

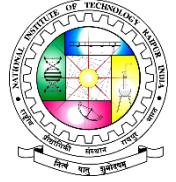
# DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

## Scheme (Fourth Year)

### Eighth Semester

S. No.	Subject Name	Course Title	Subject Name	L	T	P	Credits
1	CS1082XXCS	Program Elective	Elective – V	3	0	0	3
2	CS1082XXCS	Program Elective	Elective – VI	3	0	0	3
3	CS1083XXCS	Open Elective	Open Elective - IV	3	0	0	3
4	CS1083XXCS	Open Elective	Open Elective - V	3	0	0	3
		<b>Total Credits</b>					<b>12</b>

Program Elective-V & VI		Open Elective-IV & V	
Subject Code	Subject Name	Subject Code	Subject Name
CS108201CS	Software Project Management	CS108301CS	Cyber Laws and Rights
CS108202CS	Design Patterns	CS108302CS	Evolutionary Computing
CS108203CS	Real Time Systems	CS108303CS	Quantum Computing
CS108204CS	Graph Theory	CS108304CS	Intellectual Property Rights
CS108205CS	Reinforcement Learning	CS108305CS	Augmented Reality & Virtual Reality
CS108206CS	Advanced Database Management System	CS108306CS	Advanced AI and edge Computing



# Software Project Management

[8th Semester, Fourth Year]

## Course Description

<b>Offered by Department</b>	<b>Credits</b>	<b>Status</b>	<b>Code</b>
Software Project Management [Pre-requisites: Software Engineering]	3-0-0, (3)	EPR	CS108201CS

## Course Objectives

1. To understand basic project attributes such as size, effort, cost etc.
2. To learn the desirable responsibilities of a good project manager.
3. To measure length, volume, effort, time and cost of a project.
4. To schedule project activities using PERT and GANTT chart.
5. To handle various project risks and configuration management.

## Course Content

### Unit-1 Introduction And Software Project Planning:

Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process, Case Study based on real life problem or Prototype project.

### Unit-2 Project Organization And Scheduling:

Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts, Case Study based on real life problem or Prototype project.

### Unit-3 Project Monitoring, Control, Software Quality Assurance And Testing:

Dimensions of Project Monitoring & Control, Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review, Concept of Testing, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model (CMM), SQA, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Clean room process, Case Study based on real life problem or Prototype project.

### Unit-4 Project Management and Project Management Tools:

Software Configuration Management, Risk Management, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project, Case Study based on real life problem or Prototype project.

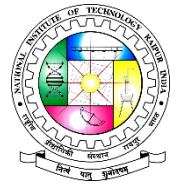
## Course Materials

### Required Text: Text books

1. Software Project Management by M. Cotterell, 6th Edition, McGraw Hill
2. Software Project Management by R. Walker, Pearson.
3. Software Project Management by S. A. Kelkar, McGraw Hill

### Optional Materials: Reference Books

1. Software Project Management by Manish Kumar Jha, Dhanpat Rai and Co.
2. Software Project Management by Er. Rajiv Chopra, 3rd Edition, Kartson Books.
3. Software Project Management by R.H. Thayer, IEEE CS Press.
4. Software engineering: A Practitioner's approach, McGraw Hill.



# Design Patterns

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Design Patterns

[Pre-requisites: Nil]

Credits

3-0-0, (3)

Status

EPR

Code

CS108202CS

## Course Objectives

1. To learn how to use a document editor.
2. To learn patterns to design software using standard protocols.
3. To learn how to use the Unified Modelling Language (UML) to represent patterns.

## Course Content

### Unit-1 Introduction:

Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

### Unit-2 A Case Study:

Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation.

### Unit-3 Design Pattern Catalog:

Creational Patterns, Structural Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.

### Unit-4 Behavioral Patterns:

Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, Class Diagram, Object Diagram, Interaction Diagram.

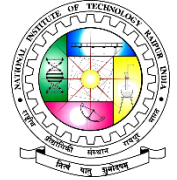
## Course Materials

### Required Text: Text books

1. Design Patterns, Elements of Reusable Object-Oriented Software, Erich Gamma, et. al., Addison-Wesley.
2. Implementation Patterns, Kent Beck, Addison-Wesley.
3. Refactoring to Patterns, Joshua Kerievsky, Addison-Wesley.

### Optional Materials: Reference Books

1. Patterns of Enterprise Application Architecture, Martin Fowler, Addison-Wesley.
2. Pattern-Oriented Software Architecture, Schmidt, et. al., Wiley.
3. Organizational Patterns of Agile Software Development, James Coplien and Neil Harrison, Prentice-Hall.



# Real Time Systems

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Real time systems

Credits

3-0-0, (3)

Status

EPR

Code

CS108203CS

[Pre-requisites:

1. OS,
2. C Programming and Computer Architecture]

## Course Objectives

1. To understand the basic concepts of Real-Time Systems, and its Applications
2. To understand the basic Design using a RTOS.
3. To analyze the Hardware, Software Integration of Embedded and Real Time system

## Course Content

### Unit-1 Fundamentals of Real-Time Systems:

Concepts and Misconceptions, Multidisciplinary Design Challenges, Birth and Evolution of Real-Time Systems Hardware for Real-Time Systems: Basic Processor Architecture, Memory Technologies, Architectural Advancements, Peripheral Interfacing, Distributed Real-Time Architectures.

### Unit-2 Real-Time Operating Systems:

From Pseudo kernels to Operating Systems, Theoretical Foundations of Scheduling, System Services for Application Programs, Memory Management Issues, Selecting Real-Time Operating Systems, Basics of Programming Languages for Real-Time Systems. Requirements Engineering for Real-Time Systems: Formal Methods in System Specification, Semi Formal Methods in System Specification, The Requirements Document, Basics of Real-time Software Design Approaches.

### Unit-3 Basic Design Using a Real-Time Operating System :

Principles, An Example - A System to Design Underground Tank Monitoring application, Encapsulating Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory Space, Saving Power, Fault Tolerance. Real-Time Performance Analysis: Applications of Queuing Theory, Input/output Performance, Analysis of Memory Requirements.

### Unit-4 Hardware/ Software Integration, Real Time Applications:

Goals of Real Time System Integration, Methodology, Embedded Real-time Software Development Tools: Cross-Compilers, Cross-Assemblers and Tool Chain, Locating Program Components, Getting Embedded Software into Target System.

## Course Materials

### Required Text: Text books

1. Real Time Systems Design and Analysis: Tools for the Practitioner, Fourth Edition by Phillip A. Laplante, Seppo J. Ovaska, EEE PRESS, WILEY, A John Wiley & Sons, Inc., Publication.
2. Real Time System by Jane W.S.Liu, Integre Technical Publishing Co., Inc.
3. An Embedded Software Premier, David E. Simon.
4. Synchronization in Real-Time Systems: A Priority Inheritance Approach: 151 (The Springer International Series in Engineering and Computer Science) by Ragnathan Rajkumar

### Optional Materials: Reference Books

1. Real-Time Systems: Theory and Practice by Rajib Mall, Prentice Hall Press.
2. Real-Time Systems Design Principles for Distributed Embedded Applications, by Kopetz, Hermann, Springer



# Graph Theory

[8th Semester, Fourth Year]

## Course Description

Offered by Department  
Graph Theory

Credits  
3-0-0, (3)

Status  
EPR

Code  
CS108204CS

[Pre-requisites: Nil]

## Course Objectives

1. Students will achieve command of the fundamental definitions and concepts of graph theory.
2. Students will understand and apply the core theorems and algorithms, generating examples as needed, and asking the next natural question.
3. Students will achieve proficiency in writing proofs, including those using basic graph theory proof techniques such as bijections, minimal counterexamples, and loaded induction.

## Course Content

### Unit-1 Fundamental concepts of graphs:

Basic definitions of graphs and multigraphs; adjacency matrices, isomorphism, girth, decompositions, independent sets and cliques, graph complements, vertex coloring, chromatic number, important graph like cubes and the Petersen graph b. Paths, cycles, and trails; Eulerian circuits, Vertex degrees and counting; large bipartite subgraphs, the handshake lemma, Havel-Hakimi Theorem d. Directed graphs: weak connectivity, connectivity, strong components, Induction and other fundamental proof techniques

### Unit-2 Trees & Matching and covering:

Basics: equivalent characterizations of trees, forests, Spanning trees and 2-switches, Distance and center, Optimization: Kruskal's Theorem and Dijkstra's Theorem, Bipartite matching, vertex cover, edge cover, independent set, M-alternating path, Hall's Theorem, König-Egervary Theorem, Gallai's Theorem.

### Unit-3 Connectivity & Network flow:

Vertex cuts, separating sets, bonds; vertex and edge connectivity, block-cutpoint tree, Menger's Theorem: undirected vertex and edge versions, Ford-Fulkerson Labeling algorithm, flow integrality, Max-flow/Min-cut Theorem, proof of Menger's Theorem

### Unit-4 Coloring & Planarity:

Chromatic number: lower bounds from clique number and maximum independent set, upper bounds from greedy coloring (& Welsh-Powell), Szekeres-Wilf, and Brooks' Theorem. Also k-critical graphs, cartesian product of graphs, and interval graphs, k-Chromatic graphs: Mycielski's construction, Turán's Theorem, Edge coloring, line graphs, Vizing's Theorem, Embeddings, dual graphs, Euler's formula, Kuratowski's Theorem, Coloring, including the 5-color theorem

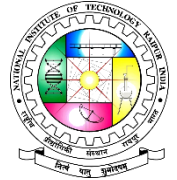
## Course Materials

### Required Text: Text books

1. Graphs and Applications: An Introductory Approach, J.M.Aldous R.J.Wilson
2. Applied Combinatorics, F.R.Roberts
3. Applied Combinatorics, A.Tucker
4. Graph Theory, R.Diestel

### Optional Materials: Reference Books

1. Graph Theory Applications, L.R.Foulds
2. Topics in Intersection Graph Theory, T.A.McKee F.R.McMorris
3. Graph Theory and Applications, Marshall
4. Bipartite Graphs and their Applications, A.S.Asratian, T.MJ Denley, R.Haggkvist



# Reinforcement Learning

[8<sup>th</sup> Semester, Fourth Year]

## Course Description

Offered by Department  
Reinforcement Learning

Credits  
3-0-0, (3)

Status  
EPR

Code  
CS108205CS

[Pre-requisites: Machine Learning]

## Course Objectives

1. To able to understand the logistics and correlation concepts.
2. To able to understand the Dynamic programming
3. To able to understand the application area of reinforcement learning.

## Course Content

### Unit-1 Introduction:

Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. Probability Primer Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.

### Unit-2 Markov Decision Process:

Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

### Unit-3 Prediction and Control by Dynamic Programming:

Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions. Monte Carlo Methods for Model Free Prediction and Control Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.

### Unit-4 Function Approximation Methods:

Function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, Eligibility trace for function approximation, After states, Control with function approximation, Least squares, Experience replay in deep Q-Networks. Policy Gradients Getting started with policy gradient methods, Log-derivative trick, Naive Reinforce algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.

## Course Materials

### Required Text: Text books

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition

### Optional Materials: Reference Books

1. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia
2. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy



# Advance Database Management System

[8th Semester, Fourth Year]

## Course Description

Offered by Department	Credits	Status	Code
Advanced Database Management System [Pre-requisites: DBMS]	3-0-0, (3)	EPR	CS108206CS

## Course Objectives

1. To evaluate emerging architectures for database management systems
2. To develop an understanding of the manner in which relational systems are implemented and the implications of the techniques of implementation for database performance
3. To assess the impact of emerging database standards on the facilities which future database management systems will provide.

## Course Content

### Unit-1 Introduction:

Advanced SQL programming, Query optimisation, Concurrency control and Transaction management, Database performance tuning, Distributed relational systems and Data Replication, Object oriented, deductive, spatial, temporal and constraint database management systems, New database applications and architectures: e.g. Native XML databases (NXD), Document orientated databases

### Unit-2 Introduction to MongoDB:

NoSQL Databases, CAP Theorem, Features of MongoDB, Installation overview, Documents, Collections, Databases, Starting and stopping MongoDB. Introduction to Mongo Shell: Basic commands in Mongo shell, Data Types in Mongo shell, Inserting and saving documents, Batch Insert, Insert Validation, Removing documents, Updating documents, Update top-level fields, Update an embedded field, Update multiple documents, Replace a document.

### Unit-3 Introduction to Redis:

What is Redis, Why Redis, Redis Data model and API introduction, Redis CLI, Redis Data Store, Redis Strings, Redis Lists, When to use Lists, Redis Lists commands, Implementing Queues with Lists, Redis Hash, When to use Hash, Redis Hash command, Implementing table rows with Hash, Redis Set, When to use Set, Redis Set Commands, Implementing Contact List with Set.

### Unit-4 SQL & Database Security:

SQL standards development, Standards for interoperability and integration e.g. Web Services 5.1 Database security - Data Encryption, redaction and masking techniques. Authentication and authorisation. Database auditing.

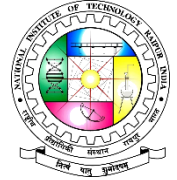
## Course Materials

### Required Text: Text books

1. Date C. J., An Introduction to Database Systems, Addison Wesley Longman (8th Ed).
2. Silberschatz A., Korth H., and Sudarshan S., Database System Concepts, McGraw-Hill (6th Ed).
3. Thomas M. Connolly, Carolyn Begg, Database Systems: practical approach to design, implementation, and management, Pearson Education Limited, (6th edition).
4. Redis in Action 1st Edition by Dr. Josiah L Carlson.
5. MongoDB Applied Design Patterns, O'Reilly Media, Inc. ISBN: 9781449340049

### Optional Materials: Reference Books

1. Melton, J., & Sim on A., SQL, Understanding Relational Language Components, Morgan-Kaufmann.
2. Peter Adams : SQL: The Ultimate Guide from Beginner to Expert - Learn and Master SQL in No Time, Addison Wesley.
3. Martin Kleppmann : Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems (1st Ed), O'Reilly.
4. Wilfried Lemahieu, Seppe vanden Broucke, Bart Baesens : Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data, Cambridge University press (1st Ed).
5. Redis: The Definitive Guide: Data modeling, caching, and messaging by Jay A. Kreibich



# Cyber Law & Rights

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Cyber Laws & Rights

Credits

3-0-0, (3)

Status

EPR

Code

CS108301CS

[Pre-requisites: Nil]

## Course Objectives

1. To learn the fundamentals of Cyber Law.
2. To understand the importance of IT act.
3. To learn types of cybercrimes and prevention measures.
4. To understand how to protect data from misuse.

## Course Content

### Unit-1 Concept of Cyberspace, Issues of Jurisdiction in Cyberspace:

Jurisdiction Principles under International law, Jurisdiction in different states, Position in India, Conflict of Laws in Cyberspace, and International Efforts for harmonization Privacy in Cyberspace.

### Unit-2 Information Technology Act, 2000:

Aims and Objects, Overview of the Act Jurisdiction, Electronic Commerce, Cyber Contract, Intellectual Property Rights and Cyber Laws UNCITRAL Model Law, Digital Signature and Digital Signature Certificates, E-Governance and Records.

### Unit-3 Cyber Crimes:

Meaning of Cyber Crime, Crime in Context of Internet, Types of Cyber Crime, Computing Damage in Internet Crime, Offences under IPC (Indian Penal Code, 1860), Offences & Penalties under IT Act 2000, IT Act Amendments, Investigation & adjudication issues, Digital Evidence.

### Unit-4 Cyber-crimes under International:

Hacking Child Pornography, Cyber Stalking, Denial of service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, and Phishing etc-Cyber Terrorism Violation of Privacy on Internet-Data Protection and Privacy.

## Course Materials

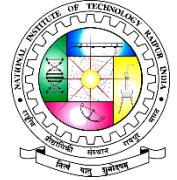
### Required Text: Text books

1. Chris Reed, Internet Law-Text and Materials, Cambridge University Press.
2. Justice Yatindra Singh: Cyber Laws, Universal Law Publishing Co., New Delhi
3. Farouq Ahmed, Cyber Law in India, New Era publications, New Delhi

### Optional Materials: Reference Books

1. Pawan Duggal, Cyber Law, The Indian perspective, Universal Law Publishing Co., New Delhi.
2. Vakul Sharma, Information Technology Law and Practice, Universal Law Publishing Co., New Delhi.





# Evolutionary Computing

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Evolutionary Computing

Credits

3-0-0, (3)

Status

EPR

Code

CS108302CS

[Pre-requisites: Nil]

## Course Objectives

1. To discuss the major approaches of evolutionary computing.
2. To develop solutions for problems using evolutionary approaches
3. To understand biological process that can be mimicked computationally.

## Course Content

### Unit-1 Introduction to Models and Concept of Computational Intelligence:

Social Behavior as Optimization- Discrete and Continuous Optimization Problems, Classification of Optimization Algorithms, Optimization background and terminology-Gradient optimization methods, sampling methods, linear programming, combinatorial optimization, Evolutionary Biology background-Genotype and phenotype, unit of selection, genes and traits, chromosomes, alleles, diploid and haploid, fitness, mutation and recombination, Selection, variation and landscapes, The strengths and weaknesses of the evolutionary model, Inductive bias, The No free lunch theorem.

### Unit-2 Genetic Algorithms & Selection Mechanism:

Representation, operators, and standard algorithm, Evolutionary strategies: Evolution in continuous variables, Transformations, Genetic Programming, Building blocks and architecture-altering operators, Libraries and Trees, Fitness proportionate, rank, tournament, Stochastic Universal Sampling and Boltzman selection methods, Niching methods, Spatial methods.

### Unit-3 Artificial landscapes and test functions & Co-evolution:

The Two armed bandit problem, Gene Expression Programming, Multi-modal and deceptive functions, Royal roads, N-k landscapes, Hierarchical and fractal functions, Pareto evolution, multiple populations and single-population co-evolution.

### Unit-4 Multi-objective evolutionary algorithms & Swarm Intelligence Techniques:

Plasticity and life-time learning, Lamarckian learning, The Baldwin effect, Symbiosis as a source of evolutionary innovation, Macro-mutations, Tabu Search-Tabu Tenure, Cycle Detection & Aspiration Criterion, Reactive Tabu Search. Particle Swarm Optimization, Ant Colony Optimization, Artificial Bees and Firefly Algorithm, Hybridization and Comparisons of Swarm Techniques, Application of Swarm Techniques in Different Domains and Real World Problems.

## Course Materials

### Required Text: Text books

1. An introduction to genetic algorithms by Melanie Mitchell, MIT Press.
2. Computational Intelligence: An Introduction by A.P. Engelbrecht, Wiley.

### Optional Materials: Reference Books

1. Genetic Algorithm in Search Optimization and Machine Learning by D. E. Goldberg, Pearson Education.



# Intellectual Property Rights

[8th Semester, Fourth Year]

## Course Description

### Offered by Department

Intellectual Property Rights

### Credits

3-0-0, (3)

### Status

EPR

### Code

CS108303CS

[Pre-requisites: Nil]

## Course Objectives

1. To give an idea about IPR, registration and its enforcement.
2. To understand their rights for the protection of their invention done in their project work.
3. To get registration in our country and foreign countries of their invention, designs and thesis or theory written by the students during their project work and for this they must have knowledge of patents, copyright, trademarks, designs and information Technology Act.
4. To understand the different types of IPR's.

## Course Content

### Unit-1 Intellectual Property A Strategic Tool:

Economic value of Intellectual Property, Motivation to IP Development, Institutions for Administering the IP System, IP Rights and Marketing Regulations: Introduction, IPR Protection, Clinical Research Regulations, IP Management Framework: Drivers of IP Management, Framework of IP Management, IP Strategies, IP Audits: Preparing for an Audit, Audit Related Issues.

### Unit-2 Intellectual Property :

Types of IPR, Indian IPR Scenario, Legal use of IP, Patents: History and Criteria for Patent, Types of Patent, Indian Patent Act, 1970, Trademarks: Types of Protectable Marks, Acquiring Property in Trademarks, Trademark – An Asset to Guard, Trademarks Act 1999, Copyrights: International Association, Copyright Act 1957, Rights of Copyright Owner.

### Unit-3 Legal Protection:

Trade Secrets, Industrial Designs, Geographical Indications, Semiconductor Integrated Circuit Layout Design, The Protection of Plant Varieties and Farmers Rights (PPVFR), Biodiversity and Traditional Knowledge.

### Unit-4 Digital Products and Law and Enforcement of IPRs:

Intellectual Property Exploitation and Risk Coverage: IPRs in CyberSpace, IPRs in Pharmaceutical Sector, Intellectual Property, Exploitation and Risk Coverage: Intellectual Property Licensing.

## Course Materials

### Required Text: Text books

1. Vinod V. Sople, Managing Intellectual Property, Prentice Hall of India pvt Ltd.
2. S. V. Satakar, Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi.

### Optional Materials: Reference Books

1. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition.
2. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd.



# Quantum Computing

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Quantum Computing

Credits

3-0-0, (3)

Status

EPR

Code

CS108304CS

[Pre-requisites: Discrete Structures]

## Course Objectives

1. The objective of this course is to provide the students an introduction to quantum computation. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

## Course Content

### Unit-1 Introduction To Quantum Computation:

Introduction to quantum computing, Quantum bits, Bloch sphere representation of a qubit, multiple qubits, Linear operators and spectral decomposition, Operator functions and tensor products, Hilbert spaces, Dirac's notation.

### Unit-2 Background Mathematics And Physics

Hilbert space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. **Quantum Circuits:** Single qubit gates, Multiple qubit gates, Design of quantum circuits.

### Unit-3 Quantum Information And Cryptography

Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, No cloning theorem. **Quantum Algorithms:** Classical computation on quantum computers, Relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.

### Unit-4 Noise And Error Correction

Graph states and codes, Quantum error correction, fault-tolerant computation.

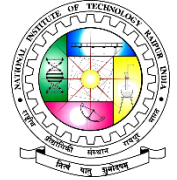
## Course Materials

### Required Text: Text books

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press., 2002.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific, 2004.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms, 2000.
4. Michael A. Nielsen and Isaac L. Chuang, Quantum computation and Quantum information, Cambridge University Press.

### Optional Materials: Reference Books

1. Elements of quantum computation and Quantum Communication, Anirban, 2013.
2. An Introduction to Quantum Computing, P Kaye, R Laflamme and M Mosca.
3. Classical and Quantum Computation, Kitaev, 2002.
4. Explorations in Quantum Computing, Williams, 2010.



# Augmented Reality & Virtual Reality

[8th Semester, Fourth Year]

## Course Description

### Offered by Department

Augmented Reality & Virtual Reality

[Pre-requisites: Nil]

### Credits

3-0-0, (3)

### Status

EPR

### Code

CS108305CS

## Course Objectives

1. This course provides students with an opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR & VR).
2. It also makes the students know the basic concept and framework of virtual reality.

## Course Content

### Unit-1 Introduction of Virtual Reality:

Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menu & 3D Scanner etc. Output -- Visual / Auditory / Haptic Devices.

### Unit-2 Visual Computation in Virtual Reality:

Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

### Unit-3 Interactive Techniques in Virtual Reality:

Body Track, Hand Gesture, 3D Manus, Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc. Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

### Unit-4 Augmented and Mixed Reality :

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

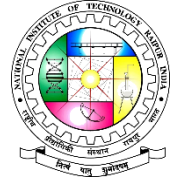
## Course Materials

### Required Text: Text books

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley -IEEE Press.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann.

### Optional Materials: Reference Books

1. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann.



# Advance AI and edge Computing

[8th Semester, Fourth Year]

## Course Description

Offered by Department

Advance AI and edge Computing

Credits

3-0-0, (3)

Status

EPR

Code

CS108306CS

[Pre-requisites: AI]

## Course Objectives

1. To cover modern paradigms of AI that goes beyond traditional learning.
2. To understand the Industrial IoT, embedded AI.

## Course Content

### Unit-1 Making decisions & Knowledge Representation :

Utility theory, utility functions, decision networks, sequential decision problems, Partially Observable MDPs, Game Theory, Ontological engineering, Situation Calculus, semantic networks, description logic.

### Unit-2 Planning:

Planning with state space search, Partial-Order Planning, Planning Graphs, Planning with Propositional Logic, hierarchical task network planning, non-deterministic domains, conditional planning, continuous planning, multi-agent planning.

### Unit-3 Deep Learning and advanced algorithm track:

Autoencoders, Natural Language Processing (NLP), Unsupervised Learning, Representation Learning, Generative Adversarial Networks, Bayesian approaches to machine learning and deep learning, GANs, Reinforcement Learning.

### Unit-4 Cloud and Edge Implementation track:

Machine Learning and Deep Learning implementation in the Google Cloud Platform, Machine Learning and Deep Learning implementation in the Azure platform, Machine Learning and Deep Learning implementation in the Amazon Web Services platform, Azure Sphere for deploying Machine Learning and Deep Learning implementation models on embedded devices, Time series development, Industrial IoT, Embedded AI (Intel, ARM platforms), Computer Vision, Predictive Maintenance with MATLAB & Simulink, Signal Processing for Deep Learning with MATLAB.

## Course Materials

### Required Text: Text books

1. S. Russel, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, 3rd Edition.
2. Gulli, Antonia, Kapoor, Amita, and Pal, Sujit, Deep Learning with TensorFlow 2 and Keras: Regression, ConvNets, GANs, RNNs, NLP, and more with TensorFlow 2 and the Keras API.

### Optional Materials: Reference Books

1. E. Rich, K. Knight, S. B. Nair, Artificial Intelligence, McGraw Hill Education, 3rd Edition.
2. R.S. Sutton, A.G. Barto, Reinforcement Learning: An Introduction, The MIT Press, 2nd Edition.
3. Osborne, Phil, and Singh, Kajal, Applications of Reinforcement Learning to Real-World Data: An educational introduction to the fundamentals of Reinforcement Learning with practical examples on real data.