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# DEPARTMENT OF INFORMATION TECHNOLOGY

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Course Structure & Syllabus  
for  
Master of Technology in Information Technology  
w.e.f Academic Session 2025 – 26



SCHOOL OF ENGINEERING & TECHNOLOGY  
NAGALAND UNIVERSITY  
(KOHIMA CAMPUS)  
MERIEMA – 797004

Course Structure of M. Tech in Information Technology

<b>Semester I</b>						
<b>Sl. No</b>	<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPG101	Foundations of Computing Science	3	1	-	4
2	ITPG102	Algorithm Design and Analysis	3	1	-	4
3	ITPGE10*	Elective -I	3	1	-	4
4	ITPGE10*	Elective -II	3	1	-	4
5	ITPGT114	Advanced Algorithms Lab	-	-	3	3
6	ITPGT105	Seminar-I	-	-	-	3
<b>Total Credits</b>						<b>22</b>

<b>Semester II</b>						
<b>Sl. No</b>	<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPG201	Advanced Computer Architecture (ACA)	3	1	-	4
2	ITPG202	Database Engineering	3	1	-	4
3	ITPGE20*	Elective III	3	1	-	4
4	ITPGE20*	Elective IV	3	1	-	4
5	ITPGT214	Advanced Database Lab	-	-	3	3
6	ITPGT205	Seminar-II				3
<b>Total Credits</b>						<b>22</b>

<b>Semester III</b>						
<b>Sl. No</b>	<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGTH1	M.Tech Thesis	-	-	20	10
2	ITPGE3**	Discipline Specific Elective -V	3	1	-	4
3	ITPG310	Research Methodology & Proposal Writing	3	1		4
4	ITPGE3**	Skill Enhancement Course Elective – VI	3	1	-	4
5	ITPGE3**	Multidisciplinary Elective - VII	3	1	-	4
<b>Total Credits</b>						<b>26</b>

<b>Semester IV</b>						
<b>Sl. No</b>	<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGTH2	M.Tech Thesis	-	-	20	10
2	ITPGVV1	Viva - Voce	-	-	-	8
<b>Total Credits</b>						<b>18</b>

<b>Elective I</b>						
<b>S.N.</b>	<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE101	Advanced Machine Learning	3	1	-	4
2	ITPGE102	Software Architecture and Design Patterns	3	1	-	4
3	ITPGE103	Parallel and Distributed Algorithms	3	1	-	4

<b>Elective II</b>						
<b>S.N.</b>	<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE104	Biometrics	3	1	-	4
2	ITPGE105	Business Intelligence & Big Data	3	1	-	4
3	ITPGE106	Soft Computing	3	1	-	4

<b>Elective III</b>						
<b>S.N.</b>	<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE201	Embedded Systems	3	1	-	4
2	ITPGE202	Advanced Graph Theory	3	1	-	4
3	ITPGE203	Predictive Analytics for Internet of Things	3	1	-	4

<b>Elective IV</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE204	Text Mining and Analytics	3	1	-	4
2	ITPGE205	Advanced-Data Visualization and Analytics	3	1	-	4
3	ITPGE206	Advanced Machine Learning for Biomedical Data Analysis	3	1	-	4

<b>Discipline Specific Elective -V</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE301	Game Theory	3	1	-	4
2	ITPGE302	Natural Language Processing	3	1	-	4
3	ITPGE303	Cloud Computing	3	1	-	4

<b>Skill Enhancement Course Elective – VI</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE304	Multimedia Technology	3	1	-	4
2	ITPGE305	Advanced Internet Technology	3	1	-	4
3	ITPGE306	Advanced Computer Networks	3	1	-	4

<b>Multidisciplinary Elective – VII</b>						
<b>S.N.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	ITPGE307	Cyber Security	3	1	-	4
2	ITPGE308	Optimization Techniques	3	1	-	4
3	ITPGE309	Image Processing & Computer Vision	3	1	-	4

### Detailed Syllabus

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPG101	Foundations of Computing Science	3	1	-	4

Unit 1: Discrete Structures -- Sets, Relations and Functions; Proof Techniques, Algebraic Structures, Morphisms, Posets, Lattices and Boolean Algebras.

Unit 2: Logic -- Propositional calculus and Predicate Calculus, Satisfiability and validity, Notions of soundness and completeness

Unit 3: Languages & Automata Theory -- Chomsky Hierarchy of Grammars and the corresponding acceptors, Turing Machines, Recursive and Recursively Enumerable Languages; Operations on Languages, closures with respect to the operations.

Unit 4: Computability -- Church-Turing Thesis, Decision Problems, Decidability and Undecidability, Halting Problem of Turing Machines; Problem reduction (Turing and mapping reduction).

Unit 5: Computational Complexity -- Time Complexity -- Measuring Complexity, The class P, The class NP, NP-Completeness, Reduction, co-NP, Polynomial Hierarchy. Space Complexity -- Savich's Theorem, The class PSPACE.

#### **Recommended Books**

##### **Text Books and References:**

1. J.P. Trembley and R. Manohar -- Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Book Co.,
2. Michael Sipser -- Introduction to The Theory of Computation, Thomson Course Technology.
3. John E. Hopcroft and J.D.Ullman -- Introduction to Automata Theory, Languages and Computation, Narosa Pub. House, N. Delhi.
4. H.R. Lewis and C.H. Papadimitrou -- Elements of the Theory of Computation, Prentice Hall, International, Inc.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPG102	Algorithm Design and Analysis	3	1	-	4

Unit 1: Algorithmic paradigms: Dynamic Programming, Greedy, Branch-and-bound; Asymptotic complexity, Amortized analysis;

Unit 2: Graph Algorithms: Shortest paths, Flow networks;

Unit 3: NP-Completeness and Approximation Algorithms: Polynomial time, Polynomial time verification, NP-completeness and reducibility, proofs, NP-completeness examples, Vertex Cover problem, Travelling Salesman Problem, Set Covering Problem

Unit 4: Randomized algorithms;

Unit 5: Linear programming;

Special topics: Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs, Priority Search trees, Quadrees and k-D trees, Plan Sweep Technique), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primality testing, cryptographic computations), Internet algorithms (text pattern matching, tries, information retrieval, data compression, Web caching).

### **Recommended Books**

References: 1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 3rd Edition, 2009.

2. Michael T. Goodrich and Roberto Tamassia, Algorithm Design Foundations, Analysis, and Internet Examples, John Wiley & Sons, Inc., 2nd Edition, 2009.

3. Gilles Brassard and Paul Bratley, Fundamentals of Algorithmics, Prentice Hall, 1996.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPG201	Advanced Computer Architecture (ACA)	3	1	-	4

Unit 1: System Architecture

History /Evolution, Definition: Hardware /Software Architecture, Flynn's Classification: SISD, SIMD, MISD, MIMD. Physical Models: PVP, MPP, SMP & Cluster of Workstations (COW). Memory Architectures: Shared, Distributed & Hybrid. Performance Metrics & Benchmarks (Micro/Macro) Architectural Trends based on TOP 500 List of Supercomputers.

Unit 2: Advanced Microprocessor Techniques

CISC, RISC, EPIC, Superscalar, Super-pipelined Architectures, Superscalar/ Super-pipelined, In Order Execution /Out of Order Execution (OOO), ILP, TLP, Power Wall, Moore's Law Redefined, Multicore Technologies, Intel's Tick-Talk Model. Study of State-of-the-ART Processors: Intel / AMD X86-64 Bit Series, Introduction to Graphics Processing Units (GPU-NVIDIA)

Unit 3: System Interconnects

SAN: System Area Networks, Storage Area Networks including InfiniBand, Gigabit Ethernet, Scalable Coherent Interface (SCI) Standard

Unit 4: Storage

Internal/External, Disk Storage, Areal Density, Seek Time, Disk Power, Advanced RAID Levels, SATA vs SAS Disks, Network Attached Storage (NAS), Direct Attached Storage (DAS), I/O Performance Benchmarks.

Unit 5: Software Architecture

Parallel Programming Models: Message Passing, Data Parallel, MPI/ PVM. Typical HPC Software Stack including Cluster Monitoring Tools, Public Domain Software like GANGLIA, CUDA Programming Environment. Case Studies: IBM SP System, C-DAC's latest PARAM Systems [PARAM Yuva-II], Sequent NUMA Q

Course Code	Course name	L	T	P	Credits
ITPG202	Database Engineering	3	1	-	4

Unit 1: Relational Model Constraints, update operations, transactions, and dealing with constraint violations, Relational database design algorithms, MVDs and 4NF, JD and 5NF, inclusion dependencies, other dependencies and normal forms.

Unit 2: Query Processing & Optimization Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions. Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans, Materialized Views, Advanced Topics in Query Optimization.

Unit 3: Object & Object-Relational Databases Concepts of Object databases, Object database standards, languages and design, Object-relational and Extended-Relational Systems.

Unit 4: Security, Advanced Modeling Database Security Enhanced data models for advanced applications – active databases, temporal databases, spatial and multimedia databases, deductive databases.

Unit 5: Advanced Transaction Processing - Transaction-Processing Monitors, Transactional Workflows, E-Commerce, Main-Memory Databases, Real-Time Transaction Systems, Long-Duration Transactions. Case studies: PostgreSQL, IBM DB2, Oracle, Microsoft SQL server.

#### Text Books:

1. Fundamentals of Database Systems, Elmasri Navrate Pearson Education, V edition.
2. Database System Concepts, Silberschatz, Korth, McGraw hill, VI edition.

#### Reference Books:

1. Database Systems Design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Introduction to Database Systems, C.J. Date Pearson Education.
3. Oracle for Professionals, The X Team, S. Shah and V. Shah, SPD.
4. Database Systems Using Oracle: A Simplified Guide to SQL and PL/SQL, Shah, PHI.
5. Fundamentals of Database Management Systems, M.L. Gillenson, Wiley Student Edition.

Course Code	Course name	L	T	P	Credits
ITPGT214	Advanced Database Lab	-	-	3	3

Objective:

1. To explore the features of a Database Management Systems.
2. To interface a database with front-end tools.
3. To understand the internals of a database system

#### Experiments

1. Basic SQL
2. Intermediate SQL
3. Advanced SQL
4. ER Modeling
5. Database Design and Normalization
6. Accessing Databases from Programs using JDBC
7. Building Web Applications using PHP & MySQL
8. Indexing and Query Processing
9. Query Evaluation Plans
10. Concurrency and Transactions
11. Big Data Analytics using Hadoop

#### Outcome:

1. Ability to use databases for building web applications.
2. Gaining knowledge about the internals of a database system.

#### References

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 4th Edition, Pearson/Addision wesley, 2007

Course Code	Course name	L	T	P	Credits
ITPGT114	Advanced Algorithms Lab	-	-	3	3

Course Objectives: Algorithms / Exercises from different units in the syllabus will be implemented in Lab. The student writes their programs in Python language.

Course Outcomes: After the lab course the student will be

- Equipped with the skill set to prove the correctness through strategies such as loop invariants and bound functions.
- Able to write programs by the principles of algorithmic design. Recommended Exercises: ● convert a recursive programme to an iterative programme
- Write programs for various paradigms such as Divide and Conquer, Dynamic Programming and Greedy Method.
- Analyze randomized algorithms
- Code various sorting algorithms

- Write code for geometric and string algorithms

**Text Book:** Thomas H Cormen, Charles E Leiserson, Ronald Rivest, Clifford Stein., Introduction to algorithms, 3rd edition, (July 31, 2009)

Course Code	Course name	L	T	P	Credits
ITPGE101	Advanced Machine Learning	3	1	-	4

Unit 1 Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension.

Unit 2 Advanced machine learning topics: Bayesian modelling and Gaussian processes, randomized methods, Bayesian neural networks, approximate inference.

Unit 3 Deep learning: regularization, convolutional neural networks, recurrent neural networks, variational autoencoders, generative models, applications.

Unit 4 Applications of machine learning in natural language processing: recurrent neural networks, backpropagation through time, long short-term memory, attention networks, memory networks, neural Turing machines, machine translation, question answering, speech recognition, syntactic and semantic parsing, GPU optimization for neural networks.

Unit 5 Evaluation in ML: metrics, cross-validation, statistics, addressing the multiple comparisons problem.

**Text Books:**

- 1 Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press 2012
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning. MIT Press 2016

**Reference Books:**

1. Bayesian Reasoning and Machine Learning David Barber, Cambridge University Press, 2012.
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc.,2001.
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.

Course Code	Course name	L	T	P	Credits
ITPGE102	Software Architecture and Design Patterns	3	1	-	4

Unit: 1 Envisioning Architecture: The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural

structures and views. Creating an Architecture: Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

Unit: 2 Analysing Architectures: Architecture Evaluation, Architecture design decision making, ATAM, CBAM.

Unit: 3 Moving from one system to many: Software Product Lines, Building systems from off-the-shelf components, Software architecture in future.

Unit: 4 Patterns: Pattern Description, Organizing catalogues, role in solving design problems, Selection and usage. Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy.

Unit: 5 Behavioural patterns: Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor. Case Studies: A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development.

**Text Books:**

1. Software Architecture in Practice, second edition, Len Bass, Paul Clements & Rick Kazman, Pearson Education, 2003.
2. Design Patterns, Erich Gamma, Pearson Education, 1995.

**Reference Books:**

1. Beyond Software architecture, Luke Hohmann, Addison Wesley, 2003.
2. Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR, 2001
3. Software Design, David Budgen, second edition, Pearson Education, 2003.
4. Head First Design patterns, Eric Freeman & Elisabeth Freeman, O'REILLY, 2007.
5. Design Patterns in Java, Steven John Metsker & William C. Wake, Pearson Education, 2006.

Course Code	Course name	L	T	P	Credits
ITPGE103	Parallel and Distributed Algorithms	3	1	-	4

Unit: 1 To learn parallel and distributed algorithms development techniques for shared memory and message passing models. To study the main classes of parallel algorithms. To study the complexity and correctness models for parallel algorithms. Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing.

Unit: 2 Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples.

Unit: 3 Pipelining- Techniques computing platform, pipeline programs examples.

Unit: 4 Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelise sharing data-parallel programming languages and constructs, open MP.

Unit: 5 Distributed shared memory systems, constant memory, distributed shared memory, programming primitives, algorithms: sorting and numerical algorithms.

**Text Book:**

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.

**Reference Book:**

1. Introduction to Parallel Algorithms by Jaja from Pearson, 1992.

Course Code	Course name	L	T	P	Credits
ITPGE104	Biometrics	3	1	-	4

Unit: 1 Introduction – Benefits of biometric security – Verification and identification – Basic working of biometric matching – Accuracy – False match rate – False non-match rate – Failure to enrol rate – Derived metrics– Layered biometric solutions.

Unit: 2 Finger scan – Features – Components – Operation (Steps)– Competing finger Scan technologies – Strength and weakness. Types of algorithms used for interpretation, Facial Scan - Features – Components – Operation (Steps) – Competing facial Scan technologies – Strength and weakness.

Unit: 3 Iris Scan - Features – Components – Operation (Steps) – Competing iris Scan technologies – Strength and weakness. Voice Scan - Features – Components – Operation (Steps) – Competing voice Scan (facial) technologies Strength and weakness.

Unit: 4 Other physiological biometrics – Hand scan – Retina scan– AFIS (Automatic Finger Print Identification Systems) – Behavioral Biometrics – Signature scan- keystroke scan.

Unit: 5 Biometrics Application – Biometric Solution Matrix – Bio privacy – Comparison of privacy factor in different biometrics technologies – Designing privacy sympathetic biometric systems. Biometric standards – (BioAPI, BAPI) – Biometric middleware, Biometrics for Network Security, Statistical measures of Biometrics, Biometric transactions.

**Text Books:**

1. Biometrics – Identity Verification in a Networked World – Samir Nanavati, Michael Thieme, Raj Nanavati, WILEY- Dream Tech.
2. Biometrics for Network Security- Paul Reid, Pearson Education.

**Reference Book:**

1. Biometrics- The Ultimate Reference- John D. Woodward, Jr. Wiley Dreamtech.

Course Code	Course name	L	T	P	Credits
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ITPGE105	Business Intelligence & Big Data	3	1	-	4
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Unit:1 Data Science – Introduction, working with data at scale, data scientist, the SMAQ stack for big data, scraping, cleaning & selling big data.

Data Hand Tools- free data tools for journalists.

Data Issues- Introduction, anonymization, risk of de-anonymization, Big data & semantic web, metadata.

Unit: 2 Applications of Data: - Product & Process – Twitter archive, data journalism & data tools, newsroom stack, bridging the data divide, data analysis path, Big data in education & academic disciplines, Discussion of Facebook.

Unit: 3 BI foundations - Understanding BI, Describing BI, Defining BI cycle, Enabling BI, Bridging the Analysis Gap Multidimensional analysis, Operation Systems, BI Systems.

Unit: 4 Defining BI Technologies- The High-level view, Reporting & Analysis, the data warehouse and Data warehousing Framework, Identifying BI opportunities.

Unit: 5 Implementing a BI solution- implementation strategy, Fundamental decisions, Case studies- Audi AG, The Frank Russell Company.

#### **Text Books:**

1. Elizabeth Vitt, Michael Luckevich, Stacia Misner, “Business Intelligence”, Microsoft Press, 2010.
2. Big Data Now, O’Reily Radar Team.

#### **Reference Books:**

1. Rajiv Sabherwal, Irma Becerra- Fernandez, “Business Intelligence-Practices, Technologies and Management”, John Wiley 2011.
2. Larissa T. Moss, ShakuAtre, “Business Intelligence Roadmap”, Addison –Wesley IT Series.
3. Yuli Vasiliev, “Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting”, SPD Shroff, 2012.

Course Code	Course name	L	T	P	Credits
ITPGE106	Soft Computing	3	1	-	4

Unit: 1 AI Problems and Search: AI problems, Techniques, Problem Spaces and Search, Heuristic Search Techniques- Generate and Test, Hill Climbing, Best First Search Problem reduction, Constraint Satisfaction and Means-End Analysis. Approaches to Knowledge Representation- Using Predicate Logic and Rules.

Unit: 2 Artificial Neural Networks: Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Backpropagation Networks. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Unit: 3 Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector

Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

Unit: 4 Introduction to Classical Sets (crisp Sets) and Fuzzy Sets- operations and Fuzzy sets. Classical Relations and Fuzzy Relations- Cardinality, Operations, Properties and Composition. Tolerance and equivalence relations. Membership functions- Features, Fuzzification, membership value assignments, Defuzzification.

Unit: 5 Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Base and Approximate Reasoning Fuzzy Decision-making Fuzzy Logic Control Systems, Genetic Algorithm- Introduction and basic operators and terminology. Applications: Optimization of TSP, Internet Search Technique.

#### **Text Books:**

1. Principles of Soft Computing- S N Sivanandam, S N Deepa, Wiley India, 2007.
2. Soft Computing and Intelligent System Design -Fakhreddine O Karray, Clarence D Silva, Pearson Edition, 2004.

#### **Reference Books:**

1. Artificial Intelligence and Soft Computing- Behavioural and Cognitive Modeling of the Human Brain Amit Konar, CRC Press, Taylor and Francis Group.
2. Artificial Intelligence – Elaine Rich and Kevin Knight, TMH, 1991, 2008.
3. Artificial Intelligence – Patric Henry Winston – Third Edition, Pearson Education.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPGE201	Embedded Systems	3	1	-	4

Unit: 1 Introduction to Embedded Systems: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software, Complex System Design, Design Process in Embedded System, Formalization of System Design, Classification of Embedded Systems.

Unit: 2 8051 and Advanced Processor Architecture: 8051 Architecture, 8051 Micro controller Hardware, Input/ output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts, Introduction to Advanced Architectures, Real World Interfacing, Processor and Memory Organization - Devices and Communication Buses for Devices Network: Serial and parallel Devices & ports, Wireless Devices, Timer and Counting Devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Internet Enabled Systems, Wireless and Mobile System protocols.

Unit: 3 Embedded Programming Concepts: Software programming in Assembly language and High-Level Language, Data types, Structures, Modifiers, Loops and Pointers, Macros and Functions, object-oriented Programming, Embedded Programming in C++ & JAVA.

Unit: 4 Real-Time Operating Systems: OS Services, Process and Memory Management, Real-Time Operating Systems, Basic Design Using an RTOS, Task Scheduling Models, Interrupt Latency, Response of Task as Performance Metrics - RTOS Programming: Basic functions and Types of RTOSes, RTOS VxWorks, Windows CE.

Unit: 5 Embedded Software Development Process and Tools: Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-Design - Testing, Simulation and Debugging Techniques and Tools: Testing on Host Machine, Simulators, Laboratory Tools.

**Text Book:**

1. Embedded Systems, Raj Kamal, Second Edition TMH.

**Reference Books:**

1. Embedded/Real-Time Systems, Dr.K.V.K.K.Prasad, DreamTech Press.
2. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson.
3. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.
4. An Embedded Software Primer, David E. Simon, Pearson Education.
5. Micro Controllers, Ajay V Deshmukhi, TMH.
- 6.

Course Code	Course name	L	T	P	Credits
ITPGE202	Advanced Graph Theory	3	1	-	4

Unit 1: Trees: Basic Properties, Spanning Trees and Enumeration, Enumeration of Trees, Spanning Trees in Graphs, Decomposition and Graceful Labeling, Optimization and Trees, Minimum Spanning Tree.

Unit 2: Matching and Factors: Matchings in Bipartite Graphs, Hall’s Matching Condition, Min-Max Theorems, Independent Sets, Tutte’s 1-Factor Theorem, Maximum Bipartite Matching , Weighted Bipartite Matching, Stable Matching, Faster Bipartite Matching

Unit 3: Connectivity and Paths: Cuts and Connectivity, Flows in Directed Graphs, Connectivity and Menger’s Theorem, Edge-Connectivity, Blocks, K-connected Graphs and k-edge-connected Graphs, 2-connected Graphs, Applications of Menger’s Theorem

Unit 4: Graph Coloring: Vertex Colorings and Upper Bounds: Definitions , Upper bounds, Brooke’s Theorem, Structure of k-chromatic Graphs, Graphs with Large Chromatic Number, Critical Graphs, Counting Proper Colorings, Chordal Graphs, A Hint of Perfect Graphs, Line Graphs and Edge Colorings, Characterization of Line Graphs.

Unit 5: Random Graph: Existence and Expectation, Properties of Almost All Graphs, Threshold Functions, Evolution and Properties of Random Graphs, Connectivity, Cliques and Colorings, Extremal Problems: Paths and Cycles, Complete Subgraphs, Hamilton Paths and Cycles, Szemerédi’s Regularity Lemma and its simple applications, Encodings of Graphs, Branchings and Gossip, List Colorings and Choosability, Circumference

**Textbooks / References**

1. Douglas B. West, Introduction to Graph Theory, Prentice-Hall, 3rd Edition, 2008
2. Béla Bollobás, Modern Graph Theory, Springer, 1998.

Course Code	Course name	L	T	P	Credits
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ITPGE203	Predictive Analytics for Internet of Things	3	1	-	4
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Unit 1: Introduction to IoT - Definitions, frameworks and key technologies. Challenges to solve in IoT - Key hardware and software elements. Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning.

Unit 2: Real-World Data representation and visualization, Introduction to Data Analytics for IoT. IoT Analytics- Definition, Challenges, Devices, Connectivity protocols, data messaging protocols- MQTT, HTTP, CoAP, Data Distribution Services (DDS)

Unit 3: IoT Data Analytics – Elastic Analytics Concepts, Scaling. Cloud Analytics and Security, AWS / Azure / ThingWorx. Design of data processing for analytics, application of big data technology to storage,

Unit 4: Exploring and visualizing data, solution for industry-specific analysis problem. Visualization and Dashboard – Designing visual analysis for IoT data- creating dashboard – creating and visualizing alerts.

Unit 5: Basics of geospatial analytics- vector based methods-raster based methods- storage of geospatial data - processing of geospatial data- Anomaly detection forecasting. case study: pollution reporting problem.

#### **Textbooks / References:**

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things: A Hands-on Approach”, Hardcover – Import, 2014.
2. Andrew Minter, Analytics for Internet of Things, Packt Publications Mumbai 2017
3. Kai Hwang, Min Chen, Big Data Analytics for Cloud, IoT and Cognitive Computing Hardcover, 2017

Course Code	Course name	L	T	P	Credits
ITPGE204	Text Mining and Analytics	3	1	-	4

Unit 1: Introduction to Natural Language Processing -Words -Regular Expressions -N-grams -Language modelling - Part-of-Speech Tagging - Named Entity Recognition

Unit 2: Syntactic and Semantic Parsing – Morphological Analysis Text Representation and Transformation - Vector space models -Bag-of-Words -Term Frequency - Inverse Document Frequency - Word Vector representations: Word2vec, GloVe, FastText,

Unit 3: BERT – Topic Modelling Neural language models - Recurrent Neural Network - Long Short-Term Memory Networks

Unit 4: Encoder decoder architecture - Attention mechanism - Transformer networks

Unit 5: Text classification – Sentiment Analysis – Neural Machine Translation - Question answering - Text Summarization.

#### **Textbook / References**

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing,” 3rd edition, 2020. [Available on: [https://web.stanford.edu/~jurafsky/slp3/ed3book\\_dec302020.pdf](https://web.stanford.edu/~jurafsky/slp3/ed3book_dec302020.pdf)]

2. Christopher Manning and Hinrich Schütze, "Foundations of statistical natural language processing," MIT press, 1999.
3. Jacob Eisenstein, "Introduction to natural language processing," Illustrated edition, The MIT press, 2019.
4. Bengfort, Benjamin, Rebecca Bilbro, and Tony Ojeda. Applied text analysis with python: Enabling language-aware data products with machine learning. " O'Reilly Media, Inc.", 2018.
5. Yoav Goldberg, "Neural network methods for natural language processing," Synthesis lectures on human language technologies 10, no. 1 (2017): 1-309.

Course Code	Course name	L	T	P	Credits
ITPGE205	Advanced-Data Visualization and Analytics	3	1	-	4

Unit 1: Overview of Data Visualization – Importance and benefits of good data visualization– Design principles - Introduction to python libraries for visualization: seaborn, plotly express, pygal- Exploring Data – Reduce Items and Attributes: Filter and Aggregate - Creation of basic visualization: Histogram, Bar (Vertical and Horizontal) and Line Chart, Box plot, Scatter plot (Examples and Exercises to be given for practice). Color palettes – Creation of 3D Charts.

Unit 2: Creation of Advanced Visualization: Heat Map– Facet Grid - Interaction Techniques: Manipulate View – Creation of interactive Network topologies and Trees

Unit 3: Visualization of Time series data: summary statistics and plotting aggregated views - Visualization of seasonality, trends and noise– working with multiple time series data – Case study - Visualization of Geospatial data: spatial join - overlaying geospatial data to maps and adding special cues – Case Study- Visualization of multimodal data and analysis. Study sensor data and health care, genome and biomedical data.

Unit 4: Business Analytics and Visualization Tools: Tableau, PowerBI, Creating Interactive Dashboards and charts to organize data using visualization principles-

Unit 5: Data Storytelling – reading data in-depth, identifying critical messages and communicating these messages in the most effective way

#### **Textbooks/References:**

1. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.
2. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.
3. VanderPlas J. Python data science handbook: essential tools for working with data O'Reilly Media. Inc", 2016
4. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012
5. Nathan Yau, Visualize This: The Flowing Data Guide to Design, Visualization and Statistics, John Wiley & Sons, 2011.

Course Code	Course name	L	T	P	Credits
ITPGE206	Advanced Machine Learning for Biomedical Data Analysis	3	1	-	4

Unit 1: Introduction to ECG, EEG, MRI and CT datasets

Unit 2: Machine Learning Models for ECG Signal Classification

Unit 3: Hybrid Machine Learning for EEG Signal Classification

Unit 4: Benchmark Deep Learning Algorithms for Biomedical Image Segmentation:  
SwinUNet: UNet like Pure Transformer – FANet: Feedback Attention Network –  
MedT: Medical Transformer

Unit 5: Generative Adversarial Network for Synthetic Data Augmentation.

**Textbook / References:**

1. Goodfellow I, Bengio Y, Courville A, & Bengio Y, “Deep learning”, Cambridge: MIT Press, 1st Edition, 2016.
2. Michael Nielsen, “Neural Networks and Deep Learning”, Goodreads (eBook), 2013.
3. Bengio Y, “Learning Deep Architectures for AI, Foundations and Trends in Machine Learning”, new publishers, 2009.
4. Weblink: <https://paperswithcode.com/task/ecg-classification> .
5. Weblink: <https://paperswithcode.com/task/eeg> .
6. Weblink: <https://paperswithcode.com/task/medical-image-segmentation> .
7. Weblink: <https://github.com/xinario/awesome-gan-for-medical-imaging> .

Course Code	Course name	L	T	P	Credits
ITPGE306	Advanced Computer Networks	3	1	-	4

Unit 1: Review Computer Networks and the Internet: History of Computer Networking and the Internet, Networking Devices, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones. Networking Models: 5-layer TCP/IP Model, 7-layer OSI Model, Internet Protocols and Addressing, Equal Sized Packets Model: ATM.

Unit 2: Network Routing Routing and its concepts: Structure of a Router, Basic Router Configuration, Building a Routing Table, Static Routing, Dynamic Routing – Distance Vector Routing Protocol (RIPv1, RIPv2, EIGRP), Link State Routing Protocols (OSPF).

Unit 3: LAN Switching Switching and its concepts: Structure of a Switch, Basic Switch Configuration, Virtual LANs (VLANs), VLAN Trunking Protocol (VTP), Spanning Tree Protocol (STP), Inter-VLAN Routing.

Unit 4: Wide Area Networks (WANs) Introduction to WANs, Point-to-Point Protocol (PPP) concepts, Frame Relay concepts, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), IPv6.

Unit 5: Network Programming using Java TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI) - Basic RMI Process, Implementation details - Client-Server Application.

**Text Books**

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Fifth Edition, Pearson Education, 2012.
2. Network Fundamentals, Mark Dye, Pearson Education.
3. Routing Protocols & Concepts, Rick Graziani, Pearson Education.
4. LAN Switching & Wireless, Wayne Lewis, Pearson Education.
5. Accessing the WAN, Bob Vachon, Pearson Education.

### **Reference Books**

1. Computer Networks: Principles, Technologies And Protocols For Network Design, Natalia Olifer, Victor Olifer, Wiley India, 2006.
2. Computer Networks, Andrew S. Tanenbaum, Fifth Edition, Prentice Hall.
3. Computer and Communication Networks, Nader F. Mir, Pearson Education, 2007.
4. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition, Tata McGraw Hill, 2007.
5. Computer Networks, Bhushan Trivedi, Oxford University Press, 2011.
6. Fundamentals of Business Data Communications, Jerry FitzGerald and Alan Dennis, Tenth Edition, Wiley, 2009.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPGE303	Cloud Computing	3	1	-	4

Unit 1: Systems Modeling, Clustering and Virtualization: Distributed System Models and Enabling Technologies, Computer Clusters for Scalable Parallel Computing, Virtual Machines and Virtualization of Clusters and Data centers.

Unit 2: Foundations: Introduction to Cloud Computing, migrating into a Cloud, Enriching the 'Integration as a Service' Paradigm for the Cloud Era, The Enterprise Cloud Computing Paradigm.

Unit 3: Infrastructure as a Service (IAAS) & Platform and Software as a Service (PAAS / SAAS): Virtual machines provisioning and Migration services, Enhancing Cloud Computing Environments using a cluster as a Service, Secure Distributed Data Storage in Cloud Computing. Workflow Engine for Clouds, Understanding Scientific Applications for Cloud Environments.

Unit 4: Monitoring, Management and Applications: An Architecture for Federated Cloud Computing, SLA Management in Cloud Computing, Performance Prediction for HPC on Clouds, Best Practices in Architecting Cloud Applications in the AWS cloud, Building Content Delivery Networks using Clouds, Resource Cloud Mashups.

Unit 5: Governance and Case Studies: Organizational Readiness and Change management in the Cloud age, Data Security in the Cloud, Legal Issues in Cloud computing, Achieving Production Readiness for Cloud Services.

### **Text Books:**

1. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

#### Reference Books:

1. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Tata McGraw Hill, 2011.
2. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
3. Cloud Computing: Implementation, Management and Security, John W. Rittinghouse, James F. Ransome, CRC Press, 2012.
4. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly, SPD, 2011.
5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, 2011.

#### DISCIPLINE SPECIFIC ELECTIVE -V

Course Code	Course name	L	T	P	Credits
ITPGE303	Cloud Computing	3	1	-	4

#### Game Theory

##### Unit 1

Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium, dominant strategies.

##### Unit 2

Mixed-Strategy Nash Equilibrium pure and mixed strategy Nash equilibria, Iterative removal of strictly dominated strategies, minimax strategies and the minimax theorem for zero-sum game, correlated equilibria.

##### Unit 3

Extensive-Form Games: Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium, introduction to imperfect-information games, mixed versus behavioural strategies.

##### Unit 4

Repeated Games: Repeated prisoners dilemma, finite and infinite repeated games, limited-average versus future-discounted reward, folk theorems, stochastic games and learning.

## Unit 5

Bayesian Games: General definitions, ex ante/interim Bayesian Nash equilibrium. Coalitional Games: Transferable utility cooperative games, Shapley value, Core, applications.

Books/References:

1. A Course in Game Theory by M. J. Osborne and A. Rubinstein, MIT Press.
2. An Introduction to Game Theory by M. J. Osborne, Oxford University Press.
3. Algorithmic Game Theory by N. Nisan, T. Rougharden, E. Tardos and V. V. Vazirani, Cambridge University Press.
4. Fun and Games: A Text on Game theory by K. Binmore, AIBS publisher

Course Code	Course name	L	T	P	Credits
ITPGE303	Cloud Computing	3	1	-	4

## Natural Language Processing

### Unit 1

Introduction, Text Processing, and Morphology: Introduction to NLP, Various stages of NLP, The Ambiguity of Language, Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.

### Unit 2

Language Modelling and Word Sense Disambiguation: Words: Collocations, Frequency, Mean and Variance, Hypothesis testing: The t-test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: N-gram Models over Sparse Data.

### Unit 3

Preliminaries of Disambiguation, Supervised Disambiguation: Bayesian classification, An information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus-based dis-ambiguation, Disambiguation based on translations in a second-language corpus.

### Unit 4

Markov Model and POS Tagging: Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tag-ging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

## Unit 5

Syntax and Semantics: Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.

### Books/References:

1. Christopher D. Manning and Hinrich Schutze, “Foundations of Natural Language Processing”, 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
2. Daniel Jurafsky and James H. Martin “Speech and Language Processing”, 3rd edition, Prentice Hall, 2009.
3. Nitin Indurkha, Fred J. Damerau “Handbook of Natural Language Processing”, Second Edition, CRC Press, 2010.
4. James Allen, “Natural Language Understanding”, Pearson Publication 8th Edition. 2012.

Course Code	Course name	L	T	P	Credits
ITPGE303	Cloud Computing	3	1	-	4

Unit 1: Systems Modeling, Clustering and Virtualization: Distributed System Models and Enabling Technologies, Computer Clusters for Scalable Parallel Computing, Virtual Machines and Virtualization of Clusters and Data centers.

Unit 2: Foundations: Introduction to Cloud Computing, migrating into a Cloud, Enriching the ‘Integration as a Service’ Paradigm for the Cloud Era, The Enterprise Cloud Computing Paradigm.

Unit 3: Infrastructure as a Service (IAAS) & Platform and Software as a Service (PAAS / SAAS): Virtual machines provisioning and Migration services, Enhancing Cloud Computing Environments using a cluster as a Service, Secure Distributed Data Storage in Cloud Computing. Workflow Engine for Clouds, Understanding Scientific Applications for Cloud Environments.

Unit 4: Monitoring, Management and Applications: An Architecture for Federated Cloud Computing, SLA Management in Cloud Computing, Performance Prediction for HPC on Clouds, Best Practices in Architecting Cloud Applications in the AWS cloud, Building Content Delivery Networks using Clouds, Resource Cloud Mashups.

Unit 5: Governance and Case Studies: Organizational Readiness and Change management in the Cloud age, Data Security in the Cloud, Legal Issues in Cloud computing, Achieving Production Readiness for Cloud Services.

### Books/References:

1. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
3. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Tata McGraw Hill, 2011.
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
5. Cloud Computing: Implementation, Management and Security, John W. Rittinghouse, James F. Ransome, CRC Press, 2012.
6. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly, SPD, 2011.
7. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, 2011

Course Code	Course name	L	T	P	Credits
ITPGE304	<b>Multimedia Technology</b>	3	1	-	4

#### Unit 1

Introduction and elements of multimedia and animation : Animation: Introduction to Multimedia, Characteristics of Multimedia Presentation, Multimedia Architecture and Components, Visual Display System,

#### Unit 2

Text: Types, Font, Unicode Standard, Text Compression, Image: Types, Image Processing, Standards, Specification, Device Independent Color Models,

#### Unit 3

Video: Video Signal Transmission, Signal Formats, Broadcasting Standards, Digital Video Standards, Audio: Acoustics, Characteristics of Sound – Elements of Audio System: Microphone, Amplifier, Loudspeaker, Audio Mixer, Digital Audio, MIDI, Animation: Key Frames and Tweening Techniques – 2D and 3D Animation.

#### Unit 4

Multimedia Systems: Compression Types and Techniques: CODEC, GIF Coding Standards, JPEG, MPEG, Multimedia Database System, Hardware Support for Multimedia, Real Time Protocols, Play Back Architectures, Synchronization, Hypermedia Concepts and Design, Digital Copyrights.

#### Unit 5

Multimedia Tools and Application Developments: Authoring Tools: Features and Types, Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, Sound Editing Tools, Digital Movie Tools. Software Life Cycle, ADDIE Model, Conceptualization, Content Collection, Story Board, Script, Authoring Metaphors, Testing, Report Writing, Documentation.

Books/References:

1. Ranjan Parekh, Principles of Multimedia, Second Edition, McGraw-Hill Education, 2017.
2. Tay Vaughan, Multimedia: Making It Work, Ninth Edition, McGraw-Hill, 2014.
3. Ralf Steinmetz, Klara Nahrstedt, Multimedia: Computing, Communications and Applications, Prentice Hall, 1995.

Course Code	Course name	L	T	P	Credits
ITPGE305	<b>Advanced Internet Technologies</b>	3	1	-	4

Unit 1

Introduction to Internet technology: evolution of the internet. TCP/IP: addressing and routing. Internet applications: file transfer protocol, Telnet, Email, Chat, World Wide Web, hypertext transfer protocol.

Unit 2

Introduction to web technologies: web architectures. Client side scripting: HTML; DOM; CSS; JavaScript and jQuery. Server side scripting: Servlet; JSP; PHP; MySQL.

Unit 3

Server side scripting: Servlet; JSP; PHP; MySQL, Sessions, Cookies, Connection to server database

Unit 4

XML processing, AJAX, JSON, Node.js, SpringBoot, web deployment. Overview of web services. Web application development: search engine; web crawlers; e-commerce portal.

Unit 5

Web Security Concepts: HTTP Authentication; Compare and Contrast; Application Types (BASIC, DIGEST, FORM and Client CERT). Security Implementation: Retrieving Authentication Information; SQL injection; Form Based Custom authorization; Retrieving SSL authentication.

Books/References:

1. Joseph B. Miller, Internet Technologies and Information Services, 2nd Edition, Greenwood Publishing Group, 2014.
2. Scobey, P., & Lingras, P., Web Programming and Internet Technologies: An E-commerce Approach. Jones & Bartlett Publishers, 2016.
3. Freire, M., & Pereira, M., Encyclopedia of Internet technologies and applications. IGI Global, 2007.
4. Bates, C., Web Programming Building Internet Applications. John Wiley & Sons, 2002.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPGE306	<b>Advanced Computer Networks</b>	3	1	-	4

Unit 1: Review Computer Networks and the Internet: History of Computer Networking and the Internet, Networking Devices, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones. Networking Models: 5-layer TCP/IP Model, 7-layer OSI Model, Internet Protocols and Addressing, Equal Sized Packets Model: ATM.

Unit 2: Network Routing Routing and its concepts: Structure of a Router, Basic Router Configuration, Building a Routing Table, Static Routing, Dynamic Routing – Distance Vector Routing Protocol (RIPv1, RIPv2, EIGRP), Link State Routing Protocols (OSPF).

Unit 3: LAN Switching Switching and its concepts: Structure of a Switch, Basic Switch Configuration, Virtual LANs (VLANs), VLAN Trunking Protocol (VTP), Spanning Tree Protocol (STP), Inter-VLAN Routing.

Unit 4: Wide Area Networks (WANs) Introduction to WANs, Point-to-Point Protocol (PPP) concepts, Frame Relay concepts, Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), IPv6.

Unit 5: Network Programming using Java TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI) - Basic RMI Process, Implementation details - Client-Server Application.

#### Books/References:

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Fifth Edition, Pearson Education, 2012.
2. Network Fundamentals, Mark Dye, Pearson Education.
3. Routing Protocols & Concepts, Rick Graziani, Pearson Education.
4. LAN Switching & Wireless, Wayne Lewis, Pearson Education.
5. Accessing the WAN, Bob Vachon, Pearson Education.
6. Computer Networks: Principles, Technologies And Protocols For Network Design, Natalia Olifer, Victor Olifer, Wiley India, 2006.
7. Computer Networks, Andrew S. Tanenbaum, Fifth Edition, Prentice Hall.
8. Computer and Communication Networks, Nader F. Mir, Pearson Education, 2007.

<b>Course Code</b>	<b>Course name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
ITPGE307	<b>Cyber Security</b>	3	1	-	4

## Unit 1

Introduction to Cyber Security: Cyber-attacks, Defence strategies and Techniques: Access Control: Authentication and Authorization, Data Protection, Prevention and Detection, Response, Recovery & Forensics .

## Unit 2

Basics of Cryptography: Symmetric and Asymmetric key Cryptography, cryptographic Hash function, Digital signature schemes.

## Unit 3

Network Security Essentials: Security at different layers: IPSec protocol, SSL Protocol, authentication and key management protocols, Wireless LAN security, cellphone security. Software Vulnerabilities and attacks: Phishing, Buffer Overflow, Format String Attack, Cross-site Scripting, SQL injection, SYN flooding attack, DNS cache poisoning attack.

## Unit 4

Access Control in Operating System: Preliminaries: Discretionary Access Control, Mandatory Access Control, Role based access control Firewalls: Packet Filtering Firewalls, Proxy-Server based Firewall, Policies and firewall configurations: Case studies of personal firewalls: architecture, commands.

## Unit 5

Intrusion Prevention and Detection: Types of Intrusion Detection System (IDS): Anomaly vs. Signature based IDS, DDoS attack prevention/Detection, Malware Detection, port and vulnerability scanning, Packet Sniffing, Intrusion detection and penetration testing using different open-source tools.

Electronic Payment: Secure Electronic Transaction protocol. Books/References:

1. Bernard Menezes and R. Kumar, Cryptography, Network Security and Cyber Laws, Cengage Learning, 2028.
2. William Stallings, Network Security Essentials, Applications and Standards, Pearson Education,2018

Course Code	Course name	L	T	P	Credits
ITPGE308	Optimization Techniques	3	1	-	4

## Unit 1

Introduction to Optimization Techniques, Optimal Problem Formulation: Design Variables, Constraints, Objective function, Variable bounds, Engineering Optimization Problem, examples of a few engineering optimization problems, classification of optimization algorithms.

## Unit 2

Single variable optimization algorithms: Optimality Criteria, Bracketing Methods, Region Elimination Methods, Point Estimation Method, Gradient Based Method .

### Unit 3

Multivariable Optimization algorithms: Optimality Criteria, Unidirectional Search, Direct Search Methods, Gradient based methods.

### Unit 4

Constrained optimization algorithms: Kuhn-Tucker Condition, Lagrangian Duality Theory, Transformation Methods, Sensitivity Analysis, Direct search for Constrained Optimization, Feasible Direction Method,

### Unit 5

Quadratic Programming, Generalized Reduced Gradient Method, Gradient Projection Method, specialized and non traditional Optimization Algorithms: Integer Programming, Geometric Programming, Genetic Algorithms, Simulated annealing.

Books/References:

1. Kalyanmoy Deb, Optimization for Engineering Design Algorithms & Examples, PHI, 2nd Edition,2012.
2. Martins & Ning, Engineering Design Optimization, Electronic Edition,2021

Course Code	Course name	L	T	P	Credits
ITPGE309	Image Processing & Computer Vision	3	1	-	4

### Unit 1

Introduction to Digital Image Processing, basic concept of image formation and representation, steps in digital image processing, elements of digital image processing, relationship between pixels, image transformation.

### Unit 2

Image enhancement: spatial domain filtering and spatial domain filtering; sharpening; contrast enhancement; restoration. Image segmentation: point; line and edge detection; thresholding; clustering; region growing. Image compression: Image Compression models; error-free compression; Lossy compression; Image compression standards.

### Unit 4

Overview of Computer Vision, feature extraction in images, image classification techniques, object detection, object recognition, semantic segmentation.

### Unit 5

Introduction to machine learning, types of machine learning techniques: supervised and unsupervised techniques. Introduction to deep learning; convolutional neural networks. Applications of machine learning in computer visions.

Books/References:

1. Rafael C., Gonzalez Woods R.E., Digital Image Processing, Third edition, Pearson, 2013.
2. Jain A.K, Fundamentals of Digital Image Processing, Prentice Hall, Englewood Cliffs, 2002.
3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2022.
4. David A. Forsyth, Jean Ponce, Computer Vision-A Modern Approach, Pearson Education, 2015.

Course Code	Course name	L	T	P	Credits
ITPG310	Research Methodology & Proposal Writing	3	1	-	4

Unit 1

Introduction: What is a research problem?, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation

Unit 2

Effective literature studies approaches: analysis Plagiarism, Research ethics Effective technical writing: how to write report.

Unit 3

Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee .

Unit 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5

Report Writing: pre-writing considerations, thesis writing, formats of report writing, formats of publications in research journals, use of standard tools like LATEX.

Books/References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Halbert, "Resisting Intellectual Property", Taylor Francis Ltd., 2007.

4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.