Curriculum for M. Tech. in Information Technology

(Applicable from the academic session 2021-2022)

Department of Information Technology

Government College of Engineering & Ceramic Technology

(An Autonomous Institution under MAKUT)

73, A.C Banerjee Lane

Kolkata-700010

COURSE STRUCTURE

1st SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITPC101	Advanced Engineering Mathematics	3	1	0	4	4
02	ITPC102	Advanced Computer Architecture	3	1	0	4	4
03	ITPC103	Computer Network	3	1	0	4	4
04	ITPEC101	A: Internet and Web Technology B: Advanced Software Engineering C: Advanced Data Structures	3	0	0	3	3
05	ITPEC102	A: Information Theory and Coding B: Pattern Recognition C: Digital Signal Processing D: Cloud Computing	3	0	0	3	3
06	ITAUD101	A: Indian Constitution B: Value Education C: Pedagogy Studies D: Stress Management by Yoga	2	0	0	2	0
SESSIONAL/PRACTICAL							
01	ITPCL101	PC Lab. I	0	0	3	3	1.5
02	ITPEC101(A/B/C)L	PEC101 Lab.	0	0	3	3	1.5
03	ITASGN101	Seminar	0	0	0	0	1
TOTAL			**17**	**3**	**6**	**26**	**22**

2nd SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITPC204	Advanced Operating System	3	1	0	4	4
02	ITPC205	Database Design	3	1	0	4	4
03	ITPC206	Advanced Algorithm	3	1	0	4	4
04	ITPEC203	A: Image and video Processing B: Machine Learning C: Soft Computing	3	0	0	3	3
05	ITPEC204	A: Mobile Computing B: IoT and Its Application C: Data Mining	3	0	0	3	3
06	ITRES201	Research Methodology and IPR	2	0	0	2	2
SESSIONAL/PRACTICAL							
01	ITPCL202	PC Lab. II	0	0	3	3	1.5

02	ITPEC203(A/B/C)L	ITPEC203 Lab.	0	0	3	3	1.5
03	ITPRJ201	Dissertation (Part 1)	0	0	4	4	2
TOTAL			**17**	**3**	**10**	**30**	**25**
3rd SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITOEC301	A: Quantum Computing B: Big Data Analytics C: Software Project Management D: Information and System Security E: Social Network Analysis	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	ITPRJ302	Dissertation (Part 2)	0	0	18	18	9
02	ITASGN302	Comprehensive Viva-voce	0	0	0	0	1
TOTAL			**3**	**0**	**18**	**21**	**13**
4th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
SESSIONAL/PRACTICAL							
01	ITPRJ403	Dissertation (Part 3)	0	0	24	24	12
TOTAL			**0**	**0**	**24**	**24**	**12**

(Total Credit=22+25+13+12=72)

FIRST SEMESTER

1st SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITPC101	Advanced Engineering Mathematics	3	1	0	4	4
02	ITPC102	Advanced Computer Architecture	3	1	0	4	4
03	ITPC103	Computer Network	3	1	0	4	4
04	ITPEC101	A: Internet and Web Technology B: Advanced Software Engineering C: Advanced Data Structures	3	0	0	3	3
05	ITPEC102	A: Information Theory and Coding B: Pattern Recognition C: Digital Signal Processing D: Cloud Computing	3	0	0	3	3
06	ITAUD101	A: Indian Constitution B: Value Education C: Pedagogy Studies D: Stress Management by Yoga	2	0	0	2	0
SESSIONAL/PRACTICAL							
01	ITPCL101	PC Lab. I	0	0	3	3	1.5
02	ITPEC101(A/B/C)L	PEC101 Lab.	0	0	3	3	1.5
03	ITASGN101	Seminar	0	0	0	0	1
TOTAL			**17**	**3**	**6**	**26**	**22**

Name of the course	**ADVANCED ENGINEERING MATHEMATICS**
Course Code: ITPC101	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Two Mid Term Exams: 30 Marks
Tutorial: 1 hr/week	Assignments , Quiz etc.: 20 Marks
Credit Points: 4	End Semester Exam: 50 Marks

Objective:	
1.	To understand Fourier series representation of Periodic signals.
2.	To understand basics z transform.
3.	To understand linear spaces its basis and dimension with corresponding applications in the field of computer sciences.

4.	To learn the concept of eigen values, eigen vectors, diagonalisation of matrices for understanding engineering problems.		
5.	To understand counting techniques and combinatorics in the context of discrete probability.		
6.	To learn recurrence relations and generating functions.		
7.	To understand basic concept of modelling system using fuzzy set.		
Pre-Requisite:			
1.	Discrete Mathematics		
2.	Engineering Mathematics (UG level)		
Module	**Content**	**Hours**	**Marks**
1	**Integral Transform:** Fourier Series and Transform: Periodic functions, Trigonometric functions, Trigonometric Series, Fourier series, Dirichlet conditions, Euler formula for Fourier coefficients, Even and Odd functions, Half range series expansion, Parseval's formula. Fourier transform, Properties of Fourier transform, Fourier sine and cosine transform, Convolution theorem, First Fourier transform.	8	
2	**Z- Transform:** Sequence, Representation of sequence, Basic operations on sequences, Z-transforms, Properties of Z-transforms, Change of scale, Shifting property, Inverse Z-transform, Solution of difference equation , Region of convergence.	4	
3	**Advanced Linear Algebra:** **Vector / Linear Space:** Definitions and examples, Subspace, Union and intersection of subspaces, Linear sum of two subspaces, Linear combination, independence and dependence, Linear span, Generators of vector space, Finite dimensional vector space, Replacement Theorem, Extension theorem, Statement of the result that any two bases of a finite dimensional vector space have same number of elements. Dimension of a vector space, Extraction of basis, formation of basis with special emphasis on Rn ($n \leq 3$), Eigenvalue and eigenvectors of matrices, Caley Hamilton Theorem, Simple properties of eigenvalues and eigenvectors- for symmetric, and general matrices, Diagonalisation.	10	
4	**Counting Technique:** Permutations, Combinations, Binomial Coefficients, Pigeon-hole principle, Principles of inclusion and exclusions.	3	
5	**Recurrence Relation:** Formulation, modeling, of different counting problems in terms of recurrence relation, Solution of Linear recurrence relations with constant coefficients (upto second order) by 1) iterative method, 2) characteristic roots method, 3) generating functions method. **Stochastic Process:** Review of probability, Random variable, Random process, Random walk, Brownian motion, Markov process.	8	
6	**Fuzzy sets:** Introduction, crispness, vagueness, fuzziness, uncertainty. Basic definitions and examples, basic set theoretic operations – union, intersection,	7	

	complementation and their simple properties. **Soft sets:** Introduction, Definition with examples, Soft set as generalization of fuzzy set, complement, null soft set, Absolute soft set, definition of general binary operation, union, intersection, simple properties – De Morgan's law, soft point, soft function and soft inverse function, simple properties.		

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	write periodic function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms.
CO2	solve engineering problems using Z-transformation
CO3	recognize the concept of the terms span, linear independence, basis and dimension and apply these concepts to various vector spaces and subspaces.
CO4	solve problems involving recurrence relations and generating functions
CO5	solve problems using counting techniques and combinatorics in the context of discrete probability.
CO6	analyse statistical data by using fuzzy logic methods
Learning Resources:	
1	Loknath Debnath – Integral transforms and their Applications.
2	B. Chakraborty and M. K. Sen – Discrete mathematics.
3	Koshy – Discrete Mathematics and Application
4	Jyoti Medhi – Stochastic Process
5	S. K. Mapa -Abstract and Linear Algebra
6	Zimmermann - Fuzzy Set Theory
7	Soft Set Theory – P.K.Maji et. al. – Compu. Math. Appl. 45(2003) 555-562.
8	B.Davies - Integral transforms and their Applications.
9	Kenneth H. Rosen- Discrete mathematics and their Applications.
10	Friedberg,insel,Spence –Linear Algebra
11	Barnabas Bede-Mathematics of Fuzzy sets and Fuzzy logic

Name of the course	**ADVANCED COMPUTER ARCHITECTURE**
Course Code: ITPC102	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Two Mid Term Exams: 30 Marks
Tutorial: 1 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 4	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks

	End Semester Exam: 50 Marks		
Objective:			
1.	To understand the pipeline and parallelism concepts in Programming		
2.	To introduce the advanced processor architectures.		
3.	To study Memory parallel architecture and interleaving		
4.	To study I/O, interface and Bus architecture		
5.	Case study on parallel architecture processor		
6.	To learn reconfigurable architectures.		
Pre-Requisite:			
1.	Computer Organization (UG level)		
2.	Computer architecture(UG level)		
Module	**Content**	**Hours**	**Marks**
1	**Introduction**: Introduction to High Performance Computing: Overview, Pipeline vs Parallel Processing. Taxonomy of Parallel Architectures : 1) SISD, 2) SIMD, 3) MIMD, 4) MISD. Pipeline Processing : Pipeline Performance, design of arithmetic pipelines Pipeline hazards – structural hazards, data hazards, control hazards & their solutions Pipeline scheduling Theory: Greedy pipeline scheduling algorithm – Static and Dynamic Pipelining.	10	30
2	**Advanced Processor:** RISC architecture, RISC VS CISC, VLIW architecture Vector and Array Processors, Super-scalar machines, Distributed computing architectures, Data flow architectures.	4	10
3	**Memory:** A brief overview on cache memory, paging, segmentation, virtualization. Memory parallel architecture and memory interleaving, case study on SDRAM. Flash memory: Device architecture and applications, NAND and NOR structures.	8	22
4	**Interface:** I/O system performances, Types of buses, Bus architecture, configuration, control, performance analysis, Bus arbitration, interface with operating systems, controller, direct memory access, Disk array (RAID)	6	18
5	**FPGA :** Introduction to FPGA and Reconfigurable architecture.	4	10
6	**Case study on parallel architecture:** ARM processor (Intel), Power PC (Motorola)	4	10
Course Outcomes: After completion of this course, the learners will be able to -			
CO1	Demonstrate concepts of parallelism in hardware		
CO2	Interpret performance of different pipelined processors.		
CO3	Asses memory architecture in context of memory parallelism and interleaving		
CO4	Investigate different bus architecture and arbitration schemes.		
CO5	Compose different components of processor, memory and interface for analysis of recent architectural developments.		
CO6	Explain reconfigurable architecture.		

Learning Resources:	
1	Hayes, —Computer Architecture and Organization, McGraw-Hill
2	Stallings William, "Computer organization and architecture, designing for performance", Prentice Hall of India.
3	J. L. Hennessy and D. A. Patterson, "Computer architecture: a quantitative approach", Harcourt Asia, Singapore.
4	Hwang and Briggs, —Computer Architecture and Parallel Processing, TMH.
5	Hamacher, Computer Organization, McGraw-Hill
6	M. R. Bhujade, Parallel Computing, Newage International Pvt. Ltd

Name of the course	**COMPUTER NETWORK**
Course Code: ITPC103	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term Exam. 1: 15 Marks
Tutorial: 1 hr/week	Mid Term Exam. 2: 15 Marks
Credit Points: 4	Assignment, Test based on assignment, Quiz, Presentations, Attendance, Term paper etc.: 20 Marks
	End Semester Exam.: 50 Marks

Objective:	
1.	To build an understanding of the fundamental concepts of computer networking.
2.	To Know about the design issues, services and protocols of Network layer.
3.	To study different services, protocols of transport layer.
4.	To understand congestion and QoS issues of computer network.
5.	To study some important application layer protocols
6.	To learn delay, performance issues and basic management issues of networking.

Pre-Requisite:			
1.	Computer Network (UG level)		
Module	**Content**	**Hours**	**Marks**
1	**Introduction:** Computer networks, Internetworking and the Internet, Layered Protocol concept and Reference models; Switching, Overview of underlying Technologies (PPP, Multiple Access, Ethernet, ADSL), Error and flow control.	6	
2	**Network layer design issues:** Services, Network layer Addressing, Autonomous system, Interior and Exterior Routing, Routing Algorithms (Distance vector, Link State and Hierarchical), Broadcast Routing Techniques: Flooding, Spanning Tree; Routing Table, Multicast Routing: Overview.	6	

3	**Network layer protocols:** IPv4: Datagram, fragmentation, Addressing (classful and classless); A brief overview of IPv6, NAT, ICMP, Routing Protocols (RIP, OSPF, BGP), ARP, DHCP.	8	
4	**Transport layer:** Services, Connectionless and connection-oriented services, Transport Layer Protocols: UDP, TCP, SCTP, Congestion control: General principles, Congestion Prevention Policies, RED, ECN, ELN, Congestion Control in TCP (TCP TAHOE, TCP Reno), Quality of Service: Characteristics & Traffic Shaping technique	7	
5	**Application layer protocols:** DNS, HTTP(s), protocols for file transfer, E-mail and remote login.	4	
6	**Delay and Performance:** Basic Queuing Models, Arrival Processes, Service time Queuing System, M/M/1 Queue and basic multiplexer model, Performance measures and Little's result, The M/G/1 model, Erlang Formula and M/M/c/c system priority queue; Network Management: Overview, SNMP, Management Information Base.	5	

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	explain the fundamental concepts of data communication, computer networking to analyse the functionalities of different layers of OSI–ISO and TCP/IP protocol suite.
CO2	justify the design issues of network layer to evaluate the needs of different routing protocols
CO3	explain different protocols and addressing schemes of network and transport layers
CO4	compare different transport layer protocols, congestion control issues and QoS provisioning.
CO5	illustrate the concepts of some common application layer protocols.
CO6	identify some delay and performance issues required in basic network management scenarios.
Learning Resources:	
1	Behrouz A. Forouzan, —Data Communications and Networking, 4th Edition, Tata McGraw-Hill.
2	James F. Kuross, Keith W. Ross, —Computer Networking, A Top-Down Approach Featuring the Internet, Third Edition, Addison Wesley.
3	Behrouz A. Forouzan, —TCP/IP Protocol Suite, 2nd Edition, Tata McGraw-Hill.
4	Andrew S. Tanenbaum, —Computer Networks, 6th Edition, PHI Learning.
5	A Leon Garcia, Indra Widjaja, —Communication Networks, 2nd Edition, McGraw-Hill.
6	Larry L. Peterson, Bruce S. Davie - Computer Networks: A Systems Approach, 5th Edition, Elsevier.

Name of the course	**INTERNET & WEB TECHNOLOGY**
Course Code: ITPEC101A	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**

Theory: 3 hrs./week		Two Mid Semester Exams: 30 Marks	
Credit Points: 3		Assignment , Quiz etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objective:			
1.	To build an understanding of the basic concepts of Internetworking, its services and security.		
2.	To apply different web design tools & techniques for developing web application.		
3.	To recognize the underlying architecture of web-based applications.		
4.	To solve the common ecommerce site design and maintenance problems.		
Pre-Requisite:			
1.	Object Oriented Methodology (UG level)		
2.	Database Management System (UG level)		
Module	**Content**	**Hours**	**Marks**
1	**Module1: Internet Principles** Internetworking principles and services, Internet Architecture, Client Server Model, Internet Security in different layers, DNS, E-mail and its security, World Wide Web, HTTP/ HTTPs.	9	
2	**Module2: JavaScript and XML** Variables, Expressions, Control Statements, Arrays, Objects, Functions, Events and Validations, Regular Expressions, Document, Document Type Definition, XML Schema, Document Object Model, Presenting XML, Using XML Parsers: DOM and SAX	6	
3	**Module3: JDBC and Java Beans** Introduction to Java database connectivity, JDBC Drivers, establishing connection, query execution, Result processing, Database Metadata, Working with PreparedStatement, Callable Statement, Introduction to Java Beans, Naming Patterns for Bean Properties, Simple Properties, Indexed Properties, Bound Properties, Constrained Properties, Bean Info Classes, JavaBeans Persistence, Customizers	5	
4	**Module4: Java Servlet** Server-side programming, Servlet API, The Servlet Life Cycle, Reading Servlet parameters, Reading Initialization parameters, Handling Http Request & Responses, Processing form data, Database connectivity through servlet, ServletConfig and ServletConext, Servlet chaining. Cookie creation, Contents of a Cookie, Sessions, Session tracking with servlet.	5	
5	**Module5: Java Server Pages** The Anatomy of a JSP Page, JSP Life Cycle, JSP Architecture, JSP Elements, Directives, Action Elements, Objects, Generating Dynamic Content, Requests and Users Passing Control, Data between Pages, Sharing Session and Application Data	5	
6	**Module6: Enterprise Java Beans and Distributed Objects**	8	

	Session Bean, Entity Bean, Message Driven Bean, Writing Enterprise Bean, Introduction to EJB, Enterprise Bean Architecture, Benefits of Enterprise Bean, Types of Enterprise Bean, Writing Enterprise Beans.		

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	Illustrate the concepts of Internetworking and some of its common services and security.
CO2	Apply the skills related to client-side validation technique and able to recognize different aspects of document type definition in web design.
CO3	Design the front-end of any web application with the help of associated technologies and
CO4	Categorize different database management system and also able to perform different database CRUD operations.
CO5	Create dynamic web pages and also be able to develop server-side scripting for server-side processing.
CO6	Apply user sessions in dynamic web project and also be able to design enterprise business logic.
Learning Resources:	
1	Java EE for Beginners, Sharanam Shah, SPD Publications.
2	Beginning Java EE 5: From Novice to Professional, Mukhar and Zelenak, Apress.
3	Behrouz A. Forouzan, —Data Communications and Networking, 4th Edition, Tata McGraw-Hill.
4	Professional Java Server Programming, Allamaraju, WROX Publishers.
5	Java Server Programming Java EE 7 (J2EE 1.7), Kogent Learning Solutions Inc.

Name of the course	**ADVANCED SOFTWARE ENGINEERING**
Course Code: ITPEC101B	**Semester: 1ST**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Class performance & Attendance: 20 Marks
	End Semester Exam & Viva: 50 Marks

Objective:	
1.	To understand the procedures and properties of software development models.
2.	To understand software design and software testing activities.
3.	To analyze the software reliability and software quality.
4.	To apply different techniques for software project management.
Pre-Requisite:	
	Programming Language

Module	Content	Hours	Marks
1	**Software Development** Overview of Information System, Business System Concept, System Development Life Cycle, SRS design, Waterfall Model, Spiral Model, RAD model, V model, Agile model, Feasibility Analysis, Cost- Benefit Analysis, COCOMO model- Basic, Intermediate and Detailed, Function point analysis, Halstead metrics.	8	
2	**Software Design** Fundamental issues of Software Design, Coupling & Cohesion, Top-Down and Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach, Unified modeling language (UML), User Interface design	6	
3	**Software Testing** Software coding standards, Software Testing – Levels of Testing, Black-box & White-box testing, Cyclomatic complexity, Mutation testing, Test case generation, Testing life cycle, Validation & Verification, Acceptance testing- Alpha testing & Beta testing.	6	
4	**Software Reliability** Hardware reliability vs Software reliability, Reliability metrics, Reliability models- Prediction model & Estimation model, MTTF, MTBF, Software availability, hazards; SEI CMM & ISO, PSP & Six sigma.	6	
5	**Software Quality** Software quality, quality factors, McCall's Quality Factors, Software quality assurance (SQA), Total Quality Management (TQM),	4	
6	**Software Project Management** Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Project Monitoring, Risk Management, Software maintenance, Software reuse, Client-Server Software development. Project management tools- WBS, Gantt chart, PERT, CPM	6	
Course Outcomes: After completion of the course students will able to -			
CO1	Review and analyze different types of software development models.		
CO2	Select and apply different design tools and techniques.		
CO3	Analyze the different software testing techniques.		
CO4	Determine the software reliability.		
CO5	Evaluate the software quality.		
CO6	Analyze and evaluate software project management activities.		
Learning Resources:			
1	R.G. Pressman : Software Engineering,TMH		
2	Behforooz, Software Engineering Fundamentals, OUP		
3	C. Ghezzi, M. Jazayeri and D. Mandrioli : Fundamentals of Software Engineering, PHI		

4	I. SomerVille : Software Engineering, Pearson Education
5	Royce : Software Project Management, Pearson Education
6	P. James, Pedrycz and Witold : Software Engineering- An Engineering Approach, John Wiley
7	Humphrey : Managing the Software Process, Pearson Education

Name of the course	**ADVANCED DATA STRUCTURES**
Course Code: ITPEC101C	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Assignments, Class performance & Attendance, Quiz: 20 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To learn implementations of advanced Data structures.
2.	To understand advanced data structures to solve complex problems in various domains.
3.	To operate on the various structured data.
4.	To choose the appropriate data structures that effectively model the information in a problem.

Pre-Requisite:

1.	Data Structure & Algorithms (UG level)

Module	Content	Hours	Marks
1	**Hashing:** Introduction, Static Hashing – Hash table, Hash Function, overflow Handling, Dynamic Hashing.	7	
2	**Skip Lists:** Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists.	4	
3	**Trees:** Binary Search Trees, search efficiency, insertion and deletion operations, importance of balancing, AVL Trees, searching, insertion and deletion in AVL trees, Introduction to Red Black Trees, insertion and deletion in Red Black Trees, B- Tree, insertion and deletion in B-tree, B+-Tree, insertion and deletion in B+-Tree, Splay Trees, insertion and deletion in Splay tree.	9	
4	**Heap:** Binary Heaps, Binary Heaps operations, d-heap, Skew Heaps operations, Binomial Heaps operations, Fibonacci Heaps operations.	9	
5	**Multidimensional Searching:** One Dimensional Range Searching, Two-Dimensional Range Searching, Quad trees, k-D Trees operations.	7	

Course Outcomes:

After completion of this course, the learners will be able to -

CO1	Describe the hash function and concepts of collision and its resolution methods.
CO2	Implement algorithms for skip lists.
CO3	Apply tree data structure in various problems.
CO4	Analyze algorithms for various variations of Heaps.
CO5	Identify suitable data structures for Multidimensional Searching.
Learning Resources:	
1	Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, Universities Press, 2008.
2	Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2004
3	Data Structures and Algorithms, 3/e, Adam Drozdek, Cengage
4	Michael T Goodrich, Roberto Tamassia, Data Structures and Algorithms in C++, Second Edition John Wiley & Sons, Inc., 2011.
5	Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures using C and C++", Second Edition, PHI Learning Private Limited, 2010
6	Ellis Horowitz, Dinesh Mehta, Sartaj Sahni, Fundamentals of Data Structures in C++, University Press

Name of the course		**INFORMATION THEORY AND CODING**	
Course Code: ITPEC102A		**Semester: 1st**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Term Exam. 1: 15 Marks	
Credit Points: 3		Mid Term Exam. 2: 15 Marks	
		Assignment, Test based on assignment, Quiz, Presentations, Attendance, Term paper etc.: 20 Marks	
		End Semester Exam.: 50 Marks	
Objective:			
1.	To define, interpret and apply the basic concepts of information theory		
2.	To learn the principles of information theory in communication systems		
3.	To understand the theoretical framework upon which error-control codes are built		
4.	Make use of various error control encoding and decoding techniques		
5.	To analyze the performance of various error control codes		
Pre-Requisite:			
1.	Engineering Mathematics (UG level)		
Module	**Content**	**Hours**	**Marks**
1	Information Theory: Review of probability theory, Uncertainty and Information, Self and Mutual Information, Entropy, Mathematical Properties of the Entropy	4	

	Function.		
2	Source Coding: Entropy and Coding, Shannon-Fano Coding, Variable-Length Codes: Unique Decoding, Instantaneous Codes, Construction of Instantaneous Codes, Prefix tree for prefix code, The Kraft Inequality, Huffman codes.	6	
3	Information Channel: Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.	4	
4	Error Control Coding: Introduction, Examples of Error control coding, Minimum Distance of a Block code, Linear Block Codes: Matrix description of linear block codes, Error-Detecting and Error-correcting Capabilities of a Linear Block code, parity check matrix, Encoding and decoding of Linear Block-codes, Syndrome Decoding, Hamming Codes.	7	
5	Cyclic Codes: Polynomial representation of codewords, Generator Polynomial, Systematic Codes, Syndrome Calculation and Error Detection, Decoding of Cyclic Codes, Generator and Parity-check Matrices, Golay Codes, Introduction to Galois Field, BCH Codes: Properties of BCH codes, examples of BCH codes; Reed Solomon Code.	10	
6	Convolutional Codes: Introduction, Polynomial description of Convolutional Codes, Generating function, Matrix description of Convolutional Codes, Viterbi Decoding of Convolutional codes, Trellis codes	5	
Course Outcomes: After completion of this course, the learners will be able to-			
CO1	explain the basic notions of information and channel capacity.		
CO2	analyse the channel performance issues using Information theory.		
CO3	illustrate various properties of error control coding		
CO4	implement some linear block codes and cyclic codes for error detection and correction		
CO5	justify BCH & RS codes for Channel performance improvement against burst errors.		
CO6	apply convolution codes for performance analysis.		
Learning Resources:			
1	Information theory, coding and cryptography - Ranjan Bose; TMH.		
2	Introduction to Error Control Codes – S Gravano; Oxford.		
3	Coding and Information Theory – R. W. Hamming; Prentice Hall.		
4	Information and Coding Theory - G. A. Jones and J. M. Jones ; Springer – Verlag.		
5	Essentials of Error-Control Coding – Jorge C. Moreira and Patrick G Farrell; Wiley.		
6	Error Control Coding - Shu Lin and D J Costello Jr.; Prentice Hall.		

Name of the course	**PATTERN RECOGNITION**
Course Code: ITPEC102B	**Semester: 1st**

Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Assignments, Class performance & quiz etc.: 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	Learn the fundamentals of pattern recognition and its relevance to classical and modern problems.
2.	Identify where, when and how pattern recognition can be applied.
Pre-Requisite:	
1.	Good foundation of Mathematics and statistics.
2.	Good working knowledge of Matlab or Python.

Module	**Content**	**Hours**	**Marks**
1	**Introduction : S**tatistical pattern recognition; Three learning paradigms; Basic structure of pattern recognition systems; Comparison between classifiers.	4	
2	**Bayes Decision Theory** : General framework; Naïve Bayes; Optimal decisions; Classification; Simple performance bounds.	4	
3	**Learning - Parametric approaches** : Basic statistical issues; Sources of error; Bias and variance; Different approaches to classification: density estimation, regression and discriminant analysis; Empirical error criteria; Optimization methods.	5	
4	**Supervised Learning:** Linear and quadratic discriminants; Shrinkage; Logistic Regression; Generalized linear classifiers; Perceptron (non parametric); Maximum Margin; Error Correcting Codes.	5	
5	**Unsupervised Learning :** Different clustering algorithms - Partitive, hierarchical and density based, Clustering for big data, Anomaly Detection using Gaussian Mixtures, Assessment Metrics for Clustering Algorithms.	6	
6	**Nonparametric Classification:** Histograms rules; Nearest neighbour methods; Kernel approaches; Local polynomial fitting; Flexible metrics; Automatic kernels methods.	4	
7	**Feature Extraction & Selection :** Optimal features; Optimal linear transformations; Linear and nonlinear principal components; Feature subset selection.	5	
8	**Neural Network** : For supervised and unsupervised learning; Ensembles.	5	

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	Understand a variety of pattern recognition systems and their combinations.
CO2	Learn performance evaluation methods.
CO3	Apply pattern recognition to real-world challenging problems.

CO4	
CO5	
Learning Resources:	
1	Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2	R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
3	Statistical pattern Recognition; K. Fukunaga; Academic Press, 2000.
4	S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

Name of the course	**DIGITAL SIGNAL PROCESSING**		
Course Code: ITPEC102C	**Semester: 1st**		
Duration: 6 months	**Maximum Marks: 100**		
Teaching Scheme	**Examination Scheme**		
Theory: 3 hrs/week	Mid Term Examination 1: 15 Marks		
Credit Points: 3	Mid Term Examination 2: 15 Marks		
	Assignment, Test based on assignment, Surprise tests, Quizzes, Presentations, Attendance: 20 Marks		
	End Semester Exam: 50 Marks		
Objective:			
1.	To analyze the properties of discrete time signals and systems.		
2.	To estimate spectra of discrete-time signals using the Discrete Fourier transform.		
3.	To design IIR and FIR digital filters.		
Pre-Requisite:			
1.	Engineering Mathematics		
Module	**Content**	**Hours**	**Marks**
1.	**Discrete-time signals and systems:** Concept of discrete-time signal, different types of discrete time sequences: periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials. **LTI Systems:** Definition, representation, impulse response, concept of convolution, Structures for the implementation of LTI systems: Direct form I and II structures, linear constant co-efficient difference equation, recursive and non-recursive systems.	10	
2.	**Z-Transform** Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, inverse Z-transform, multiplication using Z-transform, initial value theorem, Perseval's relation.	6	

3.	**Discrete Fourier Transform** Concept and relations for DFT/IDFT, **Fast Fourier Transform** :Radix-2 algorithm, decimation-in-time, decimation-in-frequency FFT algorithms, Radix-3 and Radix-4 FFTs.	6	
4.	**Digital Filter** Basic concepts of IIR and FIR digital filters. design of Butterworth IIR filter using impulse invariant and bilinear transformation method, Realization of IIR digital filters, Direct form-I and Direct form-II realization. Design of FIR filters: Linear-phase FIR filters, symmetric and antisymmetric impulse responses, magnitude and phase characteristics of the frequency response, design examples, Window techniques, concept of main and side lobes, Rectangular, Hamming, Hanning, Blackman and Bartlett Window functions, comparison of different types of windows.	10	
5.	**Digital Signal Processor**: Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, Assembly level Programming, introduction to Code Composer Studio.	4	

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	analyze the characteristics of linear time invariant systems.
CO2	compute Z transform of discrete time sequences and compare with laplace transform.
CO3	compute DFT of discrete time sequences using FFT algorithms.
CO4	design different types of Digital Filters.
CO5	Identify components of a DSP hardware system and program a DSP processor
Learning Resources:	
1	Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2	Discrete-Time Signal Processing, A. V. Oppenheim and R. W. Schafer, Pearson Education
3	Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
4	Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
5	Digital Signal Processing, P. Rameshbabu, Scitech Publications (India)
6	Texas Instruments DSP Processor user manuals and application

Name of the course	**CLOUD COMPUTING**
Course Code: ITPEC102D	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Term Examination 1: 15 Marks

Credit Points: 3		Mid Term Examination 2: 15 Marks	
		Assignment, Test based on assignment, Surprise tests, Quizzes, Presentations, Attendance: 20 Marks	
		End Semester Exam: 50 Marks	
Objective:			
1.	To understand the concept of cloud computing.		
2.	To introduce the various levels of services that can be achieved by cloud.		
3.	To understand the concepts of the virtualization and virtual machine		
4.	To gain knowledge on the concept of Resource Management and Load Balancing in cloud computing.		
5.	To understand the security issues in cloud environment.		
6.	To appreciate the emergence of cloud as the next generation computing paradigm.		
Pre-Requisite:			
1.	Operating System		
2.	Computer Networks		
Module	**Content**	**Hours**	**Marks**
1.	**Introduction:** Distributed Computing and Enabling Technologies. **Cloud Fundamentals:** Cloud Definition, Evolution, Architecture, Applications, Deployment models and Service models- IaaS, PaaS, SaaS.	7	
2.	**Virtualization:** Issues with virtualization, Virtualization technologies and Architectures, Internals of virtual machine monitors/hypervisors, Virtualization of data centers, and Issues with Multi-tenancy.	7	
3.	**Cloud Platform Architecture & Programming Model:** Cloud deployment models, Categories of cloud computing, A generic Cloud architecture design; Introduction to Hadoop framework, MapReduce.	8	
4.	**Resource Management and Load Balancing:** Distributed Management of Virtual Infrastructures, Server consolidation, Resource Management, Resource Optimization, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques.	6	
5.	**Security:** Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues, IDS.	8	
Course Outcomes: After completion of this course, the learners will be able to -			
CO1	Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.		
CO2	Apply the concept of virtualization in the cloud computing.		
CO3	Apply the knowledge of resource management and load balancing.		
CO4	Identify the architecture, infrastructure of cloud computing.		
CO5	Apply the security models in the cloud environment.		
Learning Resources:			

1	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
2	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
3	Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
4	Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
5	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010
6	Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, rp2011.
7	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, 2010

Name of the course	**INDIAN CONSTITUTION**
Course Code: ITAUD101A	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 2 hrs./week	Mid Term Examination 1: 15 Marks
Credit Points: 0	Mid Term Examination 2: 15 Marks
	Assignment, Test based on assignment, Surprise tests, Quizzes, Presentations, Attendance: 20 Marks
	End Semester Exam: 50 Marks

Objective:			
1.	To understand the structure of the Indian Constitution.		
2.	To learn about the Nature-Specialty and Proposal Of Indian Constitution.		
3.	To Describe the Centre- State relationship and the role of government administration.		
4.	To gain knowledge about the Indian Jurisdiction and conceptualization of social reforms that lead to revolution in India.		
Pre-Requisite:			
1.	Basic knowledge of Civics.		
Module	**Content**	**Hours**	**Marks**
1	**History of Making of the Indian Constitution:** Sources and constitutional history, Drafting Committee,Features: Citizenship, Preamble. The Nature-Specialty and Proposal Of Indian Constitution.	3	
2	**Contours of Constitutional Rights & Duties**: Fundamental Rights, Right On: Equality, Freedom, Against Exploitation, Freedom	4	

	of Religion, Cultural and Educational Rights, Constitutional Remedies. Directive Principles of State Policy. Fundamental Duties.		
3	**Union government and its administration:** Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. State government and its administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions.	6	
4	**Local Administration**: District's Administration : Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative. Block level: Organizational Hierarchy (Different departments). Panchayati raj: Introduction, Importance and role.	3	
5	**Election Commission**: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	3	
6	**Jurisdiction:** Supreme court: Organization of supreme court, procedure, jurisdiction and power of the supreme court. High court: Organization of high court, procedure, jurisdiction and power of high court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features ,scope , principle , guidelines for admitting PIL.	5	

Course Outcomes: After completion of this course, the learners will be able to -	
CO1	Explain about different features of Indian constitution.
CO2	Identify the power and functioning of Union, state and local self-government.
CO3	Explain about jurisdiction and function of Indian Judiciary.
CO4	Applying the authority to redress a problem in the profession and in the society.
CO5	Using the basics of PIL and guideline for admission of PIL along with the functioning of local administration starting from block to municipal Corporation.
CO6	Demonstrate the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

Learning Resources:	
1	Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.
2	Indian Constitution,M P Jain,8th Edition.
3	Indian Constitution and Administration,Latika Shekhar.
4	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.

Name of the course	**PC lab I**
Course Code: ITPCL101	**Semester: 1st**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Practical: 3 hrs./week	Attendance: 10 marks
Credit Points:1.5	Preparation of Lab Report: 20 marks
	Experimental data/ Precision of work done/ Coding efficiency: 30 marks
	Presentation / analysis of the result: 20 marks
	Viva voce: 20 marks

COMPUTER ARCHITECTURE LAB. (Part I)

COMPUTER NETWORK LAB. (Part II)

Objective:

1.	To implement socket programming
2.	To configure different server
3.	To design address allocation

Pre-Requisite:

1.	Computer Network (ITPC103)

Module	**Content**
1.	TCP/UDP Socket Programming fundamentals
2.	UDP and TCP ECHO server and client/ UDP and TCP Time Server and Client
3.	Chat Server and Client programming
4.	Stop and Wait ARQ in UDP with CRC
5.	Server Setup and Configuration FTP, Telnet, DNS.
6.	Firewall configuration at client level
7.	IP Address allocation problem

Course Outcomes:

After completion of this course the students will be able to -

CO1	Demonstrate UDP/ TCP socket programming
CO2	Implement client server model using socket programming
CO3	Implement different server configuration
CO4	Configure firewall at client side
CO5	Design solution for real life problems of IP address allocation

Learning Resources:

1.	UNIX Network Programming: The sockets networking API, Volume 1 of UNIX Network Programming, W. Richard Stevens , Pearson Education

Name of the course		**SOFTWARE ENGINEERING LAB**
Course Code: ITPEC101(B)L		**Semester: 1st**
Duration: 6 months		**Maximum marks:100**
Teaching Scheme		**Examination scheme:**
Practical: 3 hrs./week		Attendance: 10 marks
Credit Points:1.5		Preparation of Lab Report: 30 marks
		Experimental data/ Precision of work done: 30 marks
		Presentation / analysis of the result: 30 marks
		Viva voce: 20 marks
Module	**Content**	
1.	Customer requirements analysis, feasibility analysis and cost benefit analysis.	
2.	Software design using different types of design tools.	
3.	Develop the software using a standard programming language.	
4.	Test the developed software using manual and automated testing tools.	
5.	Analyze the software using different software project management tools- WBS, Gantt chart, PERT, CPM	
Course Outcome: After completion of the course students will able to-		
CO1	Review and analyze different steps before develop a software.	
CO2	Select and apply different design tools and techniques.	
CO3	Develop a software using a standard language.	
CO4	Analyze the different software testing techniques.	
CO5	Evaluate the software using different project management tools.	
Learning Resources:		
1	Software Engineering- A R Puntambekar- Technical Publications	
2	Software Design Methodology- Hong Zhu- Elsevier	
3	Software Project Management- Walker Royce- Pearson	
4	Software Testing A Practical Approach- Sandeep Desai, Abhishek Srivastava- PHI	

Name of the course	**ADVANCED DATA STRUCTURES LAB**
Course Code: ITPECL101	**Semester: 1st**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Practical: 3 hrs/week	Attendance: 10 marks

Credit Points: 1.5	Preparation of Lab Report: 30 marks
	Experimental data/ Precision of work done: 30 marks
	Presentation / analysis of the result: 30 marks

Objective:	
1.	To understand the usage of hashing.
2.	To learn skip list.
3.	To acquire the knowledge of using advanced tree structures.
4.	To learn the usage of different heap structures.
Pre-Requisite:	
1.	Data Structure & Algorithms Lab.
Module	**Content**
	List of Experiments
1	Implement static hashing using linear probing as overflow technique.
2	Implement static hashing using chaining as overflow technique.
3	Implement Directory based dynamic hashing technique.
4	Implement Directory less dynamic hashing technique.
5	Implement skip lists.
6	Implement B tree.
7	Implement Red Black tree.
8	Implement Splay tree.
9	Implement Digital search tree.
10	Implement Binary heap structure.
11	Implement Fibonacci Heap.
12	Implement k-D tree.

Course Outcome:

After completion of the course students will able to-

SECOND SEMESTER

2nd SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITPC204	Advanced Operating System	3	1	0	4	4
02	ITPC205	Database Design	3	1	0	4	4
03	ITPC206	Advanced Algorithm	3	1	0	4	4
04	ITPEC203	A: Image and video Processing B: Machine Learning C: Soft Computing	3	0	0	3	3
05	ITPEC204	A: Mobile Computing B: IoT and Its Application C: Data Mining	3	0	0	3	3
06	ITRES201	Research Methodology and IPR	2	0	0	2	2
SESSIONAL/PRACTICAL							
01	ITPCL202	PC Lab. II	0	0	3	3	1.5
02	ITPEC203(A/B/C)L	ITPEC203 Lab.	0	0	3	3	1.5
03	ITPRJ201	Dissertation (Part 1)	0	0	4	4	2
TOTAL			**17**	**3**	**10**	**30**	**25**

Name of the course	**ADVANCED OPERATING SYSTEM**
Course Code: ITPC204	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I Exam: 15 Marks
Tutorial: 1hr./week	Mid Term II Exam: 15 Marks
Credit Points: 4	Class performance & Attendance: 20 Marks
	End Semester Exam & Viva: 50 Marks

Objective:	
1.	To review and analyze process and memory management.
2.	To identify different aspects of multiprocessor system.
3.	To understand distributed operating system.
4.	To understand and analyze real time operating system.
Pre-Requisite:	
	Operating Systems (UG level)

Module	Content	Hours	Marks
1	**Process Management** Concepts of processes, resource utilization, CPU scheduling algorithms, IPC, RPC, thread, multithreading models, deadlock.	6	
2	**Process Synchronization** Concurrent processes, race condition, semaphore, monitor, Overview of different classical synchronization problems, Creating, deleting, prioritizing mutex.	8	
3	**Memory Management** Process stack management, dynamic loading & linking, swapping, overlays, Page replacement-second chance algorithm.	4	
4	**Multiprocessor System** Motivation, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions & requirements; Design & Implementation Issue; Introduction to parallel programming; Multiprocessor Synchronization.	4	
5	**Distributed operating system** Concepts, Architectures, Issues in Distributed operating systems, Limitations of Distributed Systems, Clocks, Lamport's logical clock, Global states. Distributed Mutual Exclusion, Lamport's Algorithm, Ricart-Agrawala Algorithm, Basic concepts of deadlock in Distributed system, Distributed File system. Distributed shared memory. Basic concepts of Distributed Scheduling, Load balancing, Load Sharing. Naming, Process migration, Remote Procedure Calls.	10	
6	**Real-time OS concepts** Terminology: RTOS concepts and definitions, real-time design issues, Hardware Considerations: logic states, CPU, memory, I/O, Architectures; RTOS building blocks; Real-Time Kernel.	4	

Course Outcomes: After completion of the course students will able to -	
CO1	Review and analyze process management.
CO2	Select and apply different process synchronization techniques.
CO3	Review and determine memory management.
CO4	Determine multiprocessor system.
CO5	Evaluate distributed operating system.
CO6	Analyze real time operating system.

Learning Resources:	
1	Operating System concepts- Avi Silberschatz, Greg Gagne, and Peter Baer Galvin- Wiley India
2	Operating Systems: Internals and Design Principles-William Stallings-Pearson
3	Operating Systems Concepts & design - Milan Milenkovic, TMH
4	Distributed Operating Systems: Concepts and Design- P K Sinha- PHI

5	Advanced Concepts in operating Systems - Mukesh Singhal and Niranjan G. Shivaratri, TMH
6	Distributed Operating system- A S Tanenbaum- Pearson
7	Real-Time and Embedded Guide by Herman B.

Name of the course	**DATABASE DESIGN**
Course Code: ITPC205	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I Exam: 15 Marks
Tutorial: 1hr./week	Mid Term II Exam: 15 Marks
Credit Points: 4	Attendance, Assignments, Quiz & Presentations: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	To Understand the basic concepts of database systems, relational database design principles and queries using SQL.
2.	To be able to understand normalization and improve the database design by applying various normal forms.
3.	To be familiar with the basic issues of query processing and optimization.
4.	To get in depth knowledge of transaction management and concurrency control mechanisms.
5.	To understand some advanced database concepts and some emerging database systems.

Pre-Requisite:

1.	Data Structure (UG level)

Module	**Content**	**Hours**	**Marks**
1	**Introduction to Databases** Overview, ER Diagram, Relational Data Model, Relational Algebra: Basic operators, Composition of operators, Database modification. SQL: Introduction to data definition and manipulation, Basic queries, Updates, Joins, Views, Triggers. PL/SQL structure.	7	
2	**Normalization** Motivation, Functional Dependencies, Decomposition and different Normal Forms, Multivalued and Join Dependencies, Denormalization.	4	
3	**Query Processing and Optimization** Basic concepts of query processing, Overview of Indexing, Translation of SQL queries into Relational Algebra, Basic algorithms for executing query operations; Query tree and query graph, Heuristic optimization of query tree. Database Tuning: Normalization tuning and Query tuning.	6	
4	**Transaction Management** Transaction processing concepts: ACID properties, Schedules and serializability;	8	

	Concurrency control, Two Phase Locking Techniques, Optimistic Concurrency Control; Database recovery concepts and techniques.		
5	**Distributed Database** Distributed databases principles, architectures and design, Fragmentation, Transparencies in Distributed Databases; Overview of Transaction Management; Query Processing and Concurrency control in Distributed Database.	6	
6	**Databases on the Web and Emerging Database** Overview, Structure of XML data, Document schema, Querying and Storage of XML data, XML applications. MongoDB. Big data concept and Introduction to NOSQL systems: Categories of NOSQL Systems, CAP Theorem.	5	
Course Outcomes: After completion of the course students will able to -			
CO1	Explain various database components, models, Relational algebra and construct SQL queries.		
CO2	Apply the concept of normalization and functional dependency for database design.		
CO3	Demonstrate key notions of query evaluation and optimization techniques.		
CO4	Assess transaction processing, concurrency control and recovery in databases.		
CO5	Analyze the implementation of distributed database system.		
CO6	Examine the issues related to Web and Big data related databases.		
Learning Resources:			
1	Elmsari and Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition		
2	Korth, Silberschatz, “Fundamentals of Database System Concepts”, TMH, 6th Edition		
3	Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems (3/e), McGraw Hill		
4	C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Pearson Education, 8th Edition		
5	M Tamer Özsu and Patrick Valduriez, “Principles of distributed database systems”, Springer, 4th Edition		
6	Dennis Shasha and Philippe Bonnet, “Database Tuning: Principles, Experiments, and Troubleshooting Techniques”, Morgan Kaufmann, 1st Edition		

Name of the course:	**ADVANCED ALGORITHMS**
Course Code: ITPC206	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory Contact Hrs.: 3 hrs./week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 1	Mid Semester-2 Exam: 15 Marks
Credit Point: 4	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:			
1.	Introduce students to correctness proof of algorithms		
2.	The student should be able to select appropriate algorithm for a specific problem		
3.	To learn new techniques for solving specific problems more efficiently		
4.	To learn various algorithmic techniques for efficient processing of string data		
5.	To introduce the power of randomization in the design and analysis of algorithms		
6.	To introduce students to various problems in Computational Geometry		
Pre-Requisite:			
1.	Design and Analysis of Algorithm		
Module	**Content**	**Hours**	**Marks**
1.	**Sorting and Graphs** Insertion Sort Analysis with emphasis on correctness proof of the algorithm, Union-Find Algorithm, Example of amortized analysis	04	
2.	**String Algorithms** Rabin-Karp Algorithm, KMP, Suffix Trees	06	
3.	**Maximum Flows** Augmenting Paths, Minimum Cost Flows, Bipartite Matching	06	
4.	**Randomized Algorithms** A Min-Cut Algorithm, Las Vegas and Monte Carlo, Binary Planar Partitions, A Probabilistic Recurrence, Computation Model and Complexity Classes	06	
5.	**Approximation Algorithms** P and NP, One Way of Coping with NP-Hardness, Greedy Approximation Algorithms, Dynamic Programming and Weakly Polynomial-Time Algorithms, Randomized Rounding, Vertex Cover, Wiring, and TSP	10	
6.	**Computational Geometry** Convex Hull, Line-segment Intersection, Sweep Lines	04	
Course Outcomes: After completion of this course the students will be able to -			
CO1	Prove correctness of different algorithms		
CO2	Solve various problems using String-Matching Algorithms		
CO3	Use advanced graph algorithms to solve various problems		
CO4	Apply randomized algorithms to solve different problems		
CO5	Design approximation algorithms to solve different NP complete problems		
CO6	Implement computational geometry algorithms		
Learning Resources:			
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, The MIT Press, ISBN: 9780262033848		
2.	Jon Kleinberg, Eva Tardos, Algorithm Design, Pearson, ISBN: 9789332518643		
3.	S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN: 9780198093695		

4.	Vijay V. Vazirani, Approximation Algorithms, Springer, ISBN: 9788181283856
5.	Rajeev Motwani, Prabhakar Raghavan, Randomized ·algorithms, Cambridge University Press, ISBN 0-521-47465-5

Name of the course		**IMAGE AND VIDEO PROCESSING**	
Course Code: ITPEC203A		**Semester: 2nd**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Term I: 15 Marks	
Credit Points: 3		Mid Term II: 15 Marks	
		Assignment, Test based on assignments, Surprise tests, Quiz, Presentations, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objective:			
1.	To understand the concept of digital images and related definitions.		
2.	To learn different image processing algorithms.		
3.	To study color and video image processing techniques.		
Pre-Requisite:			
1.	Advanced Engineering Mathematics [ITPC101]		
2.	Digital Signal Processing [ITPEC102C]		
Module	**Content**	**Hours**	**Marks**
1	**Image Representation** Introduction, Gray scale and Color Images, Sampling and Quantization, Discrete Fourier transform, Walsh transform, Hadamard transform, Haar transform, Discrete Cosine Transform, Karheunen-Loeve transform, Hough transform.	5	
2	**Image Enhancement in the Spatial Domain** Some Basic Gray Level Transformations, Histogram Processing, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	6	
3	**Image Enhancement in the Frequency Domain** Fourier Transform, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.	5	
4	**Image Restoration** Models of Image Degradation/Restoration Process, Noise Models, Linear, Position- Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.	6	
5	**Image Segmentation** Detection of Discontinuities, Edge Linking and Boundary	4	

	Detection, Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds.		
6	**Image Data Compression** Introduction, Pixel coding, Predictive techniques, Transform coding, Inter-frame coding, coding of two tone images, Image Compression standards.	4	
7	**Video Processing** Fundamental Concepts in Video - Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques - Motion compensation, Search for motion vectors, H.261, H.263, MPEG T, MPEG 2, MPEG 4, MPEG 7 and beyond, Content based video indexing.	10	
Course Outcomes: After successful completion of this course, the learners will be able to -			
CO1	Understand the fundamental concept of digital images. and their.		
CO2	Describe different image enhancement techniques in spatial and frequency domains.		
CO3	Implement image segmentation algorithms.		
CO4	Compare different lossless and lossy image compression techniques.		
CO5	Apply different color models in image processing algorithms.		
Learning Resources:			
1	R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson.		
2	M. Tekalp, Digital Video Processing, Prentice Hall.		
3	A.Bovik, Handbook of Image & Video Processing, Academic Press.		
4	Jahne, Digital Image Processing, Springer, India.		
5	Solomon and Breckon, Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab, Solomon and Breckon, Wiley		

Name of the course	**MACHINE LEARNING**
Course Code: ITPEC203B	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignment, Test based on assignments, Surprise tests, Quiz-, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks
Objective:	
1.	To understand and implement supervised, unsupervised and reinforcement learning algorithms
2.	To analyze shallow and deep neural network models.

3.	To apply standard machine learning frameworks for implementing real world problems.		
Pre-Requisite:			
1.	Knowledge of Linear Algebra, Probability and Statistics		
2.	Programming knowledge in Python		
Module	**Content**	**Hours**	**Marks**
1	**Introduction:** Types of learning. Preparation of Data for Machine Learning Algorithms - Data Cleaning, Handling Text and Categorical Attributes, Handling Missing Values, Exploration of Data using Visualization, Regression - Linear regression, Multivariate regression, Multi-collinearity, Logistic Regression.	3	
2.	**Supervised Learning** : Classifiers - Classification using Regression, Multiclass Classifier, Multi-label Classification. Gradient Descent Algorithm for Linear Regression Model, Naive Bayes Classifiers, Decision Trees, Ensembles of Decision Trees: Random Forests, Support Vector Machines, Model Evaluation and Improvement.	5	
3	**Dimensionality Reduction :** Dimensionality Reduction, Feature Extraction, Feature Selection, and Manifold Learning, Principal Component Analysis (PCA), Randomized PCA, Incremental PCA, Kernel PCA, Selecting a Kernel and Tuning Hyper-parameters.	4	
4	**Unsupervised Learning:** Partitive, Hierarchical and Density based clustering, Comparative analysis, Clustering for big data, Anomaly Detection using Gaussian Mixtures, Cluster validity indices.	5	
5	**Reinforcement Learning :** Model free and model based reinforcement algorithms – Q learning, State-Action-Reward-State-Action (SARSA) etc.	4	
6	**Neural Networks :** Perceptrons, Multilayer Perceptrons, —Backpropagation learning, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation.	7	
7	**Deep Neural Networks :** Difference from shallow networks, Convolutional Neural Network and Recurrent Neural Network. Construction of Neural Network models using Machine learning frameworks - Tensorflow and Keras, SciKit - Learn, PyTorch	8	
Course Outcomes: After successful completion of this course, the learners will be able to -			
CO1	Define the fundamental issues of machine learning : data, model selection, model complexity etc.		
CO2	Analyze the underlying mathematical relationships within and across different machine learning algorithms.		
CO3	Implement different learning algorithms like supervised, un-supervised and reinforcement learning.		
CO4	Compare different network models like Convolutional, Recurrent etc.		
CO5	Apply standard machine learning frameworks for implementing real world machine learning algorithms.		
Learning Resources:			

1	Tom Mitchell, Machine Learning , McGraw Hill Education.
2	M. Mohri, A. Rostamizadeh, A. Talwalkar, Foundation of Machine Learning, MIT Press.
3	Christopher Bishop. Pattern Recognition and Machine Learning. 2e, Springer.
4	S. S. Shwartz and S. B. David, Understanding Machine Learning : From Theory to Algorithms, Cambridge University Press, 2014.
5	I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press.
6	V.S. Devi; M.N. Murty, Pattern Recognition: An Introduction, Universities Press,Hyderabad, 2011.
7	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000

Name of the course:	**MOBILE COMPUTING**		
Course Code: ITPEC204A	**Semester: 2nd**		
Duration: 6 months	**Maximum Marks: 100**		
Teaching Scheme	**Examination Scheme**		
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks		
Credit Point: 3	Mid Semester-2 Exam: 15 Marks		
	Assignment, Quiz, Presentation, term paper & class attendance: 20 Marks		
	End Semester Exam: 75 Marks (to be mapped into 50 marks)		
Objective:			
1.	To study the concept of mobile computing and evolution of mobile network		
2.	To study cellular concepts and improvements cell capacity		
3.	To study wireless network and different protocol in physical and data link layer		
4.	To study mobile IP and mobile TCP		
5.	To study mobile routing, power management and mobile security		
Pre-Requisite:			
1.	Computer Network (ITPC103)		
Module	**Content**	**Hours**	**Marks**
1.	**Introduction:** A General Overview: History of wireless communication, Multiplexing, Multiple access basics, different generations of Cellular Telephony. AMPS, GSM, GPRS, IMT-2000, UMTS, CDMA2000	3	
2.	**Wireless and Cellular Networks:** Infrastructure and ad-hoc network, IEEE 802.11: System Architecture, Protocol Architecture, Physical Layer, 802.11a and 802.11b. Media Access Techniques –CSMA/CA. Bluetooth: System and Protocol Architecture, Wi-Fi. Cellular Concept, Frequency Reuse, Channel Allocation Management, Call Setup, Location Management, Cell Handoffs, Interference.	8	

3.	**Mobile Network Layer:** Mobile IP, IP Packet Delivery, Agent Discovery, Registration, Tunneling and different types of Encapsulation, Optimizations and Reverse Tunneling.	5	
4.	**Mobile ad hoc network:** Different models of operation. Various applications of MANET. DSDV: overview, route advertisement, extending base station coverage. Properties of DSDV protocol. Dynamic Source Routing protocol: overview and properties, DSR route discovery, route maintenance. Support for heterogeneous networks and mobile IP. Multicast routing with DSR. Ad Hoc On-Demand Distance-Vector protocol - unicast route establishment, multicast route establishment. Broadcast. Optimizations and Enhancements. Link Reversal Routing, lightweight mobile routing. Temporally ordered routing algorithm. Preserving battery life of mobile nodes - effects of beaconing on battery life. Recent trends in MANET.	7	
5.	**Mobile Transport Layer:** Introduction, Traditional TCP: Congestion Control, Slow Start, Fast Retransmit/ fast recovery and its implications of Mobility. Classical TCP Improvements: Indirect TCP, Snooping TCP	4	
6.	**Mobile Security:** Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, Policy and relevant definitions	4	
7.	**Programming mobile devices:** Memory Management - Design Patterns for Limited Memory, Memory Management in Mobile Java, Memory Management in example OS, power management, green computing	5	
Course Outcomes: After completion of this course the students will be able to -			
CO1	Explain architecture and protocol stacks for different types of wireless network.		
CO2	Implement Mobile IP , encapsulations and optimization techniques.		
CO3	Assess different routing models for ad hoc network and power saving models.		
CO4	Evaluate congestion and different Mobile TCP techniques.		
CO5	Assess vulnerabilities and devise different mobile security.		
CO6	Design solution for some real life issues like routing, power management and memory management.		
Learning Resources:			
1.	J. Schiller, Mobile Communications, Addison –Wesley		
2.	T. S. Rapport, Wireless Communications, Principle and Practices		
3.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, Principles of Mobile Computing, Springer.		
4.	Asoke K Talukder, Hasan Ahmed and Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, TMH.		

Name of the course	**IOT AND ITS APPLICATION**

Course Code: ITPEC204B	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Attendance, Assignment, Presentation & Quiz: 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To learn fundamentals, genesis, Internet principles and architectures of IoT
2.	To Illustrate diverse methods of deploying smart objects and connect them to networks.
3.	To understand prototyping embedded devices for sensing real world entities
4.	To gain an understanding of the role of Application protocols and Security in IoT

Pre-Requisite:	
1.	Computer Network (ITPC103)

Module	**Content**	**Hours**	**Marks**
1	**The Internet of Things** An Overview, Genesis of IoT, Impact, challenges, The Technology of the Internet of Things, Internet Principles: Traditional Internet Review, HTTP, HTTPS, AMQP, SIP; Overview of the Architecture of an IP-based Internet of Things: Physical/Link Layer, Low-power Wi-Fi, Bluetooth, Powerline Communications, Network and higher Layers	8	
2	**IoT Network Architecture and Design** Drivers Behind New Network Architectures, IoT Architectures: The IoT World Forum (IoTWF) Standardized Architecture, IT and OT Responsibilities in the IoT Reference Model, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud.	10	
3	**Prototyping Embedded Devices** Sensors, Actuators, Micro-Electro-Mechanical Systems (MEMS) and Smart Objects, Wireless Sensor Network and its communication protocol, Machine to Machine Communication, Introduction to Arduino and Raspberry Pi.	6	
4	**Interoperability** Interoperability in Internet of Things, Cloud-based Solutions, REST and The Web of Things, IoT Access Technologies: IEEE 802.15.4; Optimizing IP for IoT: 6LoWPAN.	5	
5	**Application Protocols and Security in the IoT** IoT network management sublayer: CoAP, MQTT; Security Issues in the IoT**,** Security Mechanisms Overview: Traditional vs Lightweight security, Lightweight Cryptography, Authorization Mechanisms for Secure IoT Services. Case Study.	7	

Course Outcomes: After completion of the course students will able to -	
CO1	Interpret the impact and challenges posed by IoT and the Internet technologies behind it.
CO2	Explain the new architectural models of IoT and the different communication protocols for connecting IoT nodes.
CO3	Compare and contrast the deployment of smart objects and the technologies to connect them to networks.
CO4	Develop interoperability among some of the IoT technologies.
CO5	Implement different Application protocols and security measures for IoT.
Learning Resources:	
1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education
2	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiely,
3	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards", John Wiley & Sons.
4	Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education.

Name of the course:	**RESEARCH METHODOLOGY AND IPR**
Course Code: ITRES 201	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory Contact Hrs.: 2 hrs./week	Mid Semester-1 Exam: 15 Marks
Credit Point: 2	Mid Semester-2 Exam: 15 Marks
	Assignment, Quiz, Presentation, term paper & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To study research formulation
2.	To study technical report writing
3.	To study research proposal generation
4.	To study IPR and GI
5.	To study patent related case studies
Pre-Requisite:	
1.	

Module	Content	Hours	Marks
1.	**Introduction:** Meaning of 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, Necessary instrumentations	4	15
2.	**Research Problem:** Meaning of 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, Necessary instrumentations	6	20
3.	**Technical writing:** Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	5	15
4.	**IPR:** 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.	5	20
5.	**Patent and GI:** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	6	15
6.	**Case study:** New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	4	15
Course Outcome: After completion of this course the students will be able to -			
CO1	Understand research problem formulation		
CO2	Analyze research related information		
CO3	Follow research ethics		
CO4	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.		
CO5	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.		
CO6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.		
Learning Resources:			
1.	Research methodology: an introduction for science & engineering students, Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004		
2.	Research Methodology: An Introduction, Wayne Goddard and Stuart Melville, Juta and Company		

3.	Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd Edition, SAGE publications, 2014
4.	Resisting Intellectual Property, Halbert, Taylor & Francis Ltd, 2007
5.	Resisting Intellectual Property, Halbert, Taylor & Francis Ltd, 2007
6	Industrial Design, Mayall, McGraw Hill, 1992.
7	Product Design, Niebel, McGraw Hill, 1974
8.	Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
9.	Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008
10.	Introduction to Design, Asimov, Prentice Hall, 1962

Name of the course	**PC lab II**
Course Code: ITPCL202	**Semester: 2nd**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Practical: 3 hrs./week	Attendance: 10 marks
Credit Points:1.5	Preparation of Lab Report: 20 marks
	Experimental data/ Precision of work done/ Coding efficiency: 30 marks
	Presentation / analysis of the result: 20 marks
	Viva voce: 20 marks

Operating System Lab. (Part I)

Module	**Content**
1.	Implementation of different CPU scheduling algorithms.
2.	Implementation of different classical process synchronization problems.
3.	Implementation of deadlock avoidance and recovery techniques.
4.	Implementation of memory allocation techniques.
5.	Process management and system calls (in UNIX & Windows).
6.	Implementation of Pipe, Signal & interrupt in UNIX operating system.

Course Outcomes:

After completion of the course students will able to -

CO1	Review and implement different CPU scheduling algorithms.
CO2	Analyze and solve different process synchronization problems.
CO3	Analyze and select deadlock handling mechanisms.
CO4	Implement and review different memory allocation techniques.

CO5	Evaluate and implement process management and system administration.
Learning Resources:	
1	Mastering Linux Administration- Alexandru Calcatinge, Julian Balog-- Packt
2	Operating Systems Concepts & design - Milan Milenkovic, TMH
3	Operating Systems: Internals and Design Principles-William Stallings-Pearson
DATABASE SYSTEMS LAB. (Part II)	
Objective:	
1.	Describe the basics of SQL
2.	Construct queries using SQL
3.	Demonstrate basic database tuning principles
4.	Implement PL/SQL Concepts and Constructs
Pre-Requisite:	
1.	DBMS knowledge (ITPC205)
Module	**Content**
1.	Creating a Table, Inserting/ updating Values, Adding and Dropping Constraints in a table
2.	Using The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IS, IN, NOT IN, BETWEEN, LIKE, MINUS, ALL, ORDER BY, GROUP BY and HAVING Clause, Using Aggregate Functions, Combining Tables using JOINS, Sub queries, Printing date in specified format, Using ROUND( ) function, Taking inputs from user, Using ON DELETE CASCADE
3.	Creating Views, Dropping Views, Creating Column Aliases
4.	Tuning: Through query, using Indexing
5.	Using basic PL/SQL Structure, Using Conditional statements in PL/SQL , Using Basic loops in PL/SQL, Using Cursors in PL/SQL, Using Triggers in PL/SQL
Course Outcomes: After completion of this course the students will be able to -	
CO1	handle table schema, its different constraints and populating such schemas
CO2	compose queries to retrieve data from a Database
CO3	facilitate some management of a Database
CO4	explain some designing issues of a database through tuning
CO5	implement conditional statements, basic loops, cursors and triggers in PL/SQL
Learning Resources:	
1	Ivan Bayross, SQL, PL/SQL the Programming Language of Oracle, BPB Publications, ISBN: 9788176569644
2	Abraham Silberschatz, Henry F. Korth, S.Sudarshan, Database System Concepts, McGraw-Hill, ISBN: 9789332901384

Name of the course	**MACHINE LEARNING LAB**
Course Code: ITPEC203BL	**Semester: 2nd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Practical : 3 hrs/week	Laboratory Journal Book and Results: 40 Marks
Credit Points: 1.5	Viva-Voce conducted during semester: 40 Marks
	Attendance, Overall Conducts, Skill etc. : 20 Marks

Objective:	
1.	To learn how to make use of data sets in implementing the machine learning algorithms
2.	To implement the machine learning concepts and algorithms in Python language..
Pre-Requisite:	
1.	Programming knowledge in Python
Module	**Laboratory Assignments**
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2	Implement the Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
3	For a given set of training data stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
4	Write a program to demonstrate the working of the decision tree based algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6	Write a program to construct a Bayesian network considering data set stored in a .CSV file.
7	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library in the program.
8	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library can be used for this problem.
9	Write a program to implement naïve Bayesian Classifier. Python ML library can be used for this problem.
10	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

Course Outcomes:

After successful completion of this course, the learners will be able to -

CO1	Understand the implementation procedures for the machine learning algorithms.
CO2	Design Java/Python programs for various Learning algorithms.
CO3	Apply appropriate data sets to the Machine Learning algorithms.
CO4	Identify and apply Machine Learning algorithms to solve real world problems

THIRD SEMESTER

3rd SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	ITOEC301	A: Quantum Computing B: Big Data Analytics C: Software Project Management D: Information and System Security E: Social Network Analysis	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	ITPRJ302	Dissertation (Part 2)	0	0	18	18	9
02	ITASGN302	Comprehensive Viva-voce	0	0	0	0	1
TOTAL			**3**	**0**	**18**	**21**	**13**

Name of the course	**QUANTUM COMPUTING**
Course Code: ITOEC301A	**Semester: 3rd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To develop mathematical foundation for application in Quantum Computing.
2.	To introduce the fundamentals of quantum computing and understand the basic postulates of quantum mechanics.
3.	To apply quantum algorithms for solving various problems**.**
Pre-Requisite:	
1.	Mathematics I [BS(CS/IT)101], Physics [BS(CS/IT)]102
2.	Design and Analysis of Algorithms [PC(CS/IT)406]

Module	**Content**	**Hours**	**Marks**
1	**Mathematical Preliminaries:** Representation of states in linear vector space, Basis and Dimensions, Inner Product, Orthonormality, Bra-Ket Formalism, Hilbert Space, Hermitian, Unitary, Normal and Projection Operators, Tensor Product,	8	

	Density Operator.		
2	**Introduction to Quantum Mechanics:** Classical Deterministic Systems, Probabilistic Nature of Quantum Systems, Basics of Quantum Theory, Schrodinger's Equation and Born Rule, Wave -Particle Duality, Postulates of Quantum Mechanics, Dirac Formalism, Stern-Gerlach Experiment and Measurement, Electron Spin, Superposition of States, Quantum Entanglement.	6	
3	**Quantum Circuits:** Bits and Qubits, Bloch sphere representation of a qubit, multiple qubits. Classical gates versus quantum gates, single qubit gates, multiple qubit gates, design of quantum circuits.	8	
4	**Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	8	
5	**Quantum Algorithms:** Introduction to quantum algorithm, quantum parallelism, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization algorithm, Grover Search algorithm, Simon's algorithm, Quantum Fourier Transform.	8	
Course Outcomes: After completion of this course students will be able to-			
CO1	Define Hilbert Space and Operators.		
CO2	Explain basic concepts of quantum mechanics as applied in Quantum computing.		
CO3	Develop quantum logic gate circuits.		
CO4	Differentiate the classical and quantum information processing concepts.		
CO5	Implementation of simple quantum algorithms using quantum parallelism.		
Learning Resources:			
1.	Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010.		
2.	Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008.		
3.	Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008		
4.	Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995		
5.	Reskill Lecture notes http://www.theory.caltech.edu/~preskill/ph229/.Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill		
6.	Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, Benenti G., Casati G. and Strini G, World Scientific.		

Name of the course:	**BIG DATA ANALYTICS**
Course Code: ITOEC301B	**Semester: 3rd**
Duration: 6 months	**Maximum Marks: 100**

Teaching Scheme	**Examination Scheme**
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.:	Mid Semester-2 Exam: 15 Marks
Credit Point: 3	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To understand Big Data and its uses
2.	To provide an overview of Hadoop and its Ecosystem
3.	To understand MapReduce Jobs
4.	To learn HDFS concepts
5.	To provide exposure to Big Data Analytics with R

Pre-Requisite:	
1.	Database Design
2.	Database Design Lab.

Module	**Content**	**Hours**	**Marks**
1.	**Big Data Overview and Applications** Definition and History of big data, Elements of big data, Advantages and Disadvantages of big data, Using big data in businesses	3	
2.	**Technologies for handling Big Data** Introduction to Hadoop, Functioning of Hadoop, Cloud Computing for big data	5	
3.	**Understanding Hadoop Ecosystem** HDFS, MapReduce, Hbase, Hive, Pig, Big SQL	8	
4.	**MapReduce** Anatomy of a MapReduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, MapReduce Types and Formats, MapReduce Features	7	
5.	**HDFS(Hadoop Distributed File System)** Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data Flow, Data Ingest with Flume and Sqoop and Hadoop archives, Hadoop I/O	8	
6.	**Big Data Analytics with R** Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering, Big Data Analytics with R, Integrating R and Hadoop	5	

Course Outcomes: After completion of this course the students will be able to -	
CO1	**explain** Big Data and its business applications
CO2	**apply** the technologies for handling Big Data
CO3	**classify** the components of Hadoop Ecosystem
CO4	**demonstrate** Jobs in Hadoop Environment

CO5	**analyze** data on Distributed File System
CO6	**apply** Machine Learning Techniques using R
Learning Resources:	
1.	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley India Pvt. Ltd, ISBN: 9788126579518
2.	Tom White, Hadoop: The Definitive Guide - Storage and Analysis at Internet Scale, Shroff Publishers & Distributors Pvt Ltd, ISBN: 9789352130672
3.	Mark Hornick, Tom Plunkett, Using R to Unlock the Value of Big Data, McGraw-Hill Education - Europe, ISBN: 9780071824385
4.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, ISBN: 9783540430605
5.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, ISBN: 9781316638491
6.	Bill Franks, Taming The Big Data Tidal Wave, John Wiley & Sons Inc, ISBN: 9781118208786

Name of the course	**SOFTWARE PROJECT MANAGEMENT**		
Course Code: ITOEC301C	**Semester: 3rd**		
Duration: 6 months	**Maximum Marks: 100**		
Teaching Scheme	**Examination Scheme**		
Theory: 3 hrs/week	Mid Term I Exam: 15 Marks		
Credit Points: 3	Mid Term II Exam: 15 Marks		
	Class performance & Attendance: 20 Marks		
	End Semester Exam & Viva: 50 Marks		
Objective:			
1.	To understand the Software Project Planning and Evaluation techniques.		
2.	To plan and manage projects at each stage of the software development life cycle.		
3.	To develop skills to manage the various phases involved in project management and people management.		
4.	To deliver successful software projects that support organization ‘s strategic goals.		
Pre-Requisite:			
1.	Software Engineering		
Module	**Content**	**Hours**	**Marks**
1	**SOFTWARE PROJECT** Concept of Project, Software project, Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects, Setting objectives, Project portfolio Management, Risk evaluation, Strategic program Management, Stepwise Project Planning**.**	6	

2	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION** Software process and Process Models – Choice of Process models – Rapid Application development, Agile methods – Dynamic System Development Method, Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.	8	
3	**ACTIVITY PLANNING AND RISK MANAGEMENT** Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Gantt chart, Network Planning models, Critical path method, PERT technique, Resource Allocation, Cost schedules. Industrial strength software: features & challenges. Risk identification, Assessment, Risk Planning, Risk Management: Proactive & Reactive risk management.	8	
4	**PROJECT MANAGEMENT AND CONTROL** Framework for Management and control, Collection of data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, change control, Contract Management. Software Configuration Management- need, basic configuration, baseline of configuration. Concept of quality, quality attributes, iron triangle, TQM.	8	
5	**STAFFING IN SOFTWARE PROJECTS** Managing people, Organizational behavior, Best methods of staff selection, The Oldham – Hackman job characteristic model, Health and Safety, Ethical and Professional concerns – Working in teams, Decision making, Organizational structures, Dispersed and Virtual teams, Leadership, role of project manager.	6	

Course Outcomes: After completion of the course students will able to -	
CO1	Assess Project Management principles while developing software.
CO2	Identify the basic project management concepts, framework and the process models.
CO3	Review about software process models and software effort estimation techniques.
CO4	Estimate the risks involved in various project activities.
CO5	Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
CO6	Determine staff selection process and the issues related to people management.
Learning Resources:	
1	Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – TMH
2	Robert K. Wysocki —Effective Software Project Management‖ – Wiley
3	Software Engineering: A Practitioner's Approach- Roger Pressman--TMH
4	Ingenieria del Software-- Ian Sommerville--Pearson
5	Walker Royce: —Software Project Management‖- Addison-Wesley
6	Gopalaswamy Ramesh, —Managing Global Software Projects- McGraw Hill
7	Software Engineering- Pankaj Jalote- Wiley India

Name of the course:	**INFORMATION AND SYSTEM SECURITY**
Course Code:ITOEC301D	**Semester: 3rd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.:	Mid Semester-2 Exam: 15 Marks
Credit Point: 3	Assignment, Quiz, Presentation, term paper & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To study the concept of security
2.	To study cryptography
3.	To study Transport and IP layer security
4.	To study Internet and web security
5.	To study media security
Pre-Requisite:	
1.	Computer Network (ITPC103)

Module	**Content**	**Hours**	**Marks**
1.	**Introduction:** Need for security, Security approaches, Principles of security, Types of attacks, IP and web security, media security.	4	10
2.	**Cryptographic Techniques:** Cryptography: Cipher text, traditional method: Substitution & Transposition techniques, Symmetric & Asymmetric Key Cryptography , block ciphers: modes of operation, DES and its variants, RCS, IDEA, BlowFish, AES, Differential & Linear Cryptanalysis, Shannon -Fano perfect secrecy, Public key parameter: Modular arithmetic, gcd, primality testing, Public key Encryption: RSA, side channel attacks, key exchange algorithm, KDC	12	30
3.	**Transport and IP layer security:** Transport layer security (TLS): overview, architecture, SSL. IP layer security (IPSEC): overview, architecture, authentication header and security payload encapsulation.	5	20
4.	**Internet & Web security:** Basic of authentication and encryption in internet security: Digital signature, Knapsack algorithm, Kerberos, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall. Web security Intrusion detection systems, Expert systems, game theoretic approaches, Block chain.	10	20
5.	**Media security:** Data hiding, Steganography & Steganalysis, Digital watermarking, Visual cryptography	5	20

Course Outcomes: After completion of this course the students will be able to -	
CO1	Assess different methodologies for data and system security
CO2	Investigate different cryptography techniques
CO3	Assess different security model for transport and IP layer
CO4	Compose different security model for web
CO5	Investigate different media security methodologies
CO6	Real life design of problems and solution for security application(e.g. in cloud or IOT)
Learning Resources:	
1.	Cryptography & Network Security : Principles and practices: William Stalling, Pearson
2.	Cryptography & Network Security: Atul Kahate, TMH
3.	Cryptography & Network Security: Forouzen. Mc.graw hill

Name of the course	**SOCIAL NETWORK ANALYSIS**
Course Code: ITOEC301E	**Semester: 3rd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Two Mid term Exam: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To study the concept of online social network in graph theoretic concept
2.	To study centrality measures of online social network graph
3.	To study social network content and analyze the sentiment
4.	To study rumour detection in social media
5.	To study influence maximization and minimization in social media
Pre-Requisite:	
1.	

Module	**Content**	**Hours**	**Marks**
1	**Introduction:** A General Overview: online social network(OSN), online social network as graph, topology, Erdos Reyni concept of graph, concept of six degree separation, small world network, large scale network, scale free network, propagation approaches through social network graph	2	6

2	**Centrality measures:** Graph centrality concept, Node degree centrality, Betweenness centrality, closeness centrality, page rank centrality, Eigen vector centrality, K-core, Homophily in social network	6	15
3	**Sentiment analysis:** Concepts of natural language processing, Sentiment: positive, negative and neutral. NLP based analysis of sentiment, machine learning approaches for analysis of sentiment in OSN	5	15
4	**Rumour detection:** Detection of rumour in social network, content based rumour detection, generating dictionary for identifying misinformation, machine learning approaches to differentiate rumour content, interaction based rumour detection, identifying the profile generating rumour , anti rumour campeining	5	15
5	**Influence maximization:** Introductory concepts. Different approaches of influence maximization. Recent trends in influence maximization, applications.	6	15
6	**Influence minimization:** Introductory concepts. Different approaches of influence minimization. Application of influence minimization for rumour content in OSN	4	12
7	**Clustering and community detection:** Community detection in online social network, clustering, clustering coefficient, modularity, transitivity, average path length	4	10
8	**Application of SNA:** Real world social network issues and solution, Distributed network generation for large scale/ scale free social network.	4	12
Course Outcomes: After completion of this course the students will be able to -			

FOURTH SEMESTER

4th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
SESSIONAL/PRACTICAL							
01	ITPRJ403	Dissertation (Part 3)	0	0	24	24	12
TOTAL			**0**	**0**	**24**	**24**	**12**