Maulana Abul Kalam Azad University of Technology, WestBengal
(Formerly known as West Bengal University of Technology)
Syllabus of B.Tech in Electronics and Computer Science
Effectivefromacademicsession2023-2024

Semester - V

Artificial Intelligence
Contact Hours: 3L/week
Credit Points: 3

Course Code: PC-ECS501	**Category: Program core**
Course Name: Artificial Intelligence	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 38	
Pre-Requisite: Basic knowledge of linear algebra, probability, statistics, calculus, Python programming, data structures, and discrete mathematics	

Objectives:

1. To introduce the fundamental concepts and techniques of Artificial Intelligence, including intelligent agents, search strategies, and problem-solving approaches.
2. To enable students to apply AI techniques such as heuristic search, knowledge representation, and machine learning to solve real-world problems.

Module No.	Description of Topics	Contact Hrs.
1.	Overview – Overview of AI, Turing Test, Problems of AI, Intelligent Agent, Environment and Types of agents. State Space search problem, Production Systems explanation using standard problems like water-jug, wolf-goat-cabbage, missionary cannibals, 8-puzzle etc.	6
2.	Search Techniques – BFS, DFS, Iterative deepening and broadening, bidirectional and Comparisons among the techniques. Heuristics based searches, Greedy, Uniform Cost and A* techniques.	6
3.	Hill Climbing, AND-OR search, Constraint Satisfaction Problems. Adversarial Search- Min-max search and alpha-beta pruning	6

4.	Knowledge Representation – Propositional Logic and proof by contradiction, FOPL, Resolution, Unification Algorithm Basic Knowledge of Programming in Prolog and Python.	6
5.	Probabilistic Reasoning – Bayesian Learning, Belief Network, Fuzzy Logic and Sets, NLP, Expert Systems	6
6.	Machine Learning – Types of learning (Supervised, Unsupervised, Reinforcement), Classification Model and Learning Steps, Common Classification Algorithms (kNN, Decision Tree, Random Forest, SVM)	8

Course Outcomes:

After completion of this course, students will be able to

1. Explain the basic concepts of AI and analyze different types of agents and environments.
2. Apply various search algorithms like BFS, DFS, and A* to solve state-space problems.
3. Implement adversarial and constraint satisfaction problem-solving strategies in AI.
4. Demonstrate knowledge representation using propositional and first-order predicate logic, and
   apply resolution techniques.
5. Analyze and apply probabilistic reasoning and machine learning techniques for classification and
   decision-making

Text/References:

1. Artificial Intelligence, Ritch and Knight, TMH
2. Artificial Intelligence, Beyond Classical AI, Pearson
3. Artificial Intelligence, Nils J. Nilsson.
4. A Classical Approach to Artificial Intelligence, M.C. Trivedi, Khanna Publishing House
5. Machine Learning, Saikat Dutta, Subramanian Chandramouli, Amit Kumar Das, Pearson.
6. Fundamental of Artificial intelliengence, K.R. Chowdhary, Springer

Computer Networks
Contact Hours: 3L/week
Credit Points: 3

Course Code: PC-ECS502	**Category: Program Core**
Course Name: Computer Networks	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 38	
Pre-Requisite: Knowledge of discrete mathematics, computer organization and architecture, and digital electronics.	

Objectives:

1. To introduce the basic concepts and components of data communication and computer networking.
2. To develop an understanding of layered network architecture and its protocols, with a
   focus on OSI and TCP/IP models.
3. To analyze the functioning of key networking layers, including data link, network,
   transport, and application layers.
4. To expose students to modern networking technologies, addressing methods, routing techniques, and security concepts in networks.

Module No.	Description of Topics	Contact Hrs
1	**Data communication Components:** Representation of data, direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Protocols and Standards, Reference models: OSI reference model, TCP/IP reference model, their comparative study.	5
2	**Physical Level:** Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus.	5
3	**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control	8

	protocols – Stop and Wait, Go back – NARQ, Selective Repeat ARQ, Sliding Window, Piggybacking. Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA	
4	**Network Layer:** Switching, Addressing : IP addressing, subnetting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, RARP, ICMP, IGMP, IPV4, IPV6;.	8
5	**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	6
6	**Application Layer:** Introduction to Domain Name Space (DNS), File Transfer Protocol (FTP), WWW, HTTP, SNMP, Security: Basic concepts of Cryptography, Firewalls, Introduction to Bluetooth.	6

Textbook and Reference books:

1. Data Communications & Networking – 5th Edition- B A Forouzan- Tata McGraw-Hill.
2. Data and Computer Communications- Eighth Edition- William Stallings- Pearson Education.
3. Computer Networks- 4th Edition- Andrew S Tanenbaum- Pearson-Prentice Hall
4. Data Communications and Networks- 2nd edition -Achyut S Godbole- and Atul Kahate-Tata McGraw-Hill

Course Outcomes:

After completion of this course, students will be able to

1. Describe the basic principles of data communication, network structures, transmission types, and the role of reference models in network design.
2. Explain various physical transmission methods, switching mechanisms, and transmission media used in network communication.
3. Apply and evaluate error detection and correction techniques and access protocols used in the Data Link Layer.
4. Analyze IP addressing schemes, routing algorithms, and important network layer protocols like ARP, ICMP, and BGP.
5. Illustrate transport and application layer functionalities, including TCP/UDP protocols, congestion control, DNS, FTP, and basic cryptography concepts.

Special Remarks:

The outcomes mentioned above are not limited. Institutes may redefine outcomes based on their program educational objective.

Database Management System
Contact Hours: 3L/week
Credit Points: 3

Course Code: PC-ECS503	**Category: Program core**
Course Name: Database Management System	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 38	
Pre-Requisite: Knowledge of data structures, computer organization, discrete mathematics, and programming fundamentals	

Objectives:

1. To introduce the fundamental concepts of database systems, including architecture, data models, and data independence.
2. To develop the ability to model real-world scenarios using Entity-Relationship (ER) models and translate them into relational schemas.
3. To equip students with the knowledge of SQL for data definition, manipulation, and query processing.
4. To provide understanding of database design principles, normalization, transaction management, and concepts of concurrency and recovery.

Module No.	**Description of Topics**	**Contact Hrs.**
1.	Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.	4
2.	Entity-Relationship Model : Basic concepts, Design Issues, Mapping Constraints, Keys, Entity Relationship Diagram, Weak Entity Sets, Extended E-R features.	4
3.	Relational Model: Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of	5

	the Database.	
4.	SQL and Integrity Constraints: 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.	6
5.	Relational Database Design: 8 9 Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF	6
6.	Internals of RDBMS 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.	7
7.	File Organization & Index Structures: File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .	6

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

1. Explain the basic concepts, architecture, and various data models used in database systems.
2. Design an Entity-Relationship model for a given application and convert it into a relational schema.
3. Write and optimize queries using Structured Query Language (SQL) for data manipulation and retrieval.
4. Apply normalization techniques to improve the design of relational schemas and ensure data integrity.
5. Describe and analyze transaction management, concurrency control, and recovery mechanisms in DBMS.

Text/References:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S.
   Sudarshan, McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer
   Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson
   Education
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu,
   Addison-Wesley

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Course Code: PE-ECS501A	**Category: Professional Elective-I**
Course Name: Design and Analysis of Algorithms	**Semester: 5**
L-T-P : 3-0-0	**Credit: 3**
Total Lectures: 35	
Prerequisites: A basic knowledge of programming fundamentals, data structures, and discrete mathematics. Familiarity with basic algorithms and their analysis.	

Course Objectives:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

Syllabus:

Module No.	Description of Topics	Contact Hrs.
1	**Introduction:** Fundamentals of Algorithms, Important Problem Types, Analysis of algorithm efficiency. Analysis Framework: Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of recursive Algorithms through recurrence relation.	**8**
2	**Fundamental Algorithmic Strategies:** Brute force Techniques, Divide and Conquer, Decrease and Conquer: Insertion Sort, Space and Time tradeoffs: Input Enhancement in String Matching. Dynamic Programming: The 0/1 Knapsack Problem, Matrix Chain Multiplication Problem, Greedy Techniques: Huffman Trees, The Fractional Knapsack Problem. Backtracking: n–Queens problem, Hamiltonian Circuit Problem, Subset–Sum Problem. Branch and Bound: Assignment Problem, Knapsack Problem, TSP	**10**
3	**Graph and Tree Algorithms:** Depth First Search, Breadth First Search, Topological Sorting. Transform and Conquer: Presorting, BST, Heapsort. Warshall's and Floyd's Algorithms, Greedy Techniques : Prim's, Kruskal's and Dijkstra's Algorithm, Bellman Ford Algorithm	**8**
4	**Tractable and Intractable Problems:** Coping with limitations of algorithmic power, P, NP and NP-complete Problems, Cook's theorem, Reduction Techniques.	**5**

5	**Advanced Topics:** Approximation algorithms, Randomized algorithms.	**4**

Course Outcome:

After this course, students will be able to

1. Define various time and space complexity classes of various algorithms.
2. Determine algorithmic design paradigms such as divide-and-conquer, dynamic-
3. programming, greedy, backtracking, etc.
4. Incorporate appropriate data structures like tree, graphs to model engineering problems.
5. Apply different performance analysis methods for non-deterministic algorithms.
6. Understand various classes of advanced algorithms.

Text Book, Reference Book, and Special Resources:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, (3e), Pearson Education, 2011
2. Ellis Horowitz and SartajSahni, Computer Algorithms/C++, (2e), University Press, 2007.
3. Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein, Introduction to Algorithms, (2e), PHI, 2006
4. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

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Sensors and Transducers
Contact Hours: 3L/week
Credit Points: 3

Course Code: PE-ECS501 B	**Category: Professional Elective-I**
Course Name: Sensors and Transducers	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 45	
Pre-Requisite: Knowledge of elementary physics and mathematics, basic Electrical Engineering	

Objectives:

1. Introduce various types of sensors and transducers used in engineering applications.
2. Explain the working principles and functional characteristics of different sensing elements.
3. Explore the role of sensors in measurement and instrumentation systems.
4. Discuss the general concepts and performance characteristics of measurement systems.
5. Enable learners to understand the relevance of sensors and transducers in real-world instrumentation contexts.

Module No.	Description of Topics	Contact Hrs
1	General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Definition, principles of sensing and transduction, classification.	9
2	**Resistive transducers:** Potentiometers: theory, types, materials, specifications, error in measurements. **Strain Gauges:** theory, types, materials, design consideration, sensitivity, gauge factor, rosettes, applications-force, velocity and torque measurements. **Resistance Temperature detector:** review of materials, construction, types; measuring circuits, ranges. **Thermistor:** materials, types, constructions, ranges. **Thermocouple** – thermoelectric laws, types, working principle,	10

	thermopile, series and parallel configuration of thermocouples, cold junction compensation. **Pyrometer** (total radiation and optical types)	
3	**Capacitive sensors:** Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities; proximity measurement Stretched Diaphragm type microphones, response characteristics	8
4	**Inductive transducers:** Transformer type, eddy current transducers, **LVDT:** Construction, materials, output-input relationship, I/O curve, discussion **Optical Sensors:** LDR, Photo Diode, Stroboscope, IR Sensor. Ultrasonic sensors: working principle, industrial applications	9
5	**Magnetic sensors:** Sensors based on the Villari effect for assessment of force, torque, and rpm meters **Tachometers** – Stroboscopes, Encoders **Seismic accelerometer:** Measurement of vibration. **Ionization sensors:** construction and working principle of Geiger counters, Scintillation detectors; Introduction to Radiation sensors.	9

Course Outcomes:

After the completion of the course, the students will be able to:

1. Acquire knowledge of mechanical, electromechanical, thermal, and magnetic sensors.
2. Explain the working principles of mechanical, electromechanical, thermal, and magnetic sensors.
3. Classify sensors based on the type of measurands, such as strain, force, pressure, displacement, temperature, flow, etc.
4. Use the sensors in various applications.

Text/References:

1. D. V. S. Murty, Transducer and instrumentation, PHI, second edition, 2008.
2. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York
3. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta.
4. S. Renganathan, Transducer engineering, Allied Publishers Limited, 2003.
5. D Patranabis, Sensors and Transducers, PHI, 2nd ed.

Embedded Systems
Contact Hours: 3L/week
Credit Points: 3

Course Code: PE-ECS501C	**Category: Professional Elective-I**
Course Name: Embedded Systems	**Semester: 5**
L-T-P: 3-0-0	**Credit:3**
Total Lectures: 45	
Pre-Requisite: Knowledge of digital electronics, computer architecture, microprocessors and microcontrollers, C/Python programming	

Objectives:

1. To know the basic working of a microcontroller system and its programming in Embedded C and Python language.
2. To provide experience to integrate hardware and software for Embedded applications Systems.

Module No.	Description of Topics	Contact Hrs.
1	Introduction to Embedded System: Embedded system VS General computing systems, Purpose of Embedded systems, Design challenge – optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller, Hardware architecture of the real time systems. A/D converter and D/A Converter, RISC vs CISC, Example of Embedded system.	**7**
2	Introduction to AVR microcontroller: Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register , Port Registers (PORTx), PWM registers (8-bit), ADC registers, basics of communication, overview and interfacing I/O devices with I2C Bus, UART and Serial Peripheral Interchange (SPI) bus, Programming Embedded Systems with AVR (Arduino API).	**10**
3	Introduction to ARM microcontroller: Architecture of ARM Embedded microcontroller, ARM instruction set, Introduction to ARMv8-A based embedded development board (i.e. Raspberry Pi rev.4), Programming a Raspberry Pi rev.4 using Python 2.7, User defined LED blink using Raspberry Pi GPIOs, communication between an Arduino UNO rev.3 with Raspberry Pi 4 over USB serial.	**10**

4	Embedded operating systems : Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling; task communication: shared memory, message passing, remote procedure call and sockets, task synchronization: task communication/synchronization issues, task synchronization techniques, device drivers, how to choose an RTOS.	**10**
5	CASE Studies: i) Interfacing with Temperature Sensor (AVR microcontroller and ARM microcontroller-based). ii) Interfacing with Servo Motor (AVR microcontroller and ARM microcontroller-based). iii) Interfacing with Gas Sensor (AVR microcontroller and ARM microcontroller-based). iv)Interfacing with LDR light sensor (AVR microcontroller and ARM microcontroller-based).	**8**

Text Book, Reference Book, and Special Resources:

1. Raj Kamal, Embedded systems- Architecture, Programming and Design, McGraw Hill Education (India) Pvt. Ltd.

2. Dhananjay Gadre, "Programming and Customizing the AVR Microcontroller"; McGraw Hill Education, 2014.

3. Elliot Williams, "AVR Programming: Learning to Write Software for Hardware", Maker Media, Incorporated, 2014

4. An Embedded Software Primer – David E. Simon, Pearson Ed., 2005.

Course Outcome:
After this course, student will be able to

1. Explain the definitions, components and requirements of the Embedded System. (BT LEVEL-1)
2. Describe the processor, architecture and memory organization of the Embedded System. (BTLEVEL-2)
3. Develop the interfacing and communication techniques of the Embedded System. (BT LEVEL-3)
4. Explain the basic concept of RTOS. (BT LEVEL-4)
5. Develop algorithms for real time applications of Embedded System. (BT LEVEL-6)

Control System Engineering
Contact Hours: 3L/week
Credit Points: 3

Course Code: PE-ECS502A	**Category: Professional Elective-II**
Course Name: Control System Engineering	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 44	
Pre-Requisite: Knowledge of differential equations, Laplace transforms, linear algebra, and basic electrical circuits.	

Objectives:

1. To learn how to use transfer functions to study real-world systems and understand different control system parts.
2. To gain knowledge about how systems behave over time and how to measure steady-state errors.
3. To understand how to find and compare frequency responses in both open-loop and closed-loop systems.
4. To learn how to represent systems using state variables.
5. To study how to check if a system is stable and how to design compensators to improve system performance.

Module No.	Description of Topics	Contact Hrs
1	**Introduction:** Define the Control system with examples. Meaning of reference input, Control input, disturbance input and controlled output. Define Linear Time variant system. Modeling problem for linear time invariant system. Impulse response and convolution integral for LTI system.	4
2	**Modeling:** Transfer function modeling of systems: Input output relation in Laplace domain and Transfer function; Block Diagram reduction, signal flow graph, Mason's Gain theorem . Representation of system and reduction to their transfer function. Modeling of some physical system--- Electrical circuit, Mechanical motors, thermal (room temperature), pneumatic etc. Concepts of States, State space modeling, Solution of state equations, State space to transfer function, transfer function to state space (realization problem). Examples of state space modeling---- Coupled tank system, inverted pendulum, biological system etc.	8
3	**Feedback Characterization:** Advantages of feedback. Sensitivity, Reduction of parameter variation by use of feedback, Regenerative feedback, Effect of disturbance signal on feedback system. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and ACtacho-generators. Actuators. Block diagram level description of feedback control systems for positioncontrol, speed control of DC motors, temperature control, liquid level control, voltage control of anAlternator.	6
4	**Time domain analysis:** Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. **Error Analysis:** Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	8

5	**Stability Analysis:** Root locus techniques, construction of Root Loci for simple systems. Effects ofgain on the movement of Pole and Zeros. **Frequency Domain Analysis:** Bode plots, Polar plots, Nichols chart, Concept ofresonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase andgain margin. Determination of margins in Bode plot.	10
6	**Controller Design problem:** PID Control. Frequency domain Loop shaping approach: Lead, Lag, Lag-lead compensator. Model matching approach: Two degree of freedom controller. State feedback approach: Controllability, Observability, Pole placement, State Observer.	8

Course Outcome: After this course student will be able to

1. Remember the fundamental concepts of control systems including feedback, stability, and time/frequency response.
2. Analysis the modelling of different physical systems like electrical, mechanical, thermal, pneumatic using transfer functions and state-space methods.
3. Analyze the time and frequency domain responses of first- and second-order system.
4. Analysis the different classical controllers (PID, lead, lag, lag-lead) for analysis of system performance and stability.
5. Apply state-space methods, pole placement to advanced control problems.

Text/References:

1. Automatic Control System: Basic analysis and design by William A. Wolovich, The Oxford
Series in Electrical and Computer Engineering.
2. B. C. Kuo, “Automatic Control System”, 10th Mc Graw Hill.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 5th edition.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009
5. Control Systems Engineering, 6th edition, ISV (WSE), by Norman Nise, Wiley
6. Control Systems, Ambikapathy, Khanna Publishing House, 2018. 7. Control Systems, N K Sinha,
New Age International Pvt, 2013.

Solid State Devices
Contact Hours: 3L/week
Credit Points: 3

Course Code: PE-ECS502B	**Category: Professional Elective-II**
Course Name: Solid State Devices	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 36	
Pre-Requisite: Knowledge of semiconductor physics, basic quantum mechanics, electronic circuit theory, and carrier transport phenomena.	

Objectives:

1. To introduce the basic concepts of energy bands, charge carriers, and classification of materials as conductors, semiconductors, and insulators.
2. To develop an understanding of carrier transport mechanisms such as drift, diffusion, and Hall effect in semiconductors.
3. To provide knowledge of the working principles and characteristics of PN junctions, BJTs, and their applications in electronic circuits.
4. To explain the structure and functioning of MOS capacitors and MOSFETs, including threshold behavior and current-voltage characteristics.
5. To familiarize students with short-channel effects, scaling laws, and modeling approaches in modern semiconductor devices.

Module No.	Description of Topics	Contact Hrs
1.	Energy bands in solids, Metals, Semiconductors & insulators, Direct and indirect band gap semiconductors, charge carriers in SCs electrons & holes, effective mass, intrinsic & extrinsic material, carrier conc. Fermi level, electron & hole conc. at equilibrium, temperature dependence if carrier conc. Conductivity & mobility, drift & resistance, Hall effect	8

2.	Diffusion of carriers, built in fields, Equilibrium conditions, the contact potential, forward and reverse biased junctions, steady state conditions, reverse break down, transient & AC condition. Time variation of stored charge, reverse recovery metal- Semiconductor junction. Fundamentals of BJT operation, amplification with BJT's, Minority carrier distribution & terminal currents, coupled diode model, charge control analysis, switching, specification for switching transistors, HF & hetro-junction BJTs.	12
3.	Equilibrium in Electronic System, Idealized Metal-semiconductor junction, Current-voltage characteristics, Non rectifying contacts, Surface effects, MOS structure, Capacitance of MOS system, MOS Electronics, Oxide of Interface charges, flat-band and threshold voltages, Basic MOSFET behaviour, I-V characteristics, transconductance, bulk and surface mobility of carriers, body effect, Improved Models for short channel MOSFETs	8
4.	Small dimension effect in MOSFET, Scaling laws, MOSFET modeling, Gate coupling, velocity overshoot, high field effects, substrate current, Hot carrier effects, Gate current, Device degradation, Structure that reduce the drain field. Numerical simulation, Basic concept of simulation, Grids, Device simulation, simulation challenges	8

Course Outcomes:

1. Recall the fundamental properties of materials based on energy band theory, including conductors, semiconductors, and insulators. **(BT Level -1)**
2. Explain the behavior of charge carriers in semiconductors and their influence on conductivity and mobility. **(BT Level -2)**
3. Describe the operation of pn junctions under different biasing conditions and their current-voltage characteristics. **(BT Level -2)**
4. Apply the basic principles of BJT and MOSFET operation in understanding amplification and switching behavior. **(BT Level -3)**
5. Illustrate the effect of scaling and short-channel behavior on MOSFET characteristics using suitable models. **(BT Level -3)**

Text/References:

1. D. A. Neaman, Semiconductor Physics and Devices (Irwin, Boston, MA, 1997).
2. B. G. Streetman and S. Bannerjee, Solid State Electronic Devices (Prentice Hall,Englewood Cliffs, NJ, 2000).
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. 5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press,2011.

Theory of Computation
Contact Hours: 3L/week
Credit Points: 3

Course Code: PE-ECS502C	**Category: Professional Elective-II**
Course Name: Theory of Computation	**Semester: 5**
L-T-P: 3-0-0	**Credit: 3**
Total Lectures: 38	
Pre-Requisite: Knowledge of discrete mathematics, formal logic, set theory, and fundamental programming concepts.	

<u>Course Objective</u>

1. To introduce the fundamental concepts of formal languages, automata theory, and grammar classification.
2. To develop an understanding of deterministic and nondeterministic finite automata and their equivalence.
3. To explore the role of context-free grammars and pushdown automata in language recognition.
4. To familiarize students with Turing machines and their significance in recognizing computational problems.
5. To understand decidability, reducibility, and undecidable problems in the context of computation theory.

Module No.	Description of Topics	Contact Hrs
1	Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6

2	Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.	8
3	Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.	6
4	Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	6
5	The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.	6
6	Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.	6

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

1. Recall and explain basic concepts of alphabets, languages, grammars, and the Chomsky hierarchy.
2. Describe and analyze regular languages and their representations using finite automata and regular expressions.
3. Construct finite automata and context-free grammars for formal language representations.
4. Analyze and convert grammars to normal forms and evaluate language properties using pumping lemmas.
5. Identify and interpret problems of decidability and undecidability using Turing machines and formal proofs.

Text/References:

1. “Introduction to Automata Theory Language and Computation”, Hopcroft H.E. andUllman J. D., Pearson education.
2. “Introduction to the Theory of Computation”, Michael Sipser, 3rd Edition, Cengage India Private Limited
3. “Elements of Theory of Computation”, Lewis H.P. & Papadimitrou C.H. Pearson, PHI.
4. "Automata and Computability", Dexter C. Kozen, Springer

Industrial Management
Contact Hours: 3L/week
Credit Points: 3

Course Code: HM-HU501	Category: Humanities
Course Name: Industrial Management	Semester: 5
L-T-P: 3-0-0	Credit: 3
Total Lectures: 45	

Objectives:

1. To introduce fundamental concepts of management, organizational structures, and workplace dynamics.
2. To develop competence in project planning tools such as CPM and PERT for effective decision-making and scheduling.
3. To familiarize with materials management, inventory control techniques, and production planning strategies.
4. To expose value analysis, cost control methods, and recent industrial trends including ERP, JIT, and supply chain management.

Module No.	Description of Topics	Contact Hrs
1	**Introduction** System - concept, definition, types, parameters, variables, and behavior. Management – definition and functions. Organization structure: I. Definition. II. Goals. III. Factors considered in formulating structure. IV. Types. V. Advantages and disadvantages. VI. Applications. Concept, meaning and importance of division of labor, scalar & functional processes, span of control, delegation of authority, centralization and decentralization in industrial management. Organizational culture and climate – meaning, differences and factors affecting them. Moral-factors affecting moral. Relationship between moral and productivity. Job satisfaction- factors influencing job satisfaction. Important provisions of factory act and labor laws	**8**
2	**Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT):**	**10**

	CPM & PERT-meaning, features, difference, applications. 2.2 Understand different terms used in network diagram. Draw network diagram for a real life project ontaining 10-15 activities, computation of LPO and EPO. (Take minimum three examples). Determination of critical path on network. Floats, its types and determination of floats. Crashing of network, updating and its applications.	
3	**Materials Management:** Material management-definition, functions, importance, relationship with other departments. Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice. Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores. Inventory control: I. Definition. II. Objectives. III. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. IV. ABC analysis and other modern methods of analysis. V. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.). Material Requirement Planning (MRP) - concept, applications and brief details about software packages available in market.	**10**
4	**Production planning and Control (PPC):** Types and examples of production. PPC: I. Need and importance. II. Functions. III. Forms used and their importance. IV. General approach for each type of production. Scheduling- meaning and need for productivity and utilization. Gantt chart- Format and method to prepare. Critical ratio scheduling-method and numeric examples. Scheduling using Gantt Chart (for atleast 5-7 components having 5-6 machining operations, with processes, setting and operation	**10**

	time for each component and process, resources available, quantity and other necessary data), Atleast two examples. Bottlenecking- meaning, effect and ways to reduce.	
5	**Value Analysis (VA) and Cost Control:** VA-definition, terms used, process and importance. VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.	**4**
6	**Recent Trends in IM:** ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics- concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.	**3**

Text book and Reference books:

1. L.S. Srinath– "CPM & PERT principles and Applications".
2. Buffa – "Modern Production Management".
3. N. Nair – "Materials Management".
4. O. P. Khanna – "Industrial Engineering & Management".
5. Mikes – "Value Analysis".
6. S.C. Sharma, "Engineering Management – Industrial Engineering & Management", Khanna Book Publishing Company, New Delhi

Course Outcomes:

On completion of the course, students will be able to

1. Interpret the given organization structure, culture, climate and major provisions of factory acts and laws.
2. Explain material requirement planning and store keeping procedure.
3. Plot and analyze inventory control models and techniques.
4. Prepare and analyze CPM and PERT for given activities.
5. List and explain PPC functions.

Maulana Abul Kalam Azad University of Technology, WestBengal
(Formerly known as West Bengal University of Technology)
Syllabus of B.Tech in Electronics and Computer Science
Effectivefromacademicsession2023-2024

Course Code: PC-ECS591	**Category: Program Core**
Course Name: Software Engineering Lab	**Semester: 5**
L-T-P : 0-0-3	**Credit: 1.5**
Pre-requisites: Knowledge of basic programming concepts, understanding basic software development life cycle, familiarity with fundamental design principles, such as object-oriented design, data structures, and common design patterns.	

Software Engineering Lab
Contact Hours: 3P/week
Credit Points: 1.5

Objectives:

The aim of the course is to:

1. Provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.
2. Acquire knowledge about process models, software requirements, software design, software testing, software process/product metrics.
3. Build and test various software design diagram e.g. class diagram, sequence diagram, UML diagram.

List of Experiments:

1. Problem Analysis and Project Planning -Thorough study of the problem
2. Identify Project scope, Objectives and Infrastructure.
3. Software Requirement Analysis – Describe the individual Phases/modules of the project and identify deliverables. Identify functional and non-functional requirements.
4. Data Modeling – Use work products – data dictionary.
5. Software Designing – Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
6. Prototype model – Develop the prototype of the product.

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcome:

After this course, students will be able to

1. Understand the software engineering methodologies involved in the phases for project development.
2. Grasp knowledge about open source tools used for implementing software engineering methods.
3. Develop product-startups implementing software engineering methods.
4. Demonstrate simple optimization techniques

Text Book, Reference Book, and Special Resources:

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

Special Remarks: The SRS and prototype model should be submitted for end semester examination.

Computer Networks Lab
Contact Hours: 3P/week
Credit Points: 1.5

Course Code: PC-ECS592	**Category: Program Core**
Course Name: Computer Networks Lab	**Semester: 5**
L-T-P: 0-0-3	**Credit: 1.5**
Pre-Requisite: Knowledge of basic programming, discrete mathematics, computer organization and architecture, and digital electronics.	

Objectives:

- Students should be able to configure the peer-to-peer network.
- Apply computer engineering discipline-specific knowledge to solve core computer engineering-related problems.
- Function effectively as a leader and team member in diverse/multidisciplinary teams.
- Ability to install and configure TCP/IP protocol.

List of Experiments:

1. Configure a Peer-to-Peer Network with at least three Host.
2. Create a desired standard network cable, including a cross cable and test it by using a cable tester.
3. Connect the computer using the given topology with wired media.
4. Connect Computers Using Wireless Media.
5. Write a C Program for CRC Error Detection.
6. Create a Network Using Bluetooth. Setting up the wireless network.
7. Configure File Server. Configure client to file server and use file services.
8. Configure static and dynamic IP addresses. Configure DHCP server.
9. Run basic utilities and network commands: ipconfig, ping, tracert, netstat, path ping ,route.
10. Create two subnets and implement it with calculated subnet masking.
11. Set access rights and security permissions for user.
12. Create IPv6 environment in a small network using simulator.
13. Linux network configuration, measurement and analysis tool: Wireshark.
14. Socket Programming: TCP and UDP, peer to peer applications.
15. Client Server using RPC using threads or processes.
16. Simulation of LAN and Wi-Fi.

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Text book and Reference books:

1) “Data and Computer Communication” by William Stallings
2) “Data Communication and Networking” by Behrouz A Forouzan
3) “Internetworking with TCP/IP, Volume 1” by Douglas Comer
4) “Computer Networks 5th Edition” by Tanenbaum

Course Outcomes:

After completion of this course, students will be able to

1. Construct and test physical network connections (cabling, peer-to-peer, wireless topologies).
2. Configure essential network services (static/dynamic IP, DHCP, file sharing, user permissions, IPv6).
3. Implement network protocols programmatically (CRC error detection, TCP/UDP sockets, RPC).
4. Utilize network utilities for monitoring, analysis (Wireshark), and troubleshooting (ping, tracert, netstat).
5. Design and simulate basic network segments (subnetting, LAN/Wi-Fi simulation).

Special Remarks:

The outcomes mentioned above are not limited. Institutes may redefine outcomes based on their program educational objective.

Database Management Systems Lab
Contact Hours: 2P/week
Credit Points: 1.0

Course Code: PC-ECS593	**Category: Program Core**
Course Name: Database Management Systems Lab	**Semester: 5**
L-T-P: 0-0-2	**Credit: 1.0**
Pre-Requisite: Basic Knowledge of computers and knowledge of Database management systems (theory)	

Objectives:

1. To develop practical skills in creating and managing relational databases, tables, and constraints using SQL.
2. To perform essential data manipulation operations such as insertion, deletion, updating, and retrieval with conditional queries and aggregate functions.
3. To apply advanced querying techniques involving subqueries, joins, sorting, and grouping to extract meaningful insights from structured data.
4. To gain hands-on experience in user management, view creation, access control, and other administrative operations for secure database management.

Exp. No.	**Laboratory Experiments**
1	Creating Database I. Creating a Database II. Creating a Table III. Specifying Relational Data Types IV. Specifying Constraints V. Creating Indexes
2	Table and Record Handling I. INSERT statement II. Using SELECT and INSERT together III. DELETE, UPDATE, TRUNCATE statements IV. DROP, ALTER statements
3	Retrieving Data from a Database I. The SELECT statement II. Using the WHERE clause III. Using Logical Operators in the WHERE clause IV. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING V. Using Aggregate Functions

	VI. Combining Tables Using JOIN VII. Sub queries
4	Database Management I. Creating Views II. Creating Column Aliases III. Creating Database Users IV. Using GRANT and REVOKE

Any experiment specially designed by the college
(Detailed instructions for the Laboratory Manual to be followed for further guidance)

Course Outcome:

1. Understand, appreciate, and effectively explain the underlying concepts of database technologies.
2. Design and implement a database schema for a given problem domain.
3. Normalize a database.
4. Populate and query a database using SQL DML/DDL commands.
5. Programming PL/SQL, including stored procedures, stored functions, cursors, and packages.
6. Design and build a GUI application using a 4GL

Special Remarks:

The outcomes mentioned above are not limited. Institutes may redefine outcomes based on their program educational objective.

Design and Analysis of Algorithms Lab
Contact Hours: 3P/week
Credit Points: 1.5

Course Code: PE-ECS591 A	**Category: Professional Elective-I**
Course Name: Design and Analysis of Algorithms Lab	**Semester: 5**
L-T-P: 0-0-3	**Credit: 1.5**
Pre-Requisite: Basic knowledge in programming fundamentals, implementing data structures like array, stack, queue, tree, graph, etc, fundamental knowledge of algorithmic paradigms like divide and conquer, greedy method, dynamic programming, etc.	

Course Objectives:

The students will be able to:

- Choose appropriate data structures and algorithms for specific problems.
- Understand different algorithm design paradigms and their applications.
- Compare and contrast different algorithmic approaches.
- Solve real-world problems using algorithmic techniques.

List of Experiments:

1. Implement Selection sort and find how many steps are required to sort 10 elements.
2. Implement and Analysis factorial of a number program using iterative and recursive methods.
3. Implement Insertion Sort and analyse the time complexity.
4. Sort a given set of elements using the quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n (the number of elements in the list to be sorted).
5. Write a program to check whether a given graph is connected or not using the DFS method.
6. Apply Greedy method to compress the given data using Huffman encoding.
7. Implement fractional knapsack problem using Greedy Strategy.
8. Implement minimum spanning tree using Prim's algorithm and analyse its time complexity.
9. Apply dynamic programming methodology to implement 0/1 Knapsack problem.

10. Solve the longest common subsequence problem using dynamic programming.
11. Find the length of the longest subsequence in a given array of integers such that all elements of the subsequence are sorted in strictly ascending order.
12. Implement matrix chain multiplication and find the optimal sequence of parentheses.
13. Find a subset of a given set S = {sl, s2,....., sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1, 2, 6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.
14. Implement N-Queens problem using backtracking.
15. Implement graph coloring problem using backtracking.
16. Find the solution of the 0/1 Knapsack Problem using LC Branch and Bound.

Any experiment specially designed by the college
(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

5. Anany Levitin, Introduction to the Design and Analysis of Algorithms, (3e), Pearson Education, 2011
6. Ellis Horowitz and SartajSahni, Computer Algorithms/C++, (2e), University Press, 2007.
7. Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein, Introduction to Algorithms, (2e), PHI, 2006
8. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Course Outcomes:

After completion of this course, students will be able to

1. Calculate the time complexity of algorithm.
2. Implement programs for the problems using Divide and Conquer.
3. Implement programs for the problems using Greedy Method.
4. Implement programs for the problems using Dynamic programming.
5. Implement programs for the problems using Backtracking.

Special Remarks:

The outcomes mentioned above are not limited. Institutes may redefine outcomes based on their program educational objective.

Sensors and Transducers Lab
Contact Hours: 3P/week
Credit Points: 1.5

Course Code: PE-ECS591 B	**Category: Professional Elective-I**
Course Name: Sensors and Transducers Lab	**Semester: 5**
L-T-P: 0-0-3	**Credit: 1.5**
Pre-Requisite: Theoretical knowledge of Sensors and Transducers and awareness of laboratory safety issues.	

Objectives:

1. To develop hands-on skills in using various sensors such as LVDT, load cell, strain gauge, thermocouple, and LDR for real-world measurements.
2. To understand the operational characteristics and calibration techniques of transducers for displacement, force, torque, and temperature.
3. To enhance proficiency in selecting and interfacing appropriate sensors for specific measurement tasks.
4. To foster innovation and application-oriented thinking through the design and implementation of a mini-project.

Exp. No.	Laboratory Experiments
1	Displacement measurement by using LVDT.
2	Study of a load cell with tensile and compressive load.
3	Torque measurement using a Strain gauge transducer.
4	Study of the characteristics of an LDR.
5	Temperature measurement using RTD.
6	Study of a capacitive transducer.
7	Temperature measurement using a Thermocouple.
8	Temperature measurement using the AD590 IC sensor.
9	Design and Implementation of Mini Project.

Course Outcomes:

At the end of the course, students will be able to

1. Identify different types of sensors and transducers that are used for temperature, speed, torque, displacement, and light intensity measurement in industry as well as home appliances.
2. Demonstrate the operations of different sensors and transducers based measurement
systems.

3. Select the appropriate sensor depending on application criteria.
4. Characterize different types of sensors and draw the related curves.

Embedded Systems Lab
Contact Hours: 3P/week
Credit Points: 1.5

Course Code: PE-ECS591 C	**Category: Professional Elective-I**
Course Name: Embedded Systems Lab	**Semester: 5**
L-T-P: 0-0-3	**Credit: 1.5**
Pre-Requisite: Microcontrollers & Embedded Systems (Theory)	

Course Objectives:

- To familiarize students with microcontroller-based embedded system design.
- To provide hands-on experience with hardware and software development tools.
- To implement real-time interfacing with sensors, actuators, and communication modules.
- To develop embedded applications using RTOS and low-level programming techniques.

List of Experiments:

Section A: Microcontroller Fundamentals (Using ARM Cortex-M / AVR / PIC)

1. **GPIO Programming**: LED blinking, push button input, toggle LED.
2. **Timer and Delay Functions**: Create accurate software delays using internal timers.
3. **Interrupt Handling**: External and timer interrupt-based LED toggling.
4. **PWM Generation**: Dim LED or control DC motor speed using PWM.
5. **ADC Interface**: Analog voltage reading from a potentiometer or temperature sensor (LM35).
6. **DAC Output (if supported)**: Generate waveform output using DAC peripheral.

Section B: Sensor & Peripheral Interfacing

7. **Ultrasonic Sensor Interface**: Distance measurement and display on LCD.
8. **I2C/SPI Communication**: Interface EEPROM or RTC (DS1307/DS3231).

9. **Serial Communication (UART)**: Data exchange with PC terminal or Bluetooth module.
10. **OLED/LCD Display Interface**: Display temperature or text messages from sensors.

Section C: Application-Oriented Experiments

11. **Motor Control**: DC motor or Servo motor control using embedded system.
12. **IoT Experiment**: Sensor data publishing to cloud using ESP32 + MQTT/HTTP.
13. **Embedded System with RTOS**: Task scheduling using FreeRTOS on STM32 or ESP32.
14. **Security System Project**: Design a basic RFID or keypad-based lock system.

Different tools and platform:

- **Hardware Platforms**: Arduino, STM32 Nucleo, ESP32, Raspberry Pi Pico (RP2040), or similar
- **Software Tools**:
  - (a) Arduino IDE / PlatformIO
  - (b) Keil µVision / STM32CubeIDE
  - (c) MPLAB X IDE
  - (d) FreeRTOS
  - (e) Python (for PC-side communication)
- **Simulation Tools**: Proteus, Tinkercad Circuits, or STM32CubeMX
- **KEIL, embedded C. STM32Cube Programmer**

Course Outcomes:

After completion of this course, students will be able to

1. Demonstrate proficiency in configuring and programming microcontrollers for GPIO, timers, interrupts, ADC, DAC, and PWM applications.
2. Interface a variety of sensors, actuators, and peripheral devices using serial communication protocols such as UART, I2C, and SPI.
3. Develop embedded applications for real-time data acquisition, control, and display using modern hardware platforms.
4. Implement embedded solutions for IoT, motor control, and basic RTOS-based multitasking, fostering practical system integration and problem-solving skills.

Special Remarks:
The outcomes mentioned above are not limited. Institutes may redefine outcomes based on their program educational objective.