Course Structure and Syllabus for M.Tech (Computer Science & Engineering), JIS College of Engineering (Under West Bengal University of Technology)

**Semester 1**

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Paper Name</th>
<th>Weekly Contact Period (WCP)</th>
<th>Credit</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Theoretical:</strong></td>
<td></td>
<td></td>
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<tr>
<td>PGCS101</td>
<td>Discrete Structure</td>
<td>4 0 0 4</td>
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<tr>
<td>PGCS102</td>
<td>Design and Analysis of Algorithm</td>
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<td>PGCS103</td>
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<td></td>
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<tr>
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<td>Computer Network Laboratory</td>
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<td>Operating Systems Laboratory</td>
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**Total Credit: 23  Total Marks: 900**

**Semester 2**

<table>
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<th>Paper Code</th>
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<th>Weekly Contact Period (WCP)</th>
<th>Credit</th>
<th>Marks</th>
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<td><strong>Theoretical:</strong></td>
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<td>Advanced Mathematics</td>
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<td>PGCS202</td>
<td>Advanced Computer Architecture</td>
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<tr>
<td>PGCS203</td>
<td>Advanced DBMS</td>
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<td>PGCS204</td>
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<td>PGCS291</td>
<td>Software Engineering Laboratory</td>
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<td>PGCS292</td>
<td>DBMS Laboratory</td>
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**Total Credit: 22  Total Marks: 800**

**Semester 3**

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<th>Weekly Contact Period (WCP)</th>
<th>Credit</th>
<th>Marks</th>
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<tr>
<td></td>
<td><strong>Theoretical:</strong></td>
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<tr>
<td>PGCS301</td>
<td>Mobile Computing</td>
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<tr>
<td>PGCS302</td>
<td>Multimedia and Graphics</td>
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<tr>
<td>PGCS303</td>
<td>Seminar III</td>
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<td><strong>Practical:</strong></td>
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<td>PGCS394</td>
<td>Term Paper [Project]</td>
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**Total Credit: 20  Total Marks: 400**
Semester 4

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<tr>
<th>Paper Code</th>
<th>Paper Name</th>
<th>Weekly Contact Period (WCP)</th>
<th>Credit</th>
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<td></td>
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<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
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<td>PGCS494</td>
<td>Final Project presentation</td>
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<tr>
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<td>with VIVA</td>
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<td>PGCS495</td>
<td>Grand Viva</td>
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**Total Credit: 20 Total Marks: 200**

* Electives to be selected from the following list

*** Seminar should be presented on a very recent topic on any technological domain.

**Elective subjects:**

<table>
<thead>
<tr>
<th></th>
<th>Elective I</th>
<th>Elective II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Web Technology</td>
<td>Soft Computing</td>
</tr>
<tr>
<td>B</td>
<td>Theory of Computation</td>
<td>Advanced Compiler Design</td>
</tr>
<tr>
<td>C</td>
<td>Data Mining &amp; Data Warehousing</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>D</td>
<td>Parallel Computing</td>
<td>VLSI Design</td>
</tr>
<tr>
<td>E</td>
<td>Embedded Systems</td>
<td>Pattern Recognition</td>
</tr>
<tr>
<td>F</td>
<td>Modeling and Simulation</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>G</td>
<td>Advanced Computer Graphics</td>
<td>Natural Language Processing</td>
</tr>
<tr>
<td>H</td>
<td>Distributed Algorithms</td>
<td>Information System Audit</td>
</tr>
<tr>
<td>I</td>
<td>Cryptography &amp; Network Security</td>
<td></td>
</tr>
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</table>

**Total Course Credit: 85**
1st Semester

Discrete Structure
Code: PGCS101
Weekly Contact Hour: 4L
Credit: 4

Course Content
Review of Set Theory, Combinatorics, Basic Combinatorial Numbers, Generating Functions and Recurrence Relations, Inclusion-Exclusion Principles, Graph Theory, Connectivity, Matching, Hamiltonian Cycles, Coloring Problems, Algebraic Structure, Groups, Rings and Fields, Probabilistic Methods

Books
2. Kolman, Busby & Ross, “Discrete Mathematical structures 5th ed”, PHI

Design & Analysis of Algorithms
Code: PGCS102
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Basic concepts: algorithms, data, list, stacks, queues and dequesues, sequential and linked allocation. Trees: computer representation and traversal of trees. Models of computation, bottom-up and top-down structured programming. Algorithm design methods: greedy algorithms, divide and conquer, dynamic programming. Analysis of algorithms, matrix multiplication, integer arithmetic, Approximation Algorithm and polynomial evaluation algorithms, introduction to NP complete problems.

Books

Computer Networks & Distributed Systems
Code: PGCS103
Weekly Contact Hour: 3L
Credit: 3

Course Contents:
signatures, digital certificates, distributed system taxonomy, service models, naming and binding remote procedure calls (RPC), object brokers, distributed file system design, distributed file system case studies: NFS, AFS, clock synchronization, distributed transactions, mutual exclusion, election algorithms, distributed shared memory and memory consistency models, distributed deadlocks.

Books
1. W. R. Stevens. TCP/IP Illustrated, Volume 1: The protocols, PEARSON Education.
2. G. R. Wright. TCP/IP Illustrated, Volume 2: The Implementation, PEARSON Education.
10. Education S. Tanenbaum, “Distributed Operating Systems”, PEARSON Education

Operating Systems
Code: PGCS104
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books

2nd Semester
Advanced Mathematics
Code: PGCS201
Weekly Contact Hour: 3L
Credit: 3
Course contents
Differential equations of higher order including partial differential equation; Infinite and power series; Vectors: vector algebra in 2 and 3 spaces, vector calculus in multiple variables, gradients, divergence, curl, line integral, Green's theorem, surface integral; Matrices: basic concepts (addition, multiplication, rank, linear independence etc), Inverse of matrix, solutions of linear systems, Eigen values, eigenvectors, symmetric matrices, complex matrices; Different transformations: Fourier, Laplace, Z transform, etc, Data analysis and probability theory; Mathematical statistics.
Books
5. Sankara Rao, “Introduction to Partial Differential Equation 2nd”, PHI

Advanced Computer Architecture
Code: PGCS202
Weekly Contact Hour: 3L
Credit: 3
Course Contents
Books

Advanced Database Management Systems
Code: PGCS203
Weekly Contact Hour: 3L
Credit: 3
Course Contents
Physical storage and indexing structures, Query processing algorithms, Query optimization, Transaction processing and serializability, Concurrency Control, Recovery, Parallel and distributed databases, XQuery and XML query evaluation, Emerging database trends, data mining, data warehousing, distributed database, object oriented database, spatial and temporal database.
Books

Software Engineering
Code: PGCS204
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books

3rd Semester

Mobile Computing
Code: PGCS301
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books
1. Mobile Communications J. Schiller, Pearson education publishing 2003
2. Wireless Communications and Networks W. Stallings, Pearson education publishing 2002
4. Amjad Umar, “Mobile Computing And Wireless Communications”, Nge Solutions
8. Charles Perkins. Mobile IP. PEARSON Education.
10. Charles Perkins (ed.) Adhoc Networks. PEARSON Education.

**Multimedia and Graphics**
Code: PGCS302  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**

**Books**

**Elective Subjects**

**Web Technology**
Code: PGCS105A
Weekly Contact Hour: 3L
Credit: 3

**Course Content**
Introduction to advanced web technology, Technological issues: XML processing, RDF processing, middleware technologies (CORBA, IIOP), RMI, RPC. Taxonomies and ontologies for advanced web applications: Ontology modeling, Languages for representing ontologies on the web, Rules and inferences, Web services, Design and modeling of web services, Technologies for Implementing web services, Current applications of advanced web technologies.

**Book**
3. Wiley & Son's

**Theory of Computation**
Code: PGCS105B
Weekly Contact Hour: 3L
Credit: 3

**Course Contents**
Finite automata, regular expressions, push-down automata, context free grammars, pumping lemmas. Turing machines (deterministic, non deterministic, multitape) Church-Turing Thesis Decidability and undecidability, diagonalization, and reducibility Halting problem, Post correspondence problem, Rice's Theorem, and other undecidability results Time and space complexity P vs. NP, NP-completeness, Cook's Theorem, and other NP-complete problems PSPACE, PSPACE-completeness, PSPACE-complete problems L vs. NL, NL-completeness, Savitch's Theorem, Immerman-Szelepcsényi Theorem.

**Books**
3. Introduction to Automata Theory, Languages and Computation by J. E. Hopcroft and J. D. Ullman -- pub. PEARSON Education

**Data Mining & Data Warehousing**
Code: PGCS105C
Weekly Contact Hour: 3L
Credit: 3

**Course Contents**
Introduction, Data warehousing and OLAP, Overview of mining operations, Decision tree classifiers, Instance-based learners, Bayesian classifiers, Learning hyper planes, Meta learning, Classifier evaluation, KDD Cup Case study, Clustering, Active learning, Duplicate elimination, Similarity functions, Min hash, Set joins, Sequence mining, Hidden Markov Models, Collaborative Filtering, Association rule mining, Surprising item set mining, Temporal itemset mining, Feature selection methods, Intrusion detection, Forecasting.

**Books**
1. Pattern recognition and machine learning by Christopher Bishop
3. Hastie, Tibshirani, Friedman The elements of Statistical Learning Springer Verlag
4. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers
5. Applied Multivariate statistical analysis by Johnson and Wichern, 3rd Edition, PHI
7. Boyd and Vandenberghe Convex optimization Book available online: Local copy

**Parallel Computing**
Code: PGCS105D
Weekly Contact Hour: 3L
Credit: 3

**Course Contents**

Books
1. Introduction to Parallel Algorithms and Architectures : Arrays, Trees, Hypercubes. F. T. Leighton. Morgan Kaufmann Publishers,

Embedded Systems
Code: PGCS105E
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Introduction to Embedded systems, hardware/software code sign, Embedded micro controller cores, embedded memories, Examples of embedded systems, sensors and interfacing techniques, Real-time concepts, real-time operating systems, Required RTOS services/capabilities (in contrast with traditional OS). Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real world issues: blocking, unpredictability, interrupts, caching. Examples of OSs for embedded systems - RT Linux, VRTX. Programming languages for embedded systems e.g., Handel-C and Esterel, system support for embedded systems, selected embedded system-based applications: process-control, robotics, etc. Software Development Methodology: Model based development, Statecharts, etc. Case studies, controlling an Injection molding process, Flight simulator, digital call center handler, codec.

Books
3. various journals and conference proceedings.

Modeling and Simulation
Code: PGCS105F
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books
3. Education, Reading MA, USA 2000

Advanced Computer Graphics
Code: PGCS105G
Course Contents

Books
2. PEARSON Education. Alan Watt and Mark Watt, Advanced Animation and Rendering Techniques: Theory and Practise,

Distributed Algorithms
Code: PGCS105H
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books
1. Nancy A. Lynch, “Distributed Algorithms”, Morgan Kaufmann

Cryptography & Network Security
Code: PGCS105I
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Books

**Soft Computing**

Code: PGCS205A
Weekly Contact Hour: 3L
Credit: 3

**Course contents**
Introduction to Soft-computing tools, Fuzzy logic, Genetic algorithms, Neural Networks and probabilistic reasoning; Application of Fuzzy logic concepts in Engineering problems; Engineering optimization problem solving using genetic algorithms; Neural network approaches in engineering analysis, design and diagnostics problems; applications of probabilistic reasoning approaches.

**Books**

**Advanced Compiler Design**

Code: PGCS205B
Weekly Contact Hour: 3L
Credit: 3

**Course Contents:**

**Books**
2. LeBlanc. Crafting a Compiler , PEARSON Education. C. Fischer and R. LeBlanc. Crafting a Compiler in C , PEARSON
5. A Retargetable C Compiler: Design and Implementation , PEARSON Education. Dhamdhere. Compiler Construction , McMillan
6. India. Holmes. Object Oriented Compiler Construction , PEARSON Education. Holmes. Building your own Compiler with C++ ,
7. PEARSON Education. Wirth. Compiler Construction , PEARSON Education. Wilhelm and Maurer. Compiler Design , PEARSON
8. Education.

**Artificial Intelligence**  
Code: PGCS205C  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**  

**Books**

1. E. Charniak, et.al., Introduction to Artificial Intelligence, PEARSON Education. P. H. Winston, Artificial Intelligence, PEARSON  
2. Education. E. Rich and K. Knight, Artificial Intelligence, PEARSON Education. R. Honavar and E. Uhr, Artificial Intelligence and  

**VLSI Design**  
Code: PGCS205D  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**  

**Books**

1. C. Mead & L. Conway; “Introduction to VLSI Systems”, PEARSON Education.  
2. N. Weste, K.Eshraghian, “Principles of CMOS VLSI Design, a systems perspective”, PEARSON Education.
3. S.Y. Kung, “VLSI array processors”, PEARSON Education

**Pattern Recognition**

Code: PGCS205E  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**

Introduction to pattern recognition and applications to OCR, speech recognition, fingerprints, signatures etc. Commercial importance of applications. Introduction to Statistical, Neural and Structural Approaches. 
Statistical Pattern Recognition: Patterns and classification, discriminant functions, Bayes decision rule, nearest neighbour rule, probability of error. Linear discriminant functions: Perceptrons and training, LMSE approaches. 
Unsupervised learning and clustering. Feature extraction. 
Pattern associators and content addressable memories, hardware realizations. Syntactic pattern recognition: Formal languages and grammars Pattern grammars and higher dimensional grammars, Parsing, automata realizations, stochastic grammars, Grammatical Inference, computational learning theory, Valiant’s framework.

**Books**

   R. O. Duda and P. E. Hart, Pattern  

**Machine Learning**

Code: PGCS205F  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**

Prediction as regression and classification, Bias-variance tradeoff Non-parametric approaches, Max-margin and support vector machines Basics of PAC learning, Model averaging and ensembles Unsupervised learning, Time series analysis and prediction Sequential models, hidden markov models, Semi supervised learning, Graphical models.

**Books**

   4. J. Whittaker, Graphical models in Applied  

**Natural Language Processing**

Code: PGCS205G  
Weekly Contact Hour: 3L  
Credit: 3

**Course Contents**

A computational framework for natural language. A framework such as LFG, GPSG or Panini in some depth. Partial description of English or an Indian language in the framework, lexicon, algorithms and data structures for implementation of the framework. Introduction to semantics and knowledge representation. Some applications like machine translation, database interface.

**Books**

   3. R. O. Duda and P. E. Hart, Pattern  
   6. R. O. Duda and P. E. Hart, Pattern  

**Information System Audit**

Code: PGCS205H  
Weekly Contact Hour: 3L
Course contents

Book
5. Issues”,
8. Auditors, Inc.

Practical Papers

Software Lab
Code:   PGCS191
Weekly Contact Hour:  3P
Credit:    2

Programs, assignments covering the need of Algorithm Analysis and Design (PGCS102)

Network Lab
Code:   PGCS192
Weekly Contact Hour:  3P
Credit:    2

- IPC (Message queue)
- NIC Installation & Configuration (Windows/Linux)
- Familiarization with
  - Networking cables (CAT5, UTP)
  - Connectors (RJ45, T-connector)
  - Hubs, Switches
- TCP/UDP Socket Programming
- Multicast & Broadcast Sockets
- Implementation of a Prototype Multithreaded Server
- Implementation of
  - Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
  - Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
  - Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

Operating Systems Lab
Code:   PGCS193
Weekly Contact Hour:  3P
1. **Shell programming**: creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).
2. **Process**: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal**: signal handling, sending signals, signal interface, signal sets.
4. **Semaphore**: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads**: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel).
6. **Inter-process communication**: pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

**Software Engineering Lab**
Code: PGCS291
Weekly Contact Hour: 3P
Credit: 2

Programs, assignments covering the need of Software Engineering (PGCS204)

**DBMS Lab**
Code: PGCS292
Weekly Contact Hour: 3P
Credit: 2

**SQL:**
1. Creating, altering and dropping tables with integrity constraints.
2. Retrieving and modifying data from a database
3. Retrieving data from database using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING clause.
4. Use of scalar and aggregate functions.
5. Retrieving data from a database using Equi , Non Equi , Outer and Self Join.
6. Using sub queries, rowid and rownum for retrieving data.
7. Use of views, indexes and sequences.

**PL/SQL:**
8. Introduction to PL/SQL, using output from server.
9. Use of implicit & explicit cursors in data handling.
10. Exception handling – Oracle defined and User defined.
11. Use of stored procedures & functions in data manipulation.
12. Use of trigger in data manipulation.