B.TECH ADMISSION BATCH OF 2019

COMPUTER SCIENCE AND ENGINEERING CURRICULUM

SIKSHA 'O' ANUSANDHAN

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CONTENTS

	Program Educational Objectives
1	Our Graduates will have successful professional careers in industry, government, academia or non-profit organizations
2	Our Graduates will effectively lead, work and communicate in multidisciplinary teams and apply sound engineering principles and design methodology to solve societal problems
3	Our Graduates will maintain currency in their chosen field through higher study, through organizational participation and through participation in professional developmental activities.

After Graduation, Students will have :	
A	An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline
B	An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
C	An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
D	An ability to function effectively on teams to accomplish a common goal
E	An understanding of professional, ethical, legal, security and social issues and responsibilities
F	An ability to communicate effectively with a range of audiences
G	An ability to analyze the local and global impact of computing on individuals, organizations, and society
H	Recognition of the need for and an ability to engage in continuing professional development
I	An ability to use current techniques, skills, and tools necessary for computing practice.
J	An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
K	An ability to apply design and development principles in the construction of software systems of varying complexity.

SEMESTER 1 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 2ND YEAR)			
SUBJECT CODE	**SUBJECT NAME**	**CREDITS**	**GRADING PATTERN**
CSE 1002	Discrete Mathematics	4	6
The Foundations: Logic and Proofs, Basic Structures: Sets, Functions, Sequences, Sums, Matrices, Algorithms, Number Theory and Cryptography, Induction and Recursion, Counting, Relations, Partial Orderings		Textbooks - Discrete Mathematics and Its Applications by Rosen, Mcgraw Hill Course Format: 4 Classes/week, 1hr/Class, 4 Credits	
MTH 1001	Calculus I	4	6
Functions and Models, Limits and Derivatives, Differentiation Rules, Application of Differentiation, Integrals, Applications of Integration, Techniques of Integration, Further Applications of Integration, Parametric Equations and Polar Coordinates, Infinite Sequences and Series		Textbook – Early Transcedentals, 7th Edition, by James Stewart, Cengage Course Format: 4 Classes/week, 1hr/Class, 4 Credits	
CSE 1001	Introduction to Computer Programming	4	1
Introduction to Computers, Programs, and Java, Elementary Programming, Selections, Mathematical Functions, Characters, and Strings, Loops, Methods, Single-Dimensional Arrays, Multidimensional Arrays, Objects and Classes, Object-Oriented Thinking, Inheritance and Polymorphism, Exception Handling and Text I/O, Abstract Classes and Interfaces, Recursion, Generics		Textbook - Intro to Java Programming (Comprehensive Version) by Pearson by Y Daniel Liang Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 4 Credits	
PHY 1001	University Physics: Mechanics	4	1
1D Kinematics, 2D Kinematics, Circular Motion, Newton's Laws, Forces & Free Body Diagram, Friction, Work & Energy, Potential Energy, General Work Energy, Center of Mass, Collisions, Impulse, Rotational Kinematics, Parallel Axis, Torque, Rotational Dynamics, Statics, Angular Momentum, Harmonic Motion, Waves, Fluids		Textbook – University Physics with Modern Physics, by Young and Freedman, Pearson Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 4 Credits	
HSS 1021	Principles of Microeconomics	3	6
Introduction, How Markets Work, Markets and Welfare, The Economics of the Public Sector, Firm Behavior and the organization of Industry, The Economics of Labor Market, Theory of Consumer Choice, Frontiers of Microeconomics		Textbook – Principles of Economics, 6th Edition, by N Gregory Mankiw, Cengage Course Format: 3 Classes/week, 1hr/Class, 3 Credits	
TOTAL CREDITS		**19**	

 The textbooks prescribed for a subject are required for that subject and will be the only ones used for it

SEMESTER 2 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 2ND YEAR)			
CODE	**SUBJECT**	**CREDITS**	**GRADING PATTERN**
CSE 2001	Data Structure and Algorithms	4	1
Java primer, Object oriented design, fundamental data structures, algorithm analysis, recursion, stacks, queues, List, trees		Textbook - Data Structures and Algorithms in java by Goodrich and Tamassia, Wiley India	
		Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 4 Credits	
CSE 1004	Introductory Graph Theory	4	1
Fundamental Concepts, Trees and Distance, Matchings and Factors, Graph Coloring, Planar Graphs, Edges and Cycles		Textbooks - Introduction to graph theory by West, pearson india	
		Course Format: 3 Classes/week, 1hr/Class, 1 2hr Problem Solving Session/Week, 4 Credits	
MTH 2001	Calculus II	3	2
Vectors and Geometry of Space, Vector Functions, Partial Derivatives, Multiple Integrals, Vector Calculus		Textbook – Early Transcendentals, 7th Edition, by James Stewart, Cengage	
		Course Format: 2 Classes/week, 1hr/Class, 1 2hr Problem Solving Session/Week	
PHY 2001	University Physics: Electricity and Magnetism	4	1
Coulomb's Law, Electric Fields, Electric Fields and Flux, Gauss's Law, Electric Potential, Capacitance, Simple Circuits, Kirchhoff's Laws, RC Circuits, Magnetic Force, Forces and Magnetic Dipoles, Biot-Savart Law, Ampere's Law, Motional EMF, Faraday's Law, Self-Inductance RL Circuits, Oscillations: LC Circuits, AC Circuits, AC Power and Resonant Circuits, Maxwell's Displacement Current, Electromagnetic Waves, Polarization, Reflection and Refraction, Lenses, Mirrors, Optical Instruments		Textbook – University Physics with Modern Physics, 13th Edition, by Young and Freedman, Pearson	
		Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 4 Credits	
GED 1001	Critical Thinking and Communication	4	1
Critical Thinking and Communication : Argument and Critical Thought, Co-Oriental View of Argument, Argument Cultures and Ethics, Claims and Propositions, Evidence, Reasoning, Communicating Arguments, Argument Analysis and Criticism Communication process; Public Speaking: Ethics and learning to speak in public; Listening: The Listening Process ,Types of listening. Practising Active Listening; Audience Analysis :Making a choice of speech according to the target audience; Researching and Organizing Materials: Going through scholarly resources and gathering information; Using visual aids: Learning the use of Visual Aids in Effective presentation; Using various types of speech: Critiquing Speeches, Delivery methods and audience analysis.		Textbooks - Critical Thinking and Communication by Inch, Pearson - The Art of Public Speaking by Lucas, Tata McGraw Hill	
		Course Format: 3 Classes/week, 1hr/Class, 1 2hr Lab/Week, 4 Credits	
TOTAL CREDITS		**19**	

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SEMESTER 3 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 3RD YEAR)			
CODE	**SUBJECT**	**CREDITS**	**GRADING PATTERN**
CSE 2141	Computer Science Workshop 1	4	5
Compiling, Running, and Debugging, Interacting with the Environment, Strings and Things, Pattern Matching with Regular Expressions, Numbers, Dates and Times—New API, Structuring Data with Java, Object-Oriented Techniques, Functional Programming Techniques: Functional Interfaces, Streams, Parallel Collections, Input and Output, Directory and Filesystem Operations, Media: Graphics, Audio, Video, Network Clients, Graphical User Interfaces, Internationalization and Localization, Server-Side Java, Java and Electronic Mail, Database Access, Processing JSON Data, Processing XML, Packages and Packaging, Threaded Java. Programming Exercises and projects from the other prescribed text books.		Textbooks - Java Cookbook by Darwin, Shroff/O'Reilly - Elements of Programming Interviews in Java by Aziz, Lee and Prakash - Data Structures and Algorithms in java by Goodrich and Tamassia, Wiley India - Think Java by Downey, Shroff/O'Reilly - Think Data Structures by Downey, O'Reilly Course Format: 8 Lab Hours	
EET 1211	Digital Logic Design	4	1
Digital Systems and binary numbers, boolean algebra and logic gates, Gate level minimisation, Combinational Logic, Synchronous Sequential Logic, Registers and Counters, Memory and Programmable Logic : PLA and PLL, Design at the register transfer level. Labs from this textbook : 17 Laboratory Experiments with Standard ICs and FPGAs		Textbook – Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog by Mano, 6th Edition, Pearson Course Format: 3 Classes/Week, 1 hr/Class; 1 Lab Session/Week, 2 hrs/Lab Session = 4 Credits	
MTH 2002	Probability and Statistics	4	6
Introduction to Statistics and Data Analysis; Probability; Random Variables and Probability Distributions; Mathematical Expectations; Some Discrete Probability Distributions; Some Continuous Probability Distributions; Functions of Random Variables; Fundamental Distributions and Data Description; One and Two Sample Estimation Problems; One and Two Sided Tests of Hypotheses; Simple Linear Regression		Textbook - Probability and Statistics for Engineers and Scientists by Walpole and Myers Course Format: 4 Classes/week, 1hr/Class, 4 Credits	
MTH 3003	Applied Linear Algebra	4	6
Matrices and Gaussian Elimination, Vector Spaces, Orthogonality, Determinants, Eigen Values and Eigen Vectors, Positive Definite Matrices, Computations with Matrices		Textbook – Linear Algebra and its applications, 4th Edition, by Gilbert Strang Course Format: 4 Classes/week, 1hr/Class, 4 Credits	
HSS 2021	Principles of Macroeconomics	3	6
Introduction to Macroeconomics, Independence & gains from trade, Measuring a nations income, Measuring the Cost of Living, Production & growth, Savings, investment & the financial system, The Basic tools of finance, Unemployment and its natural rate, The Monetary System, Money, Growth & inflation, Aggregate Demand & Aggregate Supply, The Short Run tradeoff between Inflation and Unemployment		Textbook – Principles of Economics, 6th Edition, by N Gregory Mankiw Course Format: 3 Classes/week, 1hr/Class, 3 Credits	
TOTAL CREDITS		**19**	

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SEMESTER 4 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 3RD YEAR)

CODE	SUBJECT	CREDITS	GRADING PATTERN
CSE 3141	Computer Science Workshop 2	4	5
Programming in Python : A Taste of Python, Numbers, Strings, and Variables, Lists, Tuples, Dictionaries, and Sets, Code Structures, Types and Operations, Modules and Packages, Objects and Classes, Mangle Data Like a Pro, Handling Data, Web programming with python, Systems, Networks, Be a python expert, Python Programming from Cookbook : Data Structures and Algorithms, Strings and Text, Numbers, Dates, and Times, Iterators and Generators, Files and I/O, Data Encoding and Processing, Functions, Classes and Objects, Metaprogramming, Modules and Packages, Network and Web Programming, Concurrency, Utility Scripting and System Administration, Testing, Debugging, and Exceptions		Textbooks - Introducing Python by Bill Lubanovic, Shroff/O'Reilly - Python Cookbook: Recipes For Mastering Python 3, 3rd Edition by Brian Jones, David Beazley, Shroff/O'Reilly Course Format: 8 Lab Hours	
EET 2211	Computer Organisation and Architecture	4	1
Introduction, Computer Evolution and Performance, Top-Level View of Computer Function and Interconnection, Cache Memory, Internal Memory, External Memory, Input/Output, Operating System Support, Number Systems, Computer Arithmetic, Digital Logic, Instruction Sets: Characteristics and Functions, Instruction Sets: Addressing Modes and Formats, Processor Structure and Function, Reduced Instruction Set Computers, Instruction-Level Parallelism and Superscalar Processors, Parallel Processing, Multicore Computers		Textbooks : Computer Organisation and Architecture by William Stallings, Pearson Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits	
CSE 3131	Algorithms Design 1	4	1
Introduction: Some Representative Problems, Basics of Algorithms Analysis, Graphs, Greedy Algorithms, Divide and Conquer, Dynamic Programming		Textbook - Algorithm Design by kleinberg and Tardos, Pearson Course Format: 3 Classes/week, 1hr/Class, 1 2hr Problem Solving Session/Week, 4 Credits	
CSE 2033	Advanced Discrete Mathematics	3	2
What is Combinatorics, The Pigeonhole Principle, Permutations and Combinations, Generating Permutations and Combinations, Partial Orders and Equivalence Relations, The Binomial Coefficients, The Inclusion-Exclusion Principle and Applications, Recurrence Relations and Generating Functions, Special Counting Sequences Lattices and Order : Ordered sets, Lattices and complete lattices, Formal concept analysis, Modular distributive and Boolean lattices, Representation theory: the finite case, Congruences Abstract Algebra : Group Theory, Introduction to Groups, Subgroups, Quotient Group and Homomorphisms, Group Actions, Ring Theory, Introduction to Rings		Textbook - Introductory Combinatorics by Richard A. Brualdi, Pearson India - Introduction to Lattices and Order by B. A. Davey & H. A. Priestley, Cambridge University Press India - Abstract Algebra, 3ed by David S. Dummit, Wiley India Course Format: 2 Classes/week, 1hr/Class, 1 2hr Problem Solving Session/Week, 3 Credits	

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<table>
<tr><th colspan="4">SEMESTER 4 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 3RD YEAR)</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CHM 1012</td><td>Environmental Studies and Disaster Management</td><td>3</td><td>6</td></tr>
<tr><td colspan="2" rowspan="2">Environmental Studies : The Multidisciplinary Nature of Environmental Studies, Natural Resources, Ecosystems, Biodiversity & its conservation, Environmental Pollution, Social Issues & the Environment, Human Pollution & the Environment
Disaster Management : Introduction to Disaster Management, Disaster Management and Planning, Disaster Mitigation, Disaster Preparedness, Disaster Response, Disaster Recovery, Contemporary Issues and Challenges in Disaster Management</td><td colspan="2">Textbooks
- Environmental Studies : Supplied by the UGC (in the form of an Ebook)
- Disaster Management by Mrinalini Pandey, Wiley India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/week, 1hr/Class</td></tr>
<tr><td colspan="2">TOTAL CREDITS</td><td>18</td><td></td></tr>
</table>

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SEMESTER 5 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 4TH YEAR)

CODE	SUBJECT	CREDITS	GRADING PATTERN
CSE 3041	UNIX Systems Programming	4	1
Programming in C : Overview of Computers and Programming, Overview of C, Top Down Design with Functions, Selection Structures, Repetition and Loop Statements, Pointers and modular Programming, Arrays, Strings, Recursion, Structure and Union Types, Text and Binary File Processing, Dynamic Data Structures Fundamentals: Technology's Impact on Programs; Programs, Processes and Threads, Processes in UNIX, UNIX I/O, Files and Directories, UNIX Special Files, Project: The Token ring Asynchronous Events: Signals, Times and Timers, Project: Virtual Timers, Cracking Shell Concurrency: POSIX Threads, Thread Synchronization, Critical Section and Semaphores, POSIX IPC, Projects: Producer Consumer Synchronization		Textbooks - Problem Solving and Program Design in C by Hanly, Pearson India - UNIX Systems Programming: Communication, Concurrency and Threads by Robbins and Robbins, Pearson Course Format: 2 Classes/week, 1hr/Class, 2 Labs/Week, 2hr/Lab, 4 Credits	
CSE 4049	Design of Operating Systems	4	1
Operating Systems : Introduction, Operating System structures, Processes, Threads, Process Synchronisation, CPU Scheduling, Deadlocks, Main Memory, Virtual Memory, File Systems (Interface and Implementation), I/O Systems, Case Study : Linux : Introduction, Memory Addressing, Processes and Threads, Interrupts and exceptions, Kernel synchronization, Timing Measurements, Process Scheduling, Memory Management, Process Address space, System Calls, Signals, the Virtual File System, IO, Page Cache, Accessing Files		Textbooks - Operating System Concepts by Silberschatz, Galvin and gagne - Understanding the Linux kernel by Bovet and Cesati, SPD Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 1 credit = 4 Credits	
CSE 3034	Computer Networking	4	1
Physical Layer, Data Link, The Medium Access Control Sublayer, Network Layer, The Transport, Application Layer, Network Security Communication: Connection Oriented Communication, Project: WWW Redirection, Connectionless Communication and Multicast, Project : Internet Radio, Project: Server Performance		Textbook - Computer Networks by Tannenbaum, Pearson India - UNIX Systems Programming: Communication, Concurrency and Threads by Robbins and Robbins, Pearson Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 1 credit = 4 Credits	
CSE 3054	Introduction to Data Science using Python	2	5
Preliminaries, Introductory Examples, IPython: An Interactive Computing and Development Environment, NumPy Basics: Arrays and Vectorized Computation, Getting Started with pandas data structures, Data Loading, Storage, and File Formats, Data Wrangling: Clean, Transform, Merge, Reshape, Plotting and Visualization, Data Aggregation and Group Operations, Time Series, Financial and Economic Data Applications		Textbook - Python for Data Analysis by Wes McKinney, Shroff/O'reilly Course Format: 2 labs/Week, 2 hrs/Lab = 2 Credits	

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SEMESTER 5 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 4TH YEAR)			
CODE	**SUBJECT**	**CREDITS**	**GRADING PATTERN**
CSE 3031	Theory of Computation	4	1
Automata and Languages: Regular Languages, Context Free grammar Computability: The Church Turing Thesis, Decidability, Reducibility		Textbook - Introduction to the Theory of Computation by Sipser	
		Course Format: 3 Classes/week, 1hr/Class, 1 Problem Solving Session/Week, 2hr/Problem Solving Session, 1 credit = 4 Credits	
CSE 4131	Algorithm Design 2	4	1
Network Flow, NP and Computational Intractability, PSPACE: A Class of Problems Beyond NP, Extending the Limits of Tractability, Approximation Algorithms, Local Search, Randomized Algorithms		Textbook - Algorithm Design by kleinberg and Tardos, Pearson	
		Course Format: 3 Classes/week, 1hr/Class, 1 Problem Solving Session/Week, 2hr/Problem Solving Session, 1 credit = 4 Credits	
TOTAL CREDITS		**22**	

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SEMESTER 6 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 4TH YEAR)

CODE	SUBJECT	CREDITS	GRADING PATTERN
CSE 4042	UNIX Network Programming	4	1
Introduction, the transport layer, sockets introduction, Elementary TCP sockets, TCP client/server example, I/O, Socket Options, Elementary UDP and SCTP SCTP client server model, Name and address conventions, IPV4, IPV6, Daemon Processes, Advanced IO options, Unix Domain Protocols, Nonblocking I/O, IOCTL Operations, Routing Sockets, Broadcasting, Multicasting, Advanced UDP sockets, signal driven IO, threads, IP Options, Raw Sockets, Datalink access, Design Alternatives		Textbooks - Unix Network Programming Vol 1 by Stevens, Pearson Course Format: 2 Classes/week, 1hr/Class, 2 Labs/Week, 2hr/Lab, 4 Credits	
CSE 3151	Introduction to Databases	4	1
Theory (From Silberschatz) : Introduction, Relational Databases: Introduction to the Relational Model, Introduction to SQL, Intermediate SQL, Advanced SQL, Formal Query Languages; Database Design: Database Design and the ER model, Relational Database Design, Application design and development; Data Storage and Querying: Storage and the File Structure, Indexing and Hashing, Query Processing and Optimisation; Transaction Management: Transactions, Concurrency Control, Recovery System; System Architecture: Database System Architectures Labs (From Alan Beaulieu) : A Little Background, Creating and Populating a Database, Query Primer, Filtering, Querying Multiple Tables, Working with Sets, Data Generation, Conversion, and Manipulation, Grouping and Aggregates, Subqueries, Joins Revisited, Conditional Logic, Transactions, Indexes and Constraints, Views, Metadata, ER Diagram for Example Database		Textbooks - Database System Concepts, 6th Edition, by Silberschatz, Froth and Sudarsan, Tata McGraw Hill - Learning SQL : Master SQL Fundamentals, 2nd Edition by Alan Beaulieu, O Reilly/ Shroff Course Format: 3 Classes/week, 1hr/Class, 1 Lab/Week, 2hr/Lab, 1 credit = 4 Credits	
CSE 3035	Cryptography and Network Security	3	2
Overview, Classical Encryption Techniques, Block Ciphers and the Data Encryption Standard, Basic Concepts in Number Theory and Finite Fields, Advanced Encryption Standard, Multiple Encryption and Triple DES, Pseudorandom Number Generation and Stream Ciphers, Public-Key Cryptography and RSA, Cryptographic Hash Functions, Message Authentication Codes, Key Management and Distribution, User Authentication, Transport-Level Security, Wireless Security, Electronic Mail Security, IP Security. Labs from Stallings.		Textbooks – - Cryptography and Network security by stallings, pearson Course Format: 2 Classes/week, 1hr/Class, 1 2hr lab/week, 3 Credits	
CSE 4054	Introduction to Machine Learning using Python	4	1
The Machine Learning Landscape, End-to-End Machine Learning Project, Classification, Training Models, Support Vector Machines, Decision Trees, Ensemble Learning and Random Forests, Dimensionality Reduction, Neural Networks and Deep Learning, Up and Running with TensorFlow, Introduction to Artificial Neural Networks, Training Deep Neural Nets, Distributing TensorFlow Across Devices and Servers, Convolutional Neural Networks, Recurrent Neural Networks, Autoencoders, Reinforcement Learning		Textbooks : Hands-On Machine Learning with Scikit-Learn and TensorFlow by Geron, Shroff/ O'Reilly Course Format: 2 Classes/week, 1hr/Class, 2 Labs/Week, 2hr/Lab, 4 Credits	

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SEMESTER 6 (SUBJECTS with BLACK Highlighting ARE REQUIRED FOR PROMOTION TO 4TH YEAR)			
CODE	**SUBJECT**	**CREDITS**	**GRADING PATTERN**
CSE 4021	Programming Languages and Compilers	4	1
Introduction, Programming Language Syntax, Names, Scopes and Bindings, Semantic Analysis, Control flow, Data Types, Subroutines and control abstraction, Data abstraction and object orientation, Building a Runnable Program, Runtime Program Management, Code Improvement		Textbook - Programming Language Pragmatics by Scott, Elsevier Course Format: 3 Classes/week, 1hr/Class, 1 2hr/Problem Solving Session/Week	
TOTAL CREDITS		**19**	

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<table>
<tr><th colspan="4">SEMESTER 7</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4143</td><td>Mobile Application Development Project</td><td>4</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">The Android Developer's Guide made available by google will be primarily used. The design guidelines for material design shall be strictly followed.
The output of the said project is a sufficiently complex functional (working) Android App (with both front and back end). The code and the concept should be unique. Students must demonstrate the app to be working on an android phone.</td><td colspan="2">Textbooks
- Android Programming : The Big Nerd Ranch Guide
- Android Game Programming by example, Packt Publishing
- Android Developers Guide by Google, Available Online</td></tr>
<tr><td colspan="2">Course Format: 8 contact hours</td></tr>
<tr><td>GEN 1002</td><td>Legal and Ethical Aspects of Engineering</td><td>2</td><td>6</td></tr>
<tr><td colspan="2" rowspan="2">Professional Ethics; Responsibility in Engineering; Framing the Problem; Resolving Problems; The Social and Value Dimension of Technology; Trust and Reliability; Risk and Liability in Engineering; Engineers in Organizations; Engineers and the Environment; International Engineering Professionalism; Case Studies

Copyrights, Trademarks and Patents with emphasis on Patents</td><td colspan="2">Textbook
- Engineering Ethics, Concepts and Cases by Harris, Pritchard and Rabins
- Law Relating to Intellectual Property Rights by VK Ahuja, Lexis Nexis</td></tr>
<tr><td colspan="2">Course Format: 2 1 hr theory classes per week.</td></tr>
<tr><td></td><td>Departmental Elective I</td><td>4</td><td>Depends on Selected Subject</td></tr>
<tr><td></td><td>Departmental Elective II</td><td>4</td><td>Depends on Selected Subject</td></tr>
<tr><td></td><td>Departmental Elective III</td><td>4</td><td>Depends on Selected Subject</td></tr>
<tr><td></td><td>Departmental Elective IV</td><td>4</td><td>Depends on Selected Subject</td></tr>
<tr><td colspan="2">TOTAL CREDITS</td><td>22</td><td></td></tr>
</table>

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SEMESTER 8			
CODE	**SUBJECT**	**CREDITS**	**GRADING PATTERN**
	Open Elective I	4	Depends on Selected Subject
	Open Elective II	4	Depends on Selected Subject
	Open Elective III	4	Depends on Selected Subject
CSE 4101	Senior Design Project	10	3
The Design of Everyday Things: The Psychopathology of Everyday things; The Psychology of everday actions; Knowledge in the head and in the world; Knowing what to do; To err is human; The Design Challenge; User Centered Design;		Textbook - - Code Complete, 2nd Edition, By Steve McDonnell, Microsoft Dreamtech press - The Design of Everyday Things by Don Norman	
This is the Fourth year Design Project, designed as per Engineering Design/Software Engineering (as applicable) Principles		Course Format: 20 Contact hours per week	
TOTAL CREDITS		**22**	

MINIMUM NUMBER OF CREDITS (AFTER SATISFYING ALL MANDATORY REQUIREMENTS) : 160

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ELECTIVES

ELECTIVES POLICY	5 ELECTIVE AREAS
12 ELECTIVES OFFERED IN 5 AREAS	- SOFTWARE ENGINEERING - MACHINE LEARNING - DATA SCIENCE - AI AND ROBOTICS - SYSTEMS DESIGN
STUDENT MUST CHOOSE 4 *DEPARTMENTAL ELECTIVES*	

<table>
<tr><th colspan="4">AREA 1: Software Engineering</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4046</td><td>Software Testing</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Software Test and Analysis in a Nutshell, A Framework for Test and Analysis, Basic Principles, Test and Analysis Activities within a Software Process, Finite Models, Dependence and Data Flow Models, Symbolic Execution and Proof of Properties, Finite State Verification, Test Case Selection and Adequacy, Functional Testing, Combinatorial Testing, Structural Testing, Data Flow Testing, Model-Based Testing, Testing Object-Oriented Software, Fault-Based Testing, Test Execution, Inspection, Program Analysis, System, Acceptance, and Regression Testing, Automating Analysis and Test, Documenting Analysis and Test</td><td colspan="2">Textbook - Software Testing and Analysis: Process, Principles and Techniques by Mauro Pezze, Wiley India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4045</td><td>Refactoring</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Refactoring, Principles in Refactoring, Bad Smells in Code, Building Tests, Toward a Catalog of refactoring, Composing Methods, Moving features, organising data, Simplifying conditional data, making method calls simpler, dealing with generalization, big refactorings</td><td colspan="2">Textbook - Refactoring : Improving the code of existing design, Fowler</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
</table>

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<table>
<tr><th colspan="4">AREA 2: Machine Learning</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4038</td><td>Statistical Machine Learning</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Overview of Supervised Learning, Linear Models for Regression, Linear Models for classification, Basic Expansion and Regularisation, Kernel Smoothing Methods, Model Assessment and Selection, Model Inference and Averaging, Additive Modes, Trees and Related Methods, Neural Networks</td><td colspan="2">Textbooks
- The Elements of Statistical Learning by Friedman,hastie and Tibshirani</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/week, 1hr/Class, 1 2hr Problem Solving Session/Week, 4 Credits</td></tr>
<tr><td>CSE 4039</td><td>Deep Learning with Tensor Flow</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Neural Networks, Training feed forward neural networks, implementing neural networks in tensor flow, beyond gradient descent, convolutional neural networks, Embedding and Representation learning, Models for sequence analysis, memory augmented neural networks, deep reinforcement learning</td><td colspan="2">Textbook - Fundamentals Of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Shroff/O'Reilly</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/week, 1hr/Class, 1 2hr Lab Session/Week, 4 Credits</td></tr>
</table>

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<table>
<tr><th colspan="4">AREA 3: Data Science</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4052</td><td>Data Mining</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Introduction, Getting to know your data, Preprocessing, Data Warehousing and On-line analytical processing, Data Cube Technology, Mining Frequent Patterns, Associations and Correlations: Concepts and Methods,Classification: Basic Concepts, Cluster Analysis: Basic Concepts and Methods</td><td colspan="2">Textbook - Data Mining: Concepts and Techniques by Han and Kimber, Elsevier</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4053</td><td>Information Retrieval</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Boolean Retrieval, The term vocabulary and posting lists, Dictionaries and tolerant retrieval, Index construction, Index compression, Scoring, term weighting, and the vector space model, Computing scores in a complete search system, Evaluation in information Retrieval, Relevance Feedback and Query Expansion, XML retrieval, Probabilistic Information Retrieval, Language Models for information Retrieval, Text classification and naiive bayes, Vector space classification, SVM and machine learning on documents, Flat clustering, Hierarchical Clustering</td><td colspan="2">Textbook - Introduction to Information Retrieval by Manning, Cambridge University Press</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
</table>

The textbooks prescribed for each subject are required and will be the only ones used for that subject

<table>
<tr><th colspan="4">AREA 4: Artificial Intelligence and Robotics</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4033</td><td>Introduction to Artificial Intelligence</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Introduction, Intelligent Agents, Solving Problems by Search, Beyond Classical Search, Adversarial Search, Logical Agents, Constraint Satisfaction Problems, First Order Logic, Inference in First Order Logic, Classical Planning</td><td colspan="2">Texbook - Artificial Intelligence by Russell and Norvig, Pearson India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4081</td><td>Introduction to Robotics</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Fundamentals, Kinematics of Robots: Position Analysis, Differential Motions and Velocities, Dynamic Analysis and Forces, Trajectory Planning, Motion Control Systems, Actuators and Drive Systems, Sensors</td><td colspan="2">Textbook - Introduction to Robotics: Analysis, Control, Applications, 2nd Edition by Niku, Wiley India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4082</td><td>Computer Vision</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Introduction, Geometric Camera Models, Light and Shading, Colo, Linear Filters, Linear Image filters, Texture, Stereopsis, Structure from motion, Segmentation by clustering, Grouping and model fitting, Tracking, Registration</td><td colspan="2">Textbooks
- Computer Vision by Forsyth and Ponce, Pearson India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
</table>

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<table>
<tr><th colspan="4">AREA 5: Systems Design</th></tr>
<tr><th>CODE</th><th>SUBJECT</th><th>CREDITS</th><th>GRADING PATTERN</th></tr>
<tr><td>CSE 4083</td><td>Embedded Systems</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Custom Single-Purpose Processors: Hardware, General-Purpose Processors: Software, Standard Single-Purpose Processors: Peripherals, Memory, Interfacing, Digital Camera Example, State Machine and Concurrent Process Models, Control Systems, IC Technology, Design Technology</td><td colspan="2">Textbook - Embedded System Design: A Unified Hardware / Software Introduction by Vahid, Wiley India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4084</td><td>Distributed Systems</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Characterization of DS, System Models, Networking and Internetworking, Interprocess Communication, Remote Invocation, Indirect Communication, Operating System Support, Dist. Objects and Components, Web Services, Peer-to-Peer Systems, Security, Distributed File Systems, Name Services, Time and Global States, Coordination and Agreement</td><td colspan="2">Textbooks
- Distributed Systems: Concepts and Design, 5th Edition by George Coulouris, Pearson India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
<tr><td>CSE 4085</td><td>Cloud Computing</td><td>4</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Introduction, Fundamentals of cloud computing, cloud computing mechanisms, cloud computing architecture, working with clouds</td><td colspan="2">Textbooks
- Cloud Computing: Concepts, Technology & Architecture, 1e by Erl, Pearson India</td></tr>
<tr><td colspan="2">Course Format: 3 Classes/Week, 1 hr/Class; 1 labs/Week, 2 hrs/Lab = 4 Credits</td></tr>
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