Mathematics and Statistics Courses during Undergraduate Studies:

MATH C191 - Mathematics I Advanced Calculus	Functions and graphs; limit and continuity; applications of derivative and integral. Conics; polar coordinates; convergence of sequences and series. Maclaurin and Taylor series. Partial derivatives. Vector calculus in R^n ; vector analysis; theorems of Green, Gauss and Stokes.
MATH C192 – Mathematics II Complex Variables and Linear Algebra	Differential Equations Complex numbers, analytic functions, Cauchy's theorems; elementary functions; series expansions; calculus of residues and applications. Vector space; basis and dimension; linear transformation; range and kernel of a linear transformation; row reduction method and its application to linear system of equations.
MATH C241 Mathematics III Differential Equations	Eigen-values and eigen-vectors. Inner product space and orthonormal bases. Elementary differential equations, Hypergeometric equations, Lengendre polynomials, Bessel functions; Fourier series; Sturm-Liouville problem, series solution for differential equation, systems of first order equations; Laplace transformation and application to differential equations; one dimensional wave equation, one dimensional heat equation & Laplace equation in rectangular form
AAOC C111 – Probability and Statistics	Probability spaces; conditional probability and independence; random variables and probability distributions; marginal and conditional distributions; independent random variables; mathematical expectation; mean and variance; binomial, Poisson and normal distributions; sum of independent random variables; law of large numbers; central limit theorem (without proof); sampling distribution and test for mean using normal and student's t-distribution; test of hypothesis; correlation and linear regression.
AAOC C222- Optimisation	Introduction to optimization; linear programming; simplex methods; duality and sensitivity analysis; transportation model and its variants; integer linear programming nonlinear programming; multi-objective optimization; evolutionary computation techniques.
AAOC C321- Control Systems	Mathematical models of physical systems, feedback characteristics of control systems, control system components, time response analysis, stability, frequency response, state space analysis, compensation.
AAOC C31- Operations Research	Introduction to operations research; dynamic programming; network models - including CPM and PERT; probability distributions; inventory models; queuing systems; decision making- under certainty, risk, and uncertainty; game theory; simulation techniques, systems reliability.
AAOC C341- Numerical Analysis	Solution of non-linear algebraic equation; interpolation and approximation; numerical differentiation and quadrature; solution of ordinary differential equations; systems of linear equations; matrix inversion; eigenvalue and eigenvector problems; round off and conditioning.

Computer Science Courses during Undergraduate Studies:

TA C162- Computer Programming I	Introduction to computers: building blocks of computers, I/O devices, concept of auxiliary and main memory and memory devices; introduction to number systems and information representation inside computer; introduction to UNIX; problem analysis, solution design and program coding using structured programming language.
TA C252- Computer Programming II	Shell programming in Unix; use of advanced filters and other tools like sed and awk; system calls; advanced programming concepts: macro definition and usage, recursion and problem solving; concept of pointers, dynamic data structures using pointers, advanced usage of pointers; bit operations; handling command line arguments, dynamic memory allocation and management; file management; problem solving using simple data structures like stacks, queues, linked lists and binary trees. This course will focus on non-trivial VI-135 problem solving using the various programming tools available in Unix and the C programming language.
ES C263- Microprocessor Programming & Interfacing	Elements of digital electronics; PC organization; 80X86 as CPU: Instruction set register set, timing diagrams, modular assembly programming using procedures & macros, assembler, linker & loader concepts; concept of interrupts: hardware interrupts, software interrupts, BIOS and DOS interrupts; disk organization: boot sector, boot partition, root directory & FAT; memory interfacing & timing diagrams; I/O interfacing; programmable I/O devices such as 8255, 8253, 8259, etc.
BITS C372- Data Communications and Networks	Communication Concepts; Data and Voice Communications; Hardware Systems and Configurations; Network Topologies and Design Aspects; Protocols; Networking Software; Local Area Networks; Network Security and Management; Emerging Trends in Communications.
EEE C391- Digital Electronics and Computer Organization1	Introduction to computer organisation and architecture, speed considerations, memory organisation, I/O design, implementation issues. Number systems and machine representation, Boolean algebra, combinational and synchronous sequential circuits, logic minimisation, programmable logic devices, state table and state diagrams, digital integrated circuits, asynchronous circuits, arithmetic operations and algorithms. The course will also consist of laboratory practice.
BITS C342- Object Oriented Programming	Object orientation concepts & principles: abstraction, encapsulation, modularity, inheritance, and polymorphism; classes and objects; static and dynamic binding; class utilities; metaclasses; object oriented software engineering; programming and problem-solving using one or more of the popular object-oriented programming languages like C++ or Java.
AAOC C311- Data Processing	Introduction to Data Processing; Files and File Structures; Indexing Techniques; Sorting, Searching and Merging Techniques; Introduction to Database Management Systems; Design of Information Systems; Emerging trends in Data Processing.

Computer Science Courses and Specialisations certifications - MOOCS

Introduction to Discrete Mathematics for Computer Science (Coursera) by UCSD Prof. Alexander S. Kulikov, Ph.D., Associate Prof. Vladimir Podolskii, Ph.D., University of California, San Diego Mr. Michael Levin, Higher School of Economics	○ Mathematical Thinking in Computer Science ○ Combinatorics and Probability ○ Introduction to Graph Theory ○ Number Theory and Cryptography ○ Delivery Problem view certificate
Data Structures and Algorithms (Coursera) by UCSD Prof. Daniel Kane, Ph.D., Prof. Alexander S. Kulikov, Ph.D., Prof. Neil Rhodes, Pavel Pevzner, Ph.D., University of California, San Diego, Mr. Michael Levin, Higher School of Economics	○ Algorithmic Toolbox ○ Data Structures ○ Algorithms on Graphs ○ Algorithms on Strings ○ Advanced Algorithms and Complexity ○ Genome Assembly Programming Challenge view certificate
Operating Systems (Saylor Academy)	○ Introduction to Operating Systems ○ Processes and Threads ○ Synchronization ○ CPU Scheduling ○ Deadlock ○ Memory Management ○ File System ○ Security ○ Networking view certificate
Deep Learning (Coursera) Adjunct Professor Andrew Ng Computer Science	○ Neural Networks and Deep Learning ○ Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization ○ Structuring Machine Learning Projects ○ Convolutional Neural Networks ○ Sequence Models view certificate
Artificial Intelligence Search Methods for Problem Solving (NPTEL) Professor Deepak Khemani, Ph.D., Department of Computer Science Engineering, IIT Madras	○ Introduction: Overview and Historical Perspective, Turing Test, Physical Symbol Systems and the scope of Symbolic AI, Agents. ○ State Space Search: Depth First Search, Breadth First Search, DFID ○ Heuristic Search: Best First Search, Hill Climbing, Beam Search, Traveling Salesman Problem, Tabu Search, Simulated Annealing ○ Population Based Search: Genetic Algorithms, Ant Colony Optimization ○ Branch & Bound, Algorithm A, Admissibility of A, Monotone Condition, IDA, RBFS, Pruning OPEN and CLOSED in A

	○ Problem Decomposition, Algorithm AO, Game Playing ○ Game Playing: Algorithms Minimax, AlphaBeta, SSS, Rule Based Expert Systems, Inference Engine, Rete Algorithm ○ Planning: Forward/Backward Search, Goal Stack Planning, Sussman's Anomaly, Plan Space Planning, Algorithm Graphplan View certificate
Deep Learning (NPTEL) Professor Mitesh Khapra, Ph.D., Department of Computer Science Engineering, IIT Madras	○ History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm ○ Multilayer Perceptrons(MLPs),Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Back propagation. ○ Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp. ○ Principal Component Analysis and its interpretations, Singular Value Decomposition ○ Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders ○ Regularization: Bias Variance Tradeo, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying ○ Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization. ○ Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. ○ Learning Vectorial Representations of Words ○ Recurrent Neural Networks, Backpropagation through time ○ Encoder Decoder Models, Attention Mechanism, Attention over images view certificate
Deep Learning -2 (NPTEL) Professor Mitesh Khapra, Ph.D., Department of Computer Science Engineering, IIT Madras	○ A brief introduction to Directed Graphical Models ○ A brief introduction to Markov Networks, Using joint distributions for classification and sampling, Latent variables ○ Restricted Boltzmann Machines, Unsupervised Learning, Motivation for Sampling, Markov Chains, Gibbs Sampling for training RBMs, Contrastive Divergence for training RBMs ○ Variational Autoencoders, Autoregressive models, GANs