3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	AM501	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	AM502	Database Management Systems	3	0	0	3	3
3	ENGG	Major	AM503	Computer Networks	3	0	0	3	3
4	ENGG	Major	AM504A	Compiler Design	3	0	0	3	3
			AM504B	Cryptography and Network Security					
			AM504C	Computer Graphics					
5	HUM	Minor	HU(AM)501	Economics for Engineers	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	AM591	Artificial Intelligence Lab	0	0	3	3	1.5
2	ENGG	Major	AM592	Database Management Systems Lab	0	0	3	3	1.5
3	ENGG	Major	AM593	Computer Networks Lab	0	0	3	3	1.5
4		Internship	AM581	Internship/Industrial Training	0	0	2	2	2
Total of Theory and Practical								25	20.5

SYLLABUS	
Semester – 5th	
Course Code	**AM501**
Course Name	**Artificial Intelligence**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objectives of this course are to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context.
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcome:

After successful completion of this course, students will be able to:

CO1	**Understand and explain** the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Model/Agent Design Framework within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.

CO5	**Implement** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

MODULE NUMBER	COURSE CONTENT
1	**Introduction to Artificial Intelligence [1L]** Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence
2	**Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [5L]** Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching. Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.
3	**Heuristic Techniques for Goal Searching [8L]** Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search. Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.
4	**Adversarial Search for Game Playing [2L]** Basic Concepts, Minimax Search, Alpha-Beta Pruning.
5	**Knowledge Representation and Inference using Propositional Logic and Predicate Logic[5L]** Propositional Logic: Knowledge Representation and Inference using Propositional Logic

	Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic
6	**Slot-and-Filler Structure for Knowledge Representation[2L]** Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames. Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.
7	**Reasoning under Uncertainty [5L]** Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model.
8	**Planning [5L]** Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm.
9	**Introduction to Natural Language Processing [1L]** Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.
10	**Introduction to Machine Learning [2L]** Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2				-	-	-	2	2	2	3

SYLLABUS	
Semester – 5th	
Course Code	**AM502**
Course Name	**Database Management Systems**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives:

1. To Understand and Describe the basic concepts and utility of Database management system, different data models of Database management system.
2. To Design an Entity Relationship (E-R) Diagram and relational model for any kind of real-life application and able to Apply relational algebra operations, SQL, Neo4j for solving query.
3. To Analyze and Create the relational database for any real-life applications based on normalization.
4. To Apply the query optimization techniques, different file organization techniques and determine whether the transaction satisfies the ACID properties.

Course Outcome:

After successful completion of this course, students will be able to:

CO1	To Understand and Describe the basic concepts and utility of Database management system, different data models of Database management system.
CO2	To Design an Entity Relationship (E-R) Diagram and relational model for any kind of real-life application and able to Apply relational algebra operations, SQL, Neo4j for solving query.
CO3	To Analyze and Create the relational database for any real-life applications based on normalization.
CO4	To Apply the query optimization techniques, different file organization techniques and determine whether the transaction satisfies the ACID properties.

CO5	**Explore** DBMS based ideas through **developing** software programs with adequate documentation in collaborative environment for successfully carrying out projects on DBMS Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

MODULE NUMBER	COURSE CONTENT
1	**Introduction [3L]** Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.
2	**Entity-Relationship and Relational Database Model [11L]** Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.
3	**Graph Based Model [4L]** Concept of graph-based model, difference between relational model and graph-based model, application, overview of Neo4j CQL.
4	**SQL and Integrity Constraints [6L]** Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.
5	**Relational Database Design [8L]** Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Case Study**.**
6	**Internals of RDBMS [8L]** Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.
7	**File Organization & Index Structures [3L]** File & Record Concepts, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes**.**

Textbook:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.

Reference Books:

1.“Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing.
2. Ramakrishnan: Database Management System, McGraw-Hill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2				-	-	-	2	2	2	3

SYLLABUS	
Semester – 5th	
Course Code	**AM503**
Course Name	**Computer Networks**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:

1. Familiarity and knowledge of Operating Systems and Computer Architecture.

2. Also require little bit programming languages concepts like C, Java.

Course Objectives:

The objectives of this course are to enable students to

1. To be familiar with the basics of data communication

2. To be familiar with various types of computer networks

3. To have experience in designing communication protocols

4. To be exposed to the TCP/IP protocol suite

Course Outcome:

After successful completion of this course, students will be able to:

CO1	Understand OSI and TCP/IP models
CO2	Analyze MAC layer protocols and LAN technologies.
CO3	Design applications using internet protocols.
CO4	Implement routing and congestion control algorithms.
CO5	Develop application layer protocols and understand socket programming.

MODULE NUMBER	COURSE CONTENT
1	Introduction [6L] Introduction (3L): Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network. Physical Layer: [3L] Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network.
2	Data Link Layer [10L] Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop- andWait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go- Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation. [5L] Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching. [5L]
3	Network Layer [10L] IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP– Delivery protocols Other Protocols such as mobile IP in wireless Network. [5L] Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing forMobile Hosts. [5L]
4	Transport layer: [6L] Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP: Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. [5L] Advanced topic such as Remote Procedure Call, Delay Tolerant Networks. [1L]
5	Application Layer [3L] Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls
6	Socket Programming [1L] Introduction to Socket Programming, UDP socket and TCP Socket.

Textbook:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH

2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI

3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education

4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Reference Books:

1. Kurose and Rose – "Computer Networking -A top-down approach featuring the internet" – Pearson Education 2. Leon, Garica,Widjaja – "Communication Networks" – TMH

3. Walrand – "Communication Networks" – TMH.

4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO1**	**PSO**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2				-	-	-	2	2	2	3

SYLLABUS	
Semester – 5th	
Course Code	**AM504A**
Course Name	**Compiler Design**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:

- Mathematics
- Concept of programming languages
- Data structures
- Computer architecture
- Formal languages and automata theory
- Some advanced math might be required if you adventure in code optimization

Course Objectives:

The objectives of this course are to enable students to

1. Make the student understand the process involved in a compiler.
2. Create an overall view of various types of translators, linkers, loaders, and phases of a compiler.
3. Understand the concepts of syntax analysis, various types of parsers especially the top down approach.
4. Create awareness among students the various types of bottom-up parsers,
5. Understand the syntax analysis and, intermediate code generation, type checking, the role of symbol table and its organization, Code generation, machine independent code optimization and instruction scheduling.

Course Outcome:

After successful completion of this course, students will be able to:

CO1	**I**llustrate the basic concept of compilers and discuss on the components as well as the strengths and weaknesses of various phases of designing a compiler.
CO2	Design and analyze algorithms for syntactic or parsing techniques and semantic analysis of the process of designing compilers.
CO3	Develop the parsers and experiment the knowledge of activation tree, activation record and dynamic storage allocation techniques

CO4	Construct the intermediate code representations and generation.
CO5	Apply for various optimization techniques for dataflow analysis.

MODULE NUMBER	COURSE CONTENT
1	**Module I [7L]** Compilers, Cousins of the Compiler, Analysis-synthesis model, The phases of the compiler. The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).
2	**Module II [10L]** The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR, Canonical LR), Parser generators (YACC), Error Recovery strategies for different parsing techniques. Syntax directed translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom-up evaluation of inherited attributes.
3	**Module III [7L]** Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Symbol tables, dynamic storage allocation techniques.
4	**Module IV [4L]** Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).
5	**Module V [8L]** Consideration for Optimization, scope of optimization, local optimization, loop optimization, folding, DAG representation, Flow Graph, Data flow equation, global optimization, redundant sub expression elimination, induction variable elimination, copy propagation, basic blocks & flow graphs, transformation of basic blocks, DAG representation of basic blocks, peephole optimization Object code forms, machine dependent code optimization, register allocation and assignment, generic code generation algorithms, DAG for register allocation.

Textbook:

1. Alfred Aho, V. Ravi Sethi, D. Jeffery Ullman, “Compilers Principles, Techniques and Tools”, Addison Wesley, 2nd edition
2. Holub Allen. Compiler Design in C, PHI, 1993.

Reference Books:

1. Chattopadhyay, Santanu. Compiler Design. PHI Learning Pvt. Ltd., 2005
2. Tremblay and Sorenson Compiler Writing-McGraw Hill International

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2
CO2	-	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	2	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	3	2	3	-	-	-	-	-	-	-	2	3	-
CO5	3	-	2	-	3	3	-	-	-	-	-	-	-	3	3

SYLLABUS	
Semester – 5th	
Course Code	**AM504B**
Course Name	**Cryptography and Network Security**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:

The student must have basic knowledge about Computer Network and mathematics.

Course Objectives:

1. To provide introduction to the concept of Network Security Model and Cryptography systems.
2. To give the knowledge of Digital Signature and other Security Measures available.
3. To familiarize with the various techniques like PGP and S/MIME.
4. To showcase IP Security Architecture & Transport Layer Security to identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks.
5. To explain the firewall design principles and various intrusion detection system.

Course Outcome:

After successful completion of this course, students will be able to:

CO1	Understand cryptography and network security concepts and application.
CO2	Apply security principles to system design.
CO3	Identify and investigate network security threat
CO4	Analyze and design network security protocols.
CO5	Develop ideas to Propose solutions to the problems of network security and Identify problems where students can Apply the concept appropriately and analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong.

MODULE NUMBER	COURSE CONTENT
1	[7L] Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security model[1L], Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques steganography) [3L] Finite Fields

	and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm[1L]
2	[9L] Data Encryption Standard- Block cipher principles, block cipher modes of operation[2L] Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm[3L] Public key cryptography: Principles of public key cryptosystems, The RSA algorithm[2L] Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography [2L]
3	[6L] Authentication requirement, Authentication function, MAC, Hash function [2L] Security of hash function and MAC, MD5, SHA, HMAC, CMAC [2L] Digital signature and authentication protocols, DSS, ElGamal, Schnorr [2L]
4	[7L] Authentication applications, Kerberos, X.509 [1L] Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles [1L] SET for E-Commerce Transactions [1L] Intruder, Intrusion detection system [1L] Virus and related threats, Countermeasures [1L] Trusted systems, Practical implementation of cryptography and security [2L]
5	[7L] E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source [1L] Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME [2L] IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP) [1L] Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding) [1L] Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication [1L] PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction [1L]

Textbook:

[1] Kahate, A. (2013). Cryptography and network security. Tata McGraw-Hill Education.

[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York, NY: Mc Graw Hill Education (India) Private Limited.

Reference Books:

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.

[2] Daras, N. J., & Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253- 287). Springer.

[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson Education India.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2
CO2	-	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	2	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	3	2	3	-	-	-	-	-	-	-	2	3	-
CO5	3	-	2	-	3	3	-	-	-	-	-	-	-	3	3

SYLLABUS	
Semester – 5th	
Course Code	**AM504C**
Course Name	**Computer Graphics**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:

Mathematics, Computer Fundamentals & Principle of Computer Programming.

Course Objectives:

1. The objectives of this course are to enable students to Use of the component so fa graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. Understand the basic principles of 2D and 3D computer graphics.
3. Understand of how to scan convert the basic geometrical primitives, how to transform the shapes to fit the master the picture definition.
4. Understand the mapping from a world co-ordinate to device co-ordinates, clipping, and projections.
5. Discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Course Outcome:
After successful completion of this course, students will be able to:

CO1	**Understand t**he fundamental concept of Computer graphics and mathematical knowledge and explain the foundations of computer graphics and different display technology and devices.
CO2	**Demonstrate** different scan conversion algorithms, drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms, clipping algorithms, surface removal algorithms using graphics tools.
CO3	**Understand** the basic concept of graphics programming and implement clipping with the comprehension of windows, view-port scene relation to images display on screen.
CO4	**Analyze** and compare different drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms hidden surface illumination methods.

CO5	**Develop** the concept of geometric models, mathematical and algorithmic approach necessary for programming computer graphics leading to lifelong learning.

MODULE NUMBER	COURSE CONTENT
1	**Introduction [4L]** Introduction: Objective, applications, GKS/PHIGS, normalized co-ordinate system, aspect ratio.
2	**Computer Graphics System [4L]** Graphics System: Vector and raster graphics, various graphics display devices, graphics interactive devices, segmented graphics, attribute table.
3	**Computer Graphics System [4L]** Raster Scan Graphics: Line drawing algorithms, circle/ellipse drawing algorithms, polygon filling algorithms.
4	**Geometric Transformation [4L]** Geometric Transformation: Homogeneous co-ordinate system, 2D and 3D transformations, projection— orthographic and perspective.
5	**Curves and Surfaces [4L]** Curves and Surfaces: Curve approximation and interpolation, Lagrange, Hermite, Bezier and B Spline curves/surfaces and their properties, curves and surface drawing algorithms.
6	**Curves and Surfaces 2 [4L]** Geometric modelling: 3D object representation and its criteria, edge/vertex list, constructive solid geometry, wire-frame model, generalized cylinder, finite element methods.
7	**Viewing and Clipping [4L]** Clipping: Window and viewport, 2D and 3D clipping algorithms.
8	**Hidden Surfaces [4L]** Hidden Lines and Hidden Surfaces: Concept of object- and image-space methods, lines and surface removal algorithms.
9	**Illumination and Color models [4L]** Intensify, Coloring and Rendering: RGB, YIQ, HLS and HSV models and their conversions, gamma correction, half toning. Illumination models, polygon mesh shading, transparency, shadow, texture.

Textbook:

1. D. Hearn and P. M. Baker: Computer Graphics, 2nd ed. Prentice Hall of India, New Delhi, 1997.
2. W. M. Newman and R. F. Sproull: Principles of Interactive Computer Graphics, McGraw Hill, New Delhi, 1979.

Reference Books:

1. F. S. Hill: Computer Graphics, McMillan, New York, 1990.
2. D. P. Mukherjee: Fundamentals of Computer Graphics and Multimedia, Prentice Hall of India, New Delhi, 1999.
3. J. D. Foley et al.: Computer Graphics, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
4. W. K. Giloi: Interactive Computer Graphics: Data Structure, Algorithms, Languages, Prentice Hall, Englewood Cliffs, 1978.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2
CO2	-	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	2	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	3	2	3	-	-	-	-	-	-	-	2	3	-
CO5	3	-	2	-	3	3	-	-	-	-	-	-	-	3	3

SYLLABUS	
Semester – 5th A. THEORY	
Course Code	**HU(AM)501**
Course Name	**Economics for Engineers**
Lecture [per week]	**2**
Tutorial [per week]	**0**
Contact Hours [per week]	**2**
Total Contact Hours	**24**
Credit	**2**
Pre-requisites: MATH – College Algebra, Pre-Calculus Algebra and Trigonometry.	
Course Outcome[s]: On completion of the course students will be able to	
CO1	Apply the appropriate engineering economics analysis method[s] for problem solving present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and drawing references for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned and make a quantitative decision between alternate facilities and/or systems.
CO4	Evaluate the profit of a firm, carry out the break-even analysis and employ this tool to make production decision.
CO5	Discuss and solve advanced economic engineering analysis problems including taxation and inflation.
MODULE NUMBER	**COURSE CONTENT**
1	**Introduction[3L]** Managerial Economics-Relationship with other disciplines-Firms: Types, Objectives and goals-Managerial Decisions-Decision Analysis
2	**Demand and Supply Analysis[5L]** Demand-Types of demand-determinants of demand-Demand function-Demand Elasticity-Demand forecasting-Supply-Determinants of supply-Supply function-Supply Elasticity.
3	**Cost Analysis[5 L]** Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis– PV ratio.
4	**Elementary economic Analysis [4 L]** Inflation-Meaning of inflation, types, causes, measures to control inflation. National Income-Definition, Concepts of national income, Method of measuring national income.

5	**Financial Accounting [5 L]** Concepts and Definition of Accounting, Journal, Ledger, Trial Balance. Trading A/C, Profit & amp; Loss A/C and Balance Sheet.
6	**Investment Decision[2L]** Time value of money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.

Textbooks:

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
2. Principles of Economics, Deviga Vengedasalam, Karunagaran Madhavan, Oxford University Press.

Reference Books:

1. Engineering Economy by William G. Sullivan, Elin M. Wicks, C. Patric Koelling, Pearson
2. R. Paneer Seelvan, "Engineering Economics", PHI
3. Ahuja, H. L., "Principles of Microeconomics", S. Chand & Company Ltd
4. Jhingan, M. L., "Macro Economic Theory"
5. Macro Economics by S. P Gupta, TMH
6. Haniff and Mukherjee, Modern Accounting, Vol-1, TMG
7. Modern Economic Theory – K.K. Dewett [S. Chand]

Reference Books:

1. Engineering Economy by William G. Sullivan, Elin M. Wicks, C. Patric Koelling, Pearson
2. R. Paneer Seelvan, "Engineering Economics", PHI
3. Ahuja, H.L., "Principles of Microeconomics", S. Chand & Company Ltd
4. Jhingan, M. L., "Macro Economic Theory"
5. Macro Economics by S.P. Gupta, TMH
6. Haniff and Mukherjee, Modern Accounting, Vol-1, TMG
7. Modern Economic Theory – K.K. Dewett [S. Chand]

CO-PO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	-	-	-	-	-	-	2	-
CO2	-	3	-	3	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	3	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	1	-

SYLLABUS	
Semester – 5th	
Course Code	**AM591**
Course Name	**Artificial Intelligence Lab**
Practical (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objectives of this course are to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies

Course Outcome:

After successful completion of this course, students will be able to:

CO1	**Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** its utilitarian importance in current technological context leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	**Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	**Develop** ideas and **propose an** expert system offering solutions to the challenging problems of Artificial Intelligence.

CO5	**Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.

MODULE NUMBER	COURSE CONTENT
1	**Introduction to PROLOG Programming along with the IDE and its Basic Components** Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy.
2	**Arithmetic, Boolean Expression, Decision Making Strategies** Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, and Decision-Making Strategies.
3	**Recursion and Looping through Recursion** Assignments for understanding implementation of Recursion and Looping through Recursion.
4	**List of Data Items in PROLOG** Assignments for understanding the utility of List in solving various problems.
5	**Blind Search Techniques – BFS, DFS** Implementation of BFS and DFS Algorithms for Goal Searching to solve Puzzles (8-Puzzle, Water Jug Puzzle)
6	**Heuristic Search Techniques – A* Search** Implementation of A* Search Algorithm for Goal Searching to solve Puzzles (8-Puzzle, Route Finding Puzzle)
7	**Constraint Satisfaction Problem Solving** Implementation of Backtracking Strategies to solve Constraint Satisfaction Problems (Graph Coloring Problem, 8-Queens Problem)
8	**Game Playing**

	Implementation of Adversarial Search Algorithm with alpha-beta pruning strategy for Game Playing (Tic-Tac-Toe)
9	**Discussion on Project Problems and Allocation (Problem Description Report Submission)**
10	**Designing Solution Model and Proposal Report Submission**
11	**Project Implementation, Verification and Documentation**
12	**Project Demonstration and Project Report Review**

Textbook:

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
3. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

CO–PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO1**	**PSO**	**PSO**	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2	2	2	3

SYLLABUS	
Semester – 5th	
Course Code	**AM592**
Course Name	**Database Management System Lab**
Practical (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome:
After successful completion of this course, students will be able to:

CO1	Demonstrate and explain the database management system and different database languages.
CO2	Understand and apply the SQL queries related to management of data and transaction processing for solving real life problems.
CO3	Explain and analyze query processing techniques involved in query optimization.
CO4	Demonstrate and apply the PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers for solving real life complex problems.
CO5	Design and assess the commercial database systems.

MODULE NUMBER	COURSE CONTENT
1	Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)

2	Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) and apply the normalization techniques.
3	Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables
4	Practicing DML commands- Insert, Select, Update, Delete
5	Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc., Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).
6	Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping, Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger.
7	Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure, PL/SQL, Cursors- Declaring Cursor, Opening Cursor, Fetching the data, closing the cursor.

CO-PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	2	-	-	-	-	-	-	3	3	2
CO2	3	3	3	3	3	1	1	-	-	-	1	1	3	3	3
CO3	3	3	3	3	3	2	1	-	-	1	1	1	2	3	2
CO4	3	3	3	3	3	2	1	-	-	1	1	-	3	3	3
CO5	3	3	3	3	3	2	1	1	-		2	1	3	3	3

SYLLABUS	
Semester – 5th	
Course Code	**AM593**
Course Name	**Computer Network Lab**
Practical (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites:

Knowledge of Computer Organization and Architecture, Operating System, C language/ JAVA are required.

Course Outcome:

1. To design and implement small size network and to understand various networking commands.
2. To provide the knowledge of various networking tools and their related concepts.
3. To understand various application layer protocols for its implementation in client/server environment 4. Understand the TCP/IP configuration for Windows and Linux
5. Learn the major software and hardware technologies used on computer networks

CO1	To design and implement small size network and to understand various networking commands.
CO2	To provide the knowledge of various networking tools and their related concepts.
CO3	To understand various application layer protocols for its implementation in client/server environment
CO4	Understand the TCP/IP configuration for Windows and Linux.
CO5	Apply the concepts of networking basics through programs with adequate documentation in collaborative environment for successfully carrying out projects on Problems of networking and investigate their effectiveness by analyzing the outputs using proper techniques and tools and assess the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

MODULE NUMBER	COURSE CONTENT
1	Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations.
2	Implementation of flow control mechanisms.
3	Socket Programming using TCP and UDP.
4	Implementing routing protocols such as RIP, OSPF.
5	Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, Tiny OS. Server Configuration: only web server
6	List of A Few Experiments as Sample Assignments 1. Implement the following forms of IPC. a) Pipes b) FIFO 2. Implement file transfer using Message Queue form of IPC. 3. Write a Program to create an integer variable using Shared Memory concept and increment the variable simultaneously by two processes. Use Semaphores to avoid Race conditions. 4. Design TCP iterative Client and Server application to reverse the given input sentence. 5. Design TCP concurrent Client and Server application to reverse the given input sentence. 6. Design TCP Client and Server application to transfer file. 7. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select". 8. Design a TCP concurrent Server to echo given set of sentences using Poll functions. 9. Design UDP Client and Server application to reverse the given input sentence. 10. Design UDP Client Server to transfer a file. 11. Design using Poll Client Server application to multiplex TCP and UDP requests for converting a given text into upper case. 12. Design RPC application to add and subtract a given pair of integers.
7.	Mini Project

Textbooks:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH

2. S. Tanenbaum – “Computer Networks (4th Ed.)” – Pearson Education/PHI
Recommended Books: 1. TCP sockets in C Programs-Practical guide for Programmers By Micheal J Donahoo and Kenneth Calvert. 2. Socket Programming by Rajkumar Buyaa.

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**P O9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	2	2	2	-	-	-	-	-	-	3	3	2
CO2	3	3	3	3	3	1	1	-	-	-	1	1	3	3	3
CO3	3	3	3	3	3	2	1	-	-	1	1	1	2	3	2
CO4	3	3	3	3	3	2	1	-	-	1	1	-	3	3	3
CO5	3	3	3	3	3	2	1	1	-		2	1	3	3	3