B. Tech Data Science (Business Analytics)				**Semester: IV**	
Course/Module: Computer Organization and Architecture				**Module Code: BTDS04010**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks -50)**	**Term End Examinations (TEE) (Marks -100 in Question Paper)**
3	**0**	**0**	**3**	**Marks Scaled to 50**	**Marks Scaled to 50**

Objectives:

- To provide knowledge of logic circuits theory, elementary analysis and its implementation in practical cases, the popular logic families and their characteristics that will help to understand design of complex digital circuits and systems
- To have a thorough understanding of the basic structure and operation of a digital computer.
- To discuss in detail the operation of ALU including algorithms and implementation of fixed point and floating point addition, subtraction, multiplication and division.
- To study different ways of communicating with I/O devices and standard I/O interfaces
- To study hierarchical memory system including cache memories and virtual memory.

Outcomes:

After completion of the course, students would be able to :

- Solve basic binary math operations using the logic gates.
- Demonstrate programming proficiency using various logical elements to design simple logical units.
- Design different units that are elements to typical computer's CPU.
- Understand fundamental concepts of Computer organization and architecture including BUS and MEMORY.
- Understand operation of CPU, Control Unit, I/O and parallel processing.

Detailed Syllabus: (per session plan)

Unit	Description	Duration
1	**Number Systems:** Decimal, Binary, Octal and Hexadecimal number system and conversion, Binary weighted codes, signed number binary order 1's and 2's complement codes, binary arithmetic.	3

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2	**Boolean Algebra:** Binary logic function, Boolean laws, Truth tables, Associative and distributive properties, Demorgan's theorems, Realization of switching function using logic gates.	5
3	**Combinational Logic and its analysis and design:** Intro. Combinational circuit, code conversion, decoder encoder priority encoder, multiplexers as function generators, Binary address, sub-tractor, BCD adder, binary comparator and ALU.	5
4	**Sequential Logic:** Sequential circuits, flip-flop, clock and edge triggered flip-flop timing specifications counter asynchronous and synchronous, counter design with state equation registers, serial in serial out shift registers, tri-state register, register transfer timing consideration. State diagram and tables, transition table, excitation table and equation. Example using flip-flop. Construction of state diagram and counter design	3
5	**Overview**: General organization and architecture, structural / functional view of a computer, Brief history of computer.	3
6	**System Buses**: Computer functions and flow control, interrupts and interconnection, BUS design and timing, Hierarchy and arbitration.	3
7	**Memory Organization:** Internal memory: characteristics, Hierarchy, semiconductor main memory: Types of RAM, Chip Logic. Memory module organization, Cache memory: element of cache design, address mapping and translation, replacement algorithm: Advanced DRAM org: performance characteristics of two – level memories, external memory: Magnetic disk, Tape, Raid, Optical memory, High Speed memories; associative memory, interleaved memory	5
8	**CPU:** Basic instruction cycle, instruction sets, formats and addressing, processor organization, register organization, instruction pipelining, co-processors, pipeline processors, RISC computer, RISC vrs CISC.	5
9	**Control Unit:** micro – operations, hardwired implementation, micro programming control, Micro – instruction format, application of microprogramming	5
10	**Input and Output Unit:** External device, keyboard, monitor, disk drive and device and device driver, I/O modules; programmed I/O,	4

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	interrupt driven I/O, DMA, I/O channels and I/O processors, serial transmission and synchronization.	
11	**Multiprocessor processor Organization:** Flynn's classification of parallel processing systems, pipelining concepts	4
	Total	**45**

Text Book:

1. William P. Hayes "Computer Organization and Architecture: Designing of Performance", 8th edition, Pearson Education 2010
2. M. Morris Mano, "Digital Logic and Computer Design", 1st Edition Pearson 2004

Reference Books:

1. A.B. Marcontz, "Introduction to Logic Design", 1st Edition, Tata McGraw Hill Education 2007
2. John P. Hayes, "Computer Architecture and Organization", 6th edition Prentice-Hall, 2013

Any other information: NIL

Details of Internal Continuous Assessment (ICA):
Test Marks: 20
Term Work Marks: 30

Details of Term work:

- Two tests
- Assignments
- Quiz/presentations/tutorials/viva

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