



**JECRC**<sup>TM</sup>  
**UNIVERSITY**  
BUILD YOUR WORLD

**School of Engineering**

**Syllabi and Course Structure**

**B. Tech. (Computer Science & Engineering)**  
**(Computer Science and Business System)**  
**TCS**  
**(2025-2029)**

**Academic Programmes**

**JULY 2025**

The curriculum and syllabus for B.Tech. Program conforms to outcome based teaching learning process. In general, several outcomes have been identified and the curriculum and syllabus have been planned in such a way that each of the courses meets one or more of these outcomes. Student outcomes illustrate the students are expected to know and be able to do by the time of graduation. These relate to the skills, understanding, and behaviour that students acquire as they progress through the program. Further each course in the program brings out clear instructional objectives which are mapped to the student outcomes.

**B.Tech. (CSE) Program Educational Objective (PEO's):**

A graduate of the Computer Science and Engineering Program should:

**PEO- I**

Students will develop themselves as effective professionals by solving real problems through the use of computer science knowledge and with attention to team work, effective communication, critical thinking and problem solving skills.

**PEO- II**

Students will develop professional skills that prepare them for immediate employment and for life-long learning in advanced areas of computer science and related fields.

**PEO- III**

Students will demonstrate their ability to adapt to a rapidly changing environment by having learned and applied new skills and new technologies.

**PEO- IV**

Students will be provided with an educational foundation that prepares them for excellence, leadership roles along diverse career paths with encouragement to professional ethics and active participation needed for a successful career.

**Program Outcome(PO's)**

**A graduate of the Computer Science and Engineering Program will demonstrate:**

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research

methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Culture, Values and Ethics: Understand the importance of culture and Values along with the implications it has on learning, teaching, engineering practice, identity, and enculturation as an engineer. Apply ethical principles being committed to professional ethics, responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **Program Specific Outcome:**

PSO1: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, cyber security, machine learning and networking for efficient design and automation of computer-based systems of varying complexity. (Professional Skills)

PSO2: The ability to apply standard and modern practices like Python, R language, automation and strategies in software project development using open-ended programming environments to deliver a quality product for business success. (Problem-Solving Skills)

PSO3: The ability to employ modern computer languages, environments, and platforms in creating innovative career paths in the field of AI and Machine learning, Cloud Computing, Robotic automation, cyber security to be an entrepreneur, and a zest for higher studies.( Successful Career and Entrepreneurship)

## Semester 1

### Course Objective(COB)

<b>BAS017A</b>	<b>Discrete Mathematics</b>	<b>Credits 3-1-0 4</b>
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1. Understand the Foundations of Logic and Boolean Algebra
2. Develop Abstract Algebraic Thinking
3. Apply Combinatorics and Recursion in Problem Solving
4. Analyze and Solve Graph Theoretic Problems:
5. Foster Rigorous Proof and Reasoning Skills:

#### **Syllabus: Theory**

**Boolean algebra:** Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

**Abstract algebra:** Set, relation, group, ring, field.

**Combinatorics:** Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

**Graph Theory:** Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

**Logic:** Propositional calculus - propositions and connectives, syntax; Semantics - truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

### Course Outcome(CO)

CO1: Apply Boolean algebra and logic gates to design and simplify digital circuits using canonical forms and Karnaugh maps.

CO2: Analyze and construct algebraic structures like groups, rings, and fields with real-life and computational relevance.

CO3: Solve complex combinatorial problems using counting principles, recurrence relations, and generating functions.

CO4: Apply graph theory concepts to model networks and determine properties like connectivity, Eulerian/Hamiltonian paths, planarity, and coloring.

CO5: Demonstrate the ability to formally reason and prove propositions using logic systems, natural deduction, and principles of mathematical induction.

#### **Text Books:**

1. *Topics in Algebra*, I. N. Herstein, John Wiley and Sons.
2. *Digital Logic & Computer Design*, M. Morris Mano, Pearson.
3. *Elements of Discrete Mathematics*, (Second Edition) C. L. LiuMcGraw Hill, New Delhi.
4. *Graph Theory with Applications*, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
5. *Mathematical Logic for Computer Science*, L. Zhongwan, World Scientific, Singapore.

#### **Reference Books:**

1. *Introduction to linear algebra*. Gilbert Strang.
2. *Introductory Combinatorics*, R. A. Brualdi, North-Holland, New York.
3. *Graph Theory with Applications to Engineering and Computer Science*, N. Deo, Prentice Hall, Englewood Cliffs.

*Semester 1*

<b>BAS018A</b>	<b>Introductory Topics in Statistics, Probability and Calculus</b>	<b>Credits 3-0-0 3</b>
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**Course Objectives (COB)**

1. Understand the Fundamentals of Statistics
2. Develop Skills in Descriptive Statistical Analysis
3. Build a Foundation in Probability Theory
4. Familiarize with Common Probability Distributions.
5. Introduce the Role of Calculus in Statistics

**.Syllabus Theory**

**Introduction to Statistics:** Definition of Statistics. Basic objectives. Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution.

**Probability:** Concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem. Probability distributions: discrete & continuous distributions, Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions. Expected values and moments: mathematical expectation and its properties, Moments (including variance) and their properties, interpretation, Moment generating function.

**Calculus:** Basic concepts of Differential and integral calculus, application of double and triple integral.

**Course Outcome(CO)**

CO1: Define and classify data types; distinguish between primary/secondary and population/sample data; and explain the scope of statistics in scientific applications.

CO2: Organize and represent univariate and bivariate data using tables, graphs, and frequency curves, and compute descriptive statistics such as mean, median, mode, variance, and standard deviation.

CO3: Apply probability rules to compute the likelihood of events using concepts like conditional probability and Bayes' theorem.

CO4: Analyze and interpret key probability distributions (Binomial, Poisson, Normal, t, Chi-square, etc.) and compute expected values and moments.

CO5: Solve statistical problems involving continuous distributions using basic principles of differential and integral calculus, including double and triple integrals

**Text Books:**

1. *Introduction of Probability Models*, S. M. Ross, Academic Press, N.Y.
2. *Fundamentals of Statistics*, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.
3. *Higher Engineering Mathematics*, B. S. Grewal, Khanna Publication, Delhi.

**Reference Books:**

1. *A first course in Probability*, S. M. Ross, Prentice Hall.
2. *Probability and Statistics for Engineers*, (Fourth Edition), I. R. Miller, J.E. Freund and R. Johnson, PHI.
3. *Introduction to the Theory of Statistics*, A. M. Mood, F.A. Graybill and D.C. Boes, McGraw Hill Education.
4. *Advanced Engineering Mathematics*, (Seventh Edition), Peter V. O'Neil, Thomson Learning.
5. *Advanced Engineering Mathematics*, (Second Edition) M. D. Greenberg, , Pearson Education.

*Applied Mathematics*, Vol. I & II, P. N. Wartikar and J. N. Wartikar, Vidyarthi Prakashan

*Semester 1*

<b>BCO408A</b>	<b>Fundamentals of Computer Science</b>	<b>Credits 3-0-0 3</b>
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**Course Objective(COB)**

1. Develop Algorithmic Thinking for Problem Solving
2. Understand Imperative Programming Constructs in ANSI C
3. Master Control Structures, Functions, and Recursion
4. Explore Advanced C Features – Pointers, Arrays, Structures, and I/O
5. Introduce Unix System Interface and Programming Practices:

**General problem Solving concepts:** Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

**Imperative languages:** Introduction to imperative language; syntax and constructs of a specific language (ANSI C)

- Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation.
- Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming.
- Functions and Program Structure with discussion on standard library: Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types.
- Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.
- Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral structures, Table look up, typedef, unions, Bit-fields
- Input and Output: Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, stdout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.
- Unix system Interface: File Descriptor, Low level I/O – read and write, open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator.

**Programming Method:** Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.

### ***Course Outcomes (CO)***

CO1: Design algorithms and flowcharts to solve general computational problems using sequential, decision, and loop structures effectively.

CO2: Write and debug C programs using correct syntax, appropriate data types, operators, and variable naming conventions like Hungarian Notation.

CO3: Implement control structures, modularize code using functions, apply recursion, and manage scope and storage of variables in C.

CO4: Manipulate pointers and arrays, utilize complex data types such as structures and unions, and perform formatted input/output including file operations and error handling.

CO5: Perform system-level programming on Unix using file descriptors, system calls (e.g., read, write, lseek), and utilities like makefile, user-defined headers, and storage allocators.

### **Text Books:**

1. *The C Programming Language*, (Second Edition) B. W. Kernighan and D. M. Ritchi, PHI.
2. *Programming in C*, (Second Edition) B. Gottfried, Schaum Outline Series.

### **Reference Books:**

1. *C: The Complete Reference*, (Fourth Edition), Herbert Schildt, McGraw Hill.
2. *Let Us C*, Yashavant Kanetkar, BPB Publications.

*Semester 1*

<b>BCO409A</b>	<b>Fundamentals of Computer Science Lab</b>	<i>Credits 0-0-2 2</i>
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**Laboratory**

1. Algorithm and flowcharts of small problems like GCD
2. Structured code writing with:
  - i. Small but tricky codes
  - ii. Proper parameter passing
  - iii. Command line Arguments
  - iv. Variable parameter
  - v. Pointer to functions
  - vi. User defined header
  - vii. Make file utility
  - viii. Multi file program and user defined libraries
  - ix. Interesting substring matching / searching programs
  - x. Parsing related assignments

***Lab Outcomes (LO)***

**LO1:** Design and implement flowcharts and algorithms for simple problems such as finding GCD, factorial, etc., using step-by-step logic.

**LO2:** Write structured and modular C programs incorporating advanced features like proper parameter passing, variable arguments, and pointer to functions.

**LO3:** Utilize command-line arguments and create reusable code using user-defined headers and custom libraries.

**LO4:** Manage and compile large projects using multi-file programming techniques and build tools like makefile etc.

**LO5:** Develop and test small programs for pattern matching, substring search, and basic parsing, simulating real-world data processing scenarios.

*Semester 1*

<b>DEL002A</b>	<b>Principles of Electrical Engineering</b>	<b>Credits 2-0-0 2</b>
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**Course Objectives (COB)**

1. Introduce Fundamental Electrical Quantities and Components
2. Enable Analysis of DC and AC Electrical Circuits
3. Understand AC Waveforms and Power in Electrical Systems:
4. Introduce Electrostatics, Magnetism, and Energy Conversion:.
5. Familiarize with Measurements, Sensors, and Electrical Safety:

**Syllabus Theory**

**Introduction:** Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff's laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

**DC Circuits:** Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.

**AC Circuits:** AC waveform definitions, form factor, peak factor, study of R-L, R-C, RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits ( $\Delta$  &  $\lambda$ - $\lambda$ ).

**Electrostatics and Electro-Mechanics:** Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion.

**Measurements and Sensors:** Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System & Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices & system.

**For Further Reading** - Principle of batteries, types, construction and application, Magnetic material and B-H Curve, Basic concept of indicating and integrating instruments.

**Course Outcomes (CO)**

- CO1: Describe and apply fundamental electrical laws and components (resistors, capacitors, inductors, sources) and analyze simple circuits using Kirchhoff's laws, mesh, and nodal analysis.
- CO2: Analyze and simplify DC circuits using Thevenin's, Norton's, Superposition, and Maximum Power Transfer theorems; perform Star-Delta transformations.
- CO3: Represent and analyze single-phase and three-phase AC circuits using phasors, and calculate power quantities such as active, reactive, and apparent power.

CO4: Explain the concepts of electrostatics, inductance, magnetic fields, and electromechanical energy conversion with emphasis on transformer operation and characteristics.

CO5: Use appropriate measurement tools and sensors for electrical quantities, understand wiring layouts and accessories, and apply knowledge of earthing and safety systems in practice.

**Text Books:**

1. *Electric Machinery*, (Sixth Edition) A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2. *A Textbook of Electrical Technology*, (vol. I), B. L. Theraja, Chand and Company Ltd., New Delhi.
3. *Basic Electrical Engineering*, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. *Theory and problems of Basic Electrical Engineering*, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

**Reference Books:**

1. *Basic of Electrical Engineering*, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press.  
T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. *Introduction to Electrodynamics*, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. *Engineering Circuit Analysis*, William H. Hayt & Jack E. Kemmerly, McGraw-Hill Book Company Inc.
4. *Fundamentals of Electrical and Electronics Engineering*, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

*Semester 1*

<b>DEL003A</b>	<b>Principles of Electrical Engineering Lab</b>	<b>Credits 0-0-2 1</b>
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**Laboratory**

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits
2. Determination of resistance temperature coefficient
3. Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power
4. Transfer theorem)
5. Simulation of R-L-C series circuits for  $X_L > X_C$  ,  $X_L < X_C$
6. Simulation of Time response of RC circuit
7. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
8. Demonstration of measurement of electrical quantities in DC and AC systems.

**Lab Outcomes (LO)**

**LO1:** Identify and operate fundamental electrical components, sources, measuring devices, and transducers used in basic electrical circuits.

**LO2:** Experimentally determine and interpret the temperature coefficient of resistance, demonstrating understanding of resistance variation with temperature.

**LO3:** Verify and analyze key network theorems (Superposition, Thevenin, Norton, Maximum Power Transfer) through practical circuit implementation.

**LO4:** Simulate and interpret the behavior of R-L-C and RC circuits, including phase relationships and time-domain responses.

**LO5:** Analyze and verify the voltage-current relationships in balanced 3-phase star and delta systems, and perform accurate measurements in both DC and AC circuits using standard instruments.

## *Semester 1*

<b>DPH003A</b>	<b>Fundamentals of Physics</b>	<b>Credits 2-0-0 2</b>
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### ***Course Objectives (COB)***

1. Understand the Principles of Oscillations and Wave Motion:
2. Explore Wave Optics and Light Phenomena:
3. Introduce Fundamental Concepts of Modern Physics:
4. Gain Insight into Crystal Structures and Solid-State Physics:
5. Understand Lasers, Fiber Optics, and Thermodynamic Laws:

**Oscillation:** Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring-mass system. Resonance-definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.

**Interference-principle of superposition-Young's experiment:** Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction -Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.

**Polarization of light:** Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

**Basic Idea of Electromagnetisms:** Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium.

**Quantum Mechanics:** Introduction- Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box, Heisenberg Picture.

**Crystallography:** Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures, X-ray diffraction

**Semiconductor Physics:** Conductor, Semiconductor and Insulator; Origin of Band Theory, Basic concept of Band theory,

**Laser and Fiber optics:** Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO<sub>2</sub> and Neodymium YAG (Neodymium-doped Yttrium Aluminum Garnet); Properties of laser beams: monochromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers.

**Thermodynamics:** Zero-th law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

### ***Course Outcome(CO)***

CO1: Analyze mechanical and electrical oscillatory systems and distinguish between undamped, damped, and forced oscillations, including resonance and quality factor.

CO2: Apply the principles of interference, diffraction, and polarization to explain various optical phenomena and devices.

CO3: Interpret the fundamentals of electromagnetism and quantum mechanics, including Maxwell's equations, Schrödinger's equation, and the uncertainty principle.

CO4: Describe crystal geometry using crystallographic parameters like Miller indices and packing factors and analyze X-ray diffraction data.

CO5: Explain the working principles of lasers and optical fibers, and apply the laws of thermodynamics to understand energy exchanges in physical systems.

### **Text Books:**

1. .Concepts of Modern Physics, (Fifth Edition) A Beiser, McGraw Hill International.
2. Optics, (Fifth Edition)AjoyGhatak, Tata McGraw Hill.
3. Sears & Zemansky University Physics, Addison-Wesley.
4. Fundamentals of Optics,(Third Edition)Jenkins and White, McGraw-Hill.

*Semester 1*

<b>DPH004A</b>	<b>Fundamentals of Physics Lab</b>	<i>Credits 0-0-2 1</i>
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**Laboratory**

- 1) Magnetic field along the axis of current carrying coil – Stewart and Gee
- 2) Determination of Hall coefficient of semi-conductor
- 3) Determination of Plank constant
- 4) Determination of wave length of light by Laser diffraction method
- 5) Determination of wave length of light by Newton's Ring method
- 6) Determination of laser and optical fiber parameters
- 7) Determination of Stefan's Constant.

## *Semester 1*

<b>DEN014A</b>	<b>Business Communication &amp; Value Science – I</b>	<i>Credits 2-0-0 2</i>
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### **Business Communication & Value Science - I**

Course ID:

1.6 (Year 1 Semester 1)

	Leadership Oriented Learning (LOL)	
Nature of Course		
	Behavioral	
Pre requisites		
	Basic Knowledge of high school English	
Course Objectives:		
1	Understand what life skills are and their importance in leading a happy and well-adjusted life	
2	Motivate students to look within and create a better version of self	
3	Introduce them to key concepts of values, life skills and business communication	
Course Outcomes:		
Upon completion of the course, students shall have ability to		
C1.6.1	Recognize the need for life skills and values	[U]
C1.6.2	Recognize own strengths and opportunities	[U]
C1.6.3	Apply the life skills to different situations	[AP]
C1.6.4	Understand the basic tenets of communication	[U]
C1.6.5	Apply the basic communication practices in different types of communication	[AP]
Course Contents:		
<ul style="list-style-type: none"> <li>• Overview of the course with immersion activity</li> <li>• Overview of biz communication</li> <li>• Self-awareness, confidence and communication</li> <li>• Essentials of Business communication</li> <li>• Application of communication skills</li> <li>• Application of Life Skills</li> <li>• Assignment</li> </ul>		
Total Hours:		65
Text Books:		
There are no prescribed texts for Semester 1 – there will be handouts and reference links shared.		
Reference Books:		
1	English vocabulary in use – Alan Mc'Carthy and O'dell	
2	APAART: Speak Well 1 (English language and communication)	
3	APAART: Speak Well 2 (Soft Skills)	
4	Business Communication – Dr. Saroj Hiremath	
Web References:		

1	Train your mind to perform under pressure- Simon sinek <a href="https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/">https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/</a>		
2	Brilliant way one CEO rallied his team in the middle of layoffs <a href="https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html">https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html</a>		
3	Will Smith's Top Ten rules for success <a href="https://www.youtube.com/watch?v=bBsT9omTeh0">https://www.youtube.com/watch?v=bBsT9omTeh0</a>		
Online Resources:			
1	<a href="https://www.coursera.org/learn/learning-how-to-learn">https://www.coursera.org/learn/learning-how-to-learn</a>		
2	<a href="https://www.coursera.org/specializations/effective-business-communication">https://www.coursera.org/specializations/effective-business-communication</a>		
Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1	Understand	Immersion (interview)	5
C1.6.2	Understand	Create Resume	4
C1.6.3	Apply	Group Assignment – community service	5
C1.6.4	Understand	Group activities	3
C1.6.5	Apply	Record a conversation	3
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand	Paper		50
Apply	Trek followed by project		
Analyse			

#### Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	Recognize the need for life skills and values	Understand	Overview of LOL (include activity on introducing self)	Lecture & reflection	1 hour
			Class activity – presentation on favorite cricket captain in IPL and the skills and values they demonstrate	Activity	1 hour
			Self-work with immersion – interview a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them	Immersion activity	2 hours
			Overview of business communication	Lecture with videos	1 hour
			Activity: Write a newspaper report on an IPL match	Class activity with 3 iterations - Formative Evaluation	1 hour
			Activity: Record a conversation between a celebrity and an interviewer	Class activity with 3	1 hour

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
				iterations - Formative Evaluation	
			Quiz Time	Summative Evaluation for Unit	30 mins
	Recognize own strengths and opportunities	Understand	Self-awareness – identity, body awareness, stress management	Anubhaab Activities  (Please conduct at least one activity per week and include the Meditation session in it)	4 hours
2	Understand the basic tenets of communication  Unit name: Be At Ease (BAE) (in Millennial lingo it means Before Anyone Else)	Understand	Essential Grammar – I: Refresher on <u>Parts of Speech</u> – Listen to an audio clip and note down the different parts of speech followed by discussion Tenses: Applications of tenses in Functional Grammar – Take a quiz and then discuss	Lecture with audio and video	1 hour
			Sentence formation (general & Technical), Common errors, Voices. Show sequence from film where a character uses wrong sentence structure (e.g. Zindagi Na Milegi Dobaara where the characters use 'the' before every word)	Lecture with video/audio	1 hour
			Communication Skills: Overview of Communication Skills Barriers of communication, Effective communication		1 hour
			Types of communication- verbal and non – verbal – Role-play based learning Importance of Questioning	Activity based learning	1 hour
			Listening Skills: Law of nature- Importance of listening skills, Difference between listening and hearing, Types of listening.	Activity based learning	1 hour

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	Recognize own strengths and opportunities	Understand	Expressing self, connecting with emotions, visualizing and experiencing purpose	Anubhaab Activities  (Please conduct at least one activity per week and include the Meditation session in it)	4 hours
	Apply the basic communication practices in different types of communication	Apply	Activity: Skit based on communication skills	Formative Evaluation	4 hours
			Evaluation on Listening skills – listen to recording and answer questions based on them	Formative Evaluation	30 mins
3	Understand the basic tenets of communication Talk Mail Write (TMW) - In Millennial it means That Moment When	Understand	Email writing: Formal and informal emails, activity	Activity based learning	1 hour
			Verbal communication: Pronunciation, clarity of speech	Audio and video based learning	30 minutes
			Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, significant abbreviations formal business vocabulary – Read Economic Times, Reader's Digest, National Geographic and take part in a GD, using the words you learnt/liked from the articles. Group discussion using words learnt	Activity based learning (Group Discussion) Flipped classroom where students will study words before coming to class	1 hour
			Practice: Toastmaster style Table Topics speech with evaluation	Activity based learning	2 hours over 2/3 days
			Written Communication: Summary writing, story writing	Activity based learning	1 hour
			Build your CV – start writing your comprehensive CV	Formative Evaluation	30 minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			including every achievement in your life, no format, no page limit		
	Apply the basic communication practices in different types of communication	Apply	Project: Create a podcast on a topic that will interest college students	Formative Evaluation	1 hour
	Recognize own strengths and opportunities	Understand	Life skill: Stress management, working with rhythm and balance, colours, and teamwork	Anubhaab Activities  (Please conduct at least one activity per week and include the Meditation session in it)	4 hours
	Apply the basic communication practices in different types of communication	Apply	Project: Create a musical using the learnings from unit	Formative Evaluation	2 hours
4	Unit 4 Recognize the need for life skills and values  Unit name: Realities of Facing Life (ROFL)	Understand	Understanding Life Skills: Movie based learning – Pursuit of Happiness. What are the skills and values you can identify, what can you relate to?	Interactive learning	3 hours
			Introduction to life skills What are the critical life skills	Activity and Video	1 hour
			Multiple Intelligences Embracing diversity – Activity on appreciation of diversity	Video and activity based	1 hour
	Apply the life skills to different situations	Apply	Life skill: Community service – work with an NGO and make a presentation	Field work: Formative Evaluation	10 hours
			Life skill: Join a trek – Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation	Field work: Formative Evaluation	12 hours
TOTAL					65 hours

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	Summative Evaluation	Bloom's Level	Type of Assessment	Marks	Total
		Understand	Knowledge Test	20 marks	50 marks
		Apply	Project (to be evaluated by TCS)	20 marks	
		Apply	Group discussion (to be evaluated by TCS)	10 marks	

## Semester 2

DMA014A	Linear Algebra	Credits 3-1-0 4
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### Course Objective(COB)

1. To understand the fundamentals of matrices, determinants, and vector spaces.
2. To develop skills for solving linear systems using analytical and computational methods.
3. To study eigenvalues, eigenvectors, and linear transformations.
4. To learn orthogonality, projections, and matrix factorizations.
5. To explore applications of linear algebra in image processing and machine learning.

### Syllabus Theory

Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix.

Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices.

Vector space; Dimension; Basis; Orthogonality; Projections; Gram-Schmidt orthogonalization and QR decomposition.

Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices;

Singular value decomposition and Principal component analysis (Non-credit and optional); Introduction to their applications in Image Processing and Machine Learning (one or two classes).

### Note:

*Assignments & tutorials covering the following: Vectors and linear combinations, Matrices, Linear transformations, Complete solution to  $Ax = b$ , Determinants, Eigenvalues and Eigenvectors*

### Course Outcome(CO)

CO1: Apply concepts of matrices and determinants to solve systems of linear equations using Cramer's rule and matrix inversion.

CO2: Implement Gaussian elimination, LU decomposition, and QR decomposition for solving large-scale linear systems.

CO3: Analyze vector spaces in terms of dimension, basis, and orthogonality for mathematical and engineering problems.

CO4: Evaluate eigenvalues, eigenvectors, and positive definite matrices for applications in linear transformations.

CO5: Utilize singular value decomposition (SVD) and principal component analysis (PCA) for basic applications in image processing and machine learning.

### Text Books:

1. *Higher Engineering Mathematics*, B. S. Grewal, Khanna Publishers.

### Reference Books:

1. *Advanced Engineering Mathematics*, (Seventh Edition), Peter V. O'Neil, Cengage Learning.

2. *Advanced Engineering Mathematics*, (Second Edition), Michael. D. Greenberg, Pearson.
3. *Introduction to linear algebra*, (Fifth Edition), Gilbert Strang, Wellesley-Cambridge Press.
4. *Applied Mathematics* (Vol. I & II), P. N. Wartikar & J. N. Wartikar, Pune Vidyarthi Griha Prakashan.
5. *Digital Image Processing*, R C Gonzalez and R E Woods, Pearson.
6. <https://machinelearningmastery.com/introduction-matrices-machine-learning/>

## Semester 2

DMA015A	Statistical Methods	Credits 3-0-0 3
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### Course Objectives(COB)

1. To understand fundamental sampling techniques and their applications in statistical inference.
2. To learn linear statistical modeling and regression analysis for data interpretation.
3. To study estimation methods and hypothesis testing for decision-making.
4. To explore non-parametric inference techniques and their applications.
5. To introduce basics of time series analysis, forecasting, and R programming for statistical computation

### Syllabus Theory

**Sampling Techniques:** Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling

**Linear Statistical Models:** Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions. Multiple correlation, Analysis of variance (one way, two way with as well as without interaction)

**Estimation:** Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.

**Test of hypothesis:** Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing

**Non-parametric Inference:** Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test.

**Basics of Time Series Analysis & Forecasting:** Stationary, ARIMA Models: Identification, Estimation and Forecasting.

### Course Outcomes

CO1: Apply various sampling techniques for data collection and estimation from finite and infinite populations.

CO2: Analyze and interpret data using linear regression, correlation, multiple regression, and analysis of variance.

CO3: Evaluate point estimation methods and formulate as well as test statistical hypotheses using appropriate procedures.

CO4: Implement non-parametric inference techniques such as sign test, Wilcoxon test, Mann-Whitney test, and rank correlation methods.

CO5: Develop and apply ARIMA models for time series forecasting using R programming language.

### Text Books:

1. *Probability and Statistics for Engineers* (4th Edition), I.R. Miller, J.E. Freund and R. Johnson.
2. *Fundamentals of Statistics* (Vol. I & Vol. II), A. Goon, M. Gupta and B.Dasgupta.

3. *The Analysis of Time Series: An Introduction*, Chris Chatfield.

**Reference Books:**

1. *Introduction to Linear Regression Analysis*, D.C. Montgomery & E. Peck
2. *Introduction to the Theory of Statistics*, A.M. Mood, F.A. Graybill & D.C. Boes.
3. *Applied Regression Analysis*, N. Draper & H. Smith
4. *Hands-on Programming with R*, - Garrett Golemund
5. *R for Everyone: Advanced Analytics and Graphics*, Jared P. Lander

**Data Source:**

- [www.rbi.org.in](http://www.rbi.org.in)

## Semester 2

<b>DMA016A</b>	<b>Statistical Methods Lab</b>	<b>Credits 0-0-2 1</b>
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### Lab Objectives(LOB)

1. To introduce the fundamentals of R programming for statistical computing.
2. To develop skills in data handling and manipulation using R.
3. To learn control structures, functions, and simulation techniques in R.
4. To apply R for statistical modeling and analysis.
5. To visualize and interpret data using R's graphical capabilities

### Laboratory

**R statistical programming language:** Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

### Lab Outcome(LO)

- LO1:** Demonstrate understanding of R programming syntax, functions, and control flow structures.
- LO2:** Perform data input, output, and manipulation using vectors, matrices, and data frames in R.
- LO3:** Apply simulation and statistical modeling techniques using R functions.
- LO4:** Analyze datasets using linear models and interpret the results effectively.
- LO5:** Create and customize graphical visualizations in R for data interpretation and presentation.

## Semester 2

BCO410A	DATA STRUCTURES AND ALGORITHMS	Credits 3-1-0 4
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### Course Objectives

1. To understand fundamental concepts of algorithms, recursion, and performance analysis.
2. To study the representation, operations, and applications of linear data structures.
3. To learn non-linear data structures including trees and graphs with their operations.
4. To develop skills in searching, sorting, and hashing techniques for efficient data handling.
5. To understand file organization methods and graph traversal algorithms.

### Syllabus Theory

**Basic Terminologies and Introduction to Algorithm & Data Organisation:** Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction

**Linear Data Structure:** Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures

**Non-linear Data Structure:** Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations & Applications of Non-Linear Data Structures

**Searching and Sorting on Various Data Structures:** Sequential Search, Binary Search, Comparison Trees, Breadth First Search, Depth First Search Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heapsort, Introduction to Hashing

**File:** Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

**Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

### Course Outcomes

**CO1:** Explain algorithm specifications, recursion, performance analysis, and asymptotic notations.

**CO2:** Implement and apply arrays, stacks, queues, and linked lists for solving computational problems.

**CO3:** Design and use tree and graph data structures for various applications.

**CO4:** Apply searching, sorting, and hashing techniques to manipulate data efficiently.

**CO5:** Demonstrate understanding of file organization schemes and graph traversal algorithms with complexity analysis.

### Text Books:

1. *Fundamentals of Data Structures*, E. Horowitz, S. Sahni, S. A-Freed, Universities Press.
2. *Data Structures and Algorithms*, A. V. Aho, J. E. Hopcroft, J. D. Ullman, Pearson.

### Reference Books:

1. *The Art of Computer Programming: Volume 1: Fundamental Algorithms*, Donald E. Knuth.
2. *Introduction to Algorithms*, Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, The MIT Press.
3. *Open Data Structures: An Introduction (Open Paths to Enriched Learning)*, (Thirty First Edition), Pat Morin, UBC Press.

## Semester 2

<b>BCO411A</b>	<b>DATA STRUCTURES AND ALGORITHMS LAB</b>	<i>Credits 0-0-2 1</i>
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### **Laboratory**

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

### **LabOutcomes(LO)**

- **LO1:** Implement stack operations to solve problems such as Towers of Hanoi.
- **LO2:** Perform reading, writing, and arithmetic operations on polynomials using appropriate data structures.
- **LO3:** Develop applications like a line editor to display word and line counts in real time.
- **LO4:** Implement and perform all operations on trees and graphs, including traversal algorithms.
- **LO5:** Store and retrieve non-linear data structures from files using file handling techniques.

## Semester 2

BES025A	PRINCIPLES OF ELECTRONICS ENGINEERING	Credits 2-0-0 2
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### *Course Objectives(COB)*

1. To understand the fundamental properties and behavior of semiconductors.
2. To study the construction, characteristics, and applications of diodes and transistor devices.
3. To learn the principles and configurations of field-effect transistors and CMOS technology.
4. To understand feedback, oscillators, and operational amplifier circuits with their applications.
5. To introduce the basics of digital electronics and combinational/sequential circuits.

### **Syllabus Theory**

**Semiconductors:** Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.

**Diodes and Diode Circuits:** Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

**Bipolar Junction Transistors:** Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

**Field Effect Transistors:** Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

**Feed Back Amplifier, Oscillators and Operational Amplifiers:** Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

**Digital Electronics Fundamentals:** Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

### *Course Outcomes(CO)*

**CO1:** Explain the electrical properties of semiconductors and the behavior of intrinsic and extrinsic materials.

**CO2:** Analyze the characteristics of diodes and design basic rectifier and voltage regulation circuits.

**CO3:** Describe the operation of BJTs and FETs, and select suitable configurations for given applications.

**CO4:** Apply the concepts of feedback, oscillators, and operational amplifiers in analog circuit design.

**CO5:** Demonstrate the working of basic digital logic circuits including adders, multiplexers, flip-flops, and counters.

**Text Books:**

1. *Microelectronics Circuits*, Adel S. Sedra and Kenneth Carless Smith, Oxford University Press.
2. *Millman's Integrated Electronics*, Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education.
3. *Digital Logic & Computer Design*, M. Morris Mano, Pearson

**Reference Books:**

1. *Electronic Devices and Circuit Theory*, Robert L. Boylestad, Louis Nashelsky.
2. *Solid State Electronic Devices*, 6<sup>th</sup> Edition, Ben Streetman, Sanjay Banerjee
3. *Electronic Principle*, Albert Paul Malvino.
4. *Electronics Circuits: Discrete & Integrated*, D Schilling C Belove T Apelewicz R Saccardi.
5. *Microelectronics*, Jacob Millman, Arvin Gabel.
6. *Electronics Devices & Circuits*, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj

*Electronic Devices & Circuit Theory*, 11<sup>th</sup> Edition, Robert L. Boylestad, Louis Nashelsky

**Semester 2**

<b>BES026A</b>	<b>PRINCIPLES OF ELECTRONICS ENGINEERING LAB</b>	<i>Credits 0-0-2 1</i>
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**Laboratory**

1. *Semiconductor Diodes and application,*
2. *Transistor circuits,*
3. *JFET, oscillators and amplifiers.*

**Lab Outcomes(LO)**

**CO1:** Test and analyze the characteristics and applications of semiconductor diodes.

**CO2:** Construct and evaluate transistor-based circuits for various configurations.

**CO3:** Implement and study JFET circuits, oscillators, and amplifiers for practical applications.

## Semester 2

DEC001A	FUNDAMENTALS OF ECONOMICS	Credits 2-0-0 2
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### Course Objectives(COB)

1. To understand the principles of demand, supply, and market equilibrium.
2. To analyze consumer and producer behavior using economic models.
3. To study production theory, cost analysis, and market structures.
4. To understand national income concepts and macroeconomic models.
5. To evaluate the role of money, fiscal policy, and monetary policy in economic stability.

### Syllabus Theory:

**Microeconomics:** *Principles of Demand and Supply* - Supply Curves of Firms - Elasticity of Supply; *Demand Curves of Households* - Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve); *Welfare Analysis* - Consumers' and Producers' Surplus - Price Ceilings and Price Floors; *Consumer Behaviour* - Axioms of Choice - Budget Constraints and Indifference Curves; *Consumer's Equilibrium* - Effects of a Price Change, Income and Substitution Effects - Derivation of a Demand Curve; *Applications* - Tax and Subsidies - Intertemporal Consumption - Suppliers' Income Effect; *Theory of Production* - Production Function and Iso-quants - Cost Minimization; *Cost Curves* - Total, Average and Marginal Costs - Long Run and Short Run Costs; *Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition*

**Macroeconomics:** *National Income and its Components* - GNP, NNP, GDP, NDP; Consumption Function; Investment; *Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector* - Taxes and Subsidies; *External Sector* - Exports and Imports; *Money* - Definitions; *Demand for Money* - Transactionary and Speculative Demand; *Supply of Money* - Bank's Credit Creation Multiplier; *Integrating Money and Commodity Markets* - IS, LM Model; *Business Cycles and Stabilization* - Monetary and Fiscal Policy - Central Bank and the Government; *The Classical Paradigm* - Price and Wage Rigidities - Voluntary and Involuntary Unemployment

### Course Outcomes(CO)

- **CO1:** Explain the principles of demand and supply, elasticity, and market equilibrium.
- **CO2:** Analyze consumer and producer behavior using budget constraints, indifference curves, and cost functions.
- **CO3:** Evaluate market structures including perfect competition, monopoly, and monopolistic competition.
- **CO4:** Interpret national income aggregates, Keynesian models, and the IS-LM framework.
- **CO5:** Assess the impact of fiscal and monetary policies on business cycles and economic stability.

### Text Books:

1. *Microeconomics*, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. *Macroeconomics*, Dornbusch, Fischer and Startz.
3. *Economics*, Paul Anthony Samuelson, William D. Nordhaus.

### Reference Books:

1. *Intermediate Microeconomics: A Modern Approach*, Hal R, Varian.
2. *Principles of Macroeconomics*, N. Gregory Mankiw.

Semester 2

<b>DEN011A</b>	<b>Business Communication and Value Science – II</b>	<i>Credits 2-0-0 2</i>
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<b><u>TEACHING SCHEME:</u></b>	<b><u>EXAMINATION SCHEME:</u></b>	<b><u>CREDITS ALLOTTED:</u></b>
<b>Theory: 3 Hrs./Week</b>	<b>Semester Examination: 50 marks</b>	<b>4</b>
<b>Practical: 7 Hrs. / Week</b>	<b>Continuous Assessment: Yes</b>	
<b>Lab: 7 Hrs. / Week</b>	<b>Term Work: 50 marks</b>	

**Course ID:**

1.6 (Year 1 Semester 2)

	<b>Leadership Oriented Learning (LOL)</b>	
<b>Nature of Course</b>	Behavioral	
<b>Pre requisites</b>	Basic Knowledge of English (verbal and written) Completion of all units from Semester 1	
<b>Course Objectives:</b>		
1	Develop effective writing, reading, presentation and group discussion skills.	
2	Help students identify personality traits and evolve as a better team player.	
3	Introduce them to key concepts of a) Morality b) Behavior and beliefs c) Diversity & Inclusion	
<b>Course Outcomes:</b> <b>Upon completion of the course, students shall have ability to:</b>		
C2.6.1	Understand tools of structured written communication	[U]
C2.6.2	Use tools of structured written communication	[AP]
C2.6.3	Use electronic/social media to share concepts and ideas	[AP]
C2.6.4	Develop materials to create an identity for an organization dedicated to a social cause	[C]
C2.6.5	Understand the basics of presentation	[U]
C2.6.6	Apply effective techniques to make presentations.	[AP]
C2.6.7	Assess presentations based on given criteria	[E]
C2.6.8	Understand tools for quick reading.	[U]
C2.6.9	Apply the basic concept of speed reading, skimming and scanning.	[AP]
C2.6.10	Identify individual personality types and role in a team.	[U]
C2.6.11	Recognize the concepts of outward behavior and internal behavior	[AP]
C2.6.12	Understand the basic concepts of Morality and Diversity	[U]
C2.6.13	Create communication material to share concepts and ideas	[C]
C2.6.14	Argue on a topic based on morality and diversity	[E]
C2.6.15	Articulate opinions on a topic with the objective of influencing others	[C]
C2.6.16	Organize an event to generate awareness and get support for a cause	[C]

**Course Contents:**

<ul style="list-style-type: none"> <li>• <b>Identification of common errors in written communication and ways of rectification</b></li> <li>• <b>Understanding speed reading techniques – Skimming and Scanning</b></li> <li>• <b>Application of reading and writing skills</b></li> <li>• <b>Analyzing personality traits and team player style</b></li> <li>• <b>Understanding the concepts of Morality, Diversity and Inclusion</b></li> <li>• <b>Application of these concepts</b></li> <li>• <b>Creation of communication material</b></li> <li>• <b>Experiencing diversity and organizing events to support inclusion</b></li> <li>• <b>Assignment – Assimilation of concepts and present them effectively</b></li> </ul>	
<b>Total Hours:</b>	<b>61</b>
<b>Text Books:</b>	
	There are no prescribed texts for Semester 2 – there will be handouts and reference links shared.
<b>Reference Books:</b>	
1	Guiding Souls : Dialogues on the purpose of life; Dr. A.P.J Abdul Kalam ;Publishing Year-2005; Co-author--Arun Tiwari
2	The Family and the Nation; Dr. A.P.J Abdul Kalam; Publishing year: 2015; Co-author: Acharya Mahapragya
3	The Scientific India: A twenty First Century Guide to the World around Us; Dr. A.P.J Abdul Kalam; Publishing year: 2011; Co-author- Y.S.Rajan
4	Forge Your Future: Candid, Forthright, Inspiring ; Dr. A.P.J Abdul Kalam; Publishing year: 2014
5	Abundance: The Future is Better Than You Think; Peter H. Diamandis and Steven Kotler; Published: 21 Feb, 2012; Publisher: Free Press
6	Start With Why: How Great Leaders Inspire Everyone to Take Action; Simon Sinek; Published: 6 October 2011; Publisher: Penguin
7	Advertising & IMC: Principles and Practice; Sandra Moriarty, Nancy D. Mitchell, William D. Wells; Published: 15 June 2016; Publisher: Pearson Education India
<b>Web References:</b>	
1	ETHICS FUNDAMENTALS AND APPROACHES TO ETHICS <a href="https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf">https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf</a>
2	A Framework for Making Ethical Decisions <a href="https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions">https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions</a>
3	Five Basic Approaches to Ethical Decision- <a href="http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf">http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf</a>
<b>Online Resources:</b>	
1	<a href="https://youtu.be/CsaTslhSDI">https://youtu.be/CsaTslhSDI</a>
2	<a href="https://m.youtube.com/watch?feature=youtu.be&amp;v=IIKvV8_T95M">https://m.youtube.com/watch?feature=youtu.be&amp;v=IIKvV8_T95M</a>
3	<a href="https://m.youtube.com/watch?feature=youtu.be&amp;v=e80BbX05D7Y">https://m.youtube.com/watch?feature=youtu.be&amp;v=e80BbX05D7Y</a>

4	<a href="https://m.youtube.com/watch?v=dT_D68RJ5T8&amp;feature=youtu.be">https://m.youtube.com/watch?v=dT_D68RJ5T8&amp;feature=youtu.be</a>		
5	<a href="https://m.youtube.com/watch?v=7sLLEdBgYYY&amp;feature=youtu.be">https://m.youtube.com/watch?v=7sLLEdBgYYY&amp;feature=youtu.be</a>		
<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>			
<b>Formative assessment (Max. Marks:20)</b>			
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>
C1.6.1	Understand	Immersion (interview)	5
C1.6.2	Understand	Create CV	4
C1.6.3	Apply	Group Assignment- Form an NGO	5
C1.6.4	Understand	Group activities	3
C1.6.5	Create	Create and present a street play to articulate and amplify the social cause.	3
<b>Summative Assessment based on End Semester Project</b>			
<b>Bloom's Level</b>			
Understand	Written Assessment, project and group discussion		50
Apply			
Analyze			

### Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1			Icebreaker. 1) Participate in 'Join Hands Movement'. Individual identification of social issues.2) Each Individual chooses one particular social issue which they would like to address. 3) Class to be divided in teams for the entire semester. All activities to be done in teams and the grades, credit points will be captured in the leader board in the class room.4) Theory to introduce the participant Slam book to be used for capturing individual	Group discussion, Practical	60 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			learning points and observations.		
1	Understand tools of structured written communication	Understand	Research on the social cause each group will work for.	Practical (practical)	90 Minutes
1	Use tools of structured written communication	Understand	Class discussion- Good and Bad Writing. Common errors, punctuation rules, use of words.	PPT, Theory and Practical	90 Minutes
1			<b>Group Practical</b> – As a group, they will work on the social issue identified by them. Research, read and generate a report based on the findings. (Apply the learning and recap from the session)	Formative evaluation	70 Minutes
1	Create communication material to share concepts and ideas	Create	<b>Practical:</b> Plan and design an E Magazine. Apply and assimilate the knowledge gathered from Sem-1 till date. Share objective & guideline. All members to contribute an article to the magazine, trainer to evaluate the content.	Practical (Practical)	120 Minutes
1	Understand tools for Lucid writing	Understand	Lucid Writing: Encourage the students to go through the links given about Catherine Morris and Joanie McMahon's writing techniques.	Theory and Discussion	30 mins
1	Create communication material to share concepts and ideas	Create	Create the magazine	Practical (Lab)	90 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1		Understand	SATORI – Participants share the personal take away acquired from GD, writing and reading skills activities captured in their handbook. Share the most important learning points from the activities done so far and how that learning has brought a change.	Theory/Discussion	60 Minutes
1	Use electronic/social media to share concepts and ideas	Apply	Launching an E Magazine.	Practical (Lab)	120 Minutes
1			<b>Quiz Time</b>	Summative Evaluation for Unit	60 Minutes
<b>Unit 2</b>					
2	Develop materials to create an identity for an organization dedicated to a social cause	Create	Each group will form an NGO. Create Vision, Mission, Value statement, tagline and Design a logo.	Practical and Practical	90 Minutes
2	Understand the basics of presentation	Understand	Introduction to basic presentation skills & ORAI app	Theory and video	60 Minutes
2	Apply effective techniques to make presentations.	Apply	Groups to present their NGOs. Apply the learning gathered from session 2. Presentation to be recorded by the groups. feedback from the audience/ Professor	Formative evaluation	60 Minutes
2	Assess presentation based on given criteria	Evaluate	Group to come back and share their findings from the recording. Post work-individual write up to be written and evaluated for the E- magazine	Sharing of learning, written Practical and formative evaluation	60 Minutes &

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
					60 Minutes
2	<p>Create communication material to share concepts and ideas</p> <p>Use electronic/social media to share concepts and ideas</p>	<p>Create</p> <p>Apply</p>	<p>Prepare and publish the Second episode of the E Magazine.</p>	<p>Practical (Lab)</p>	<p>120 minutes</p>
2	<p>Understand the tools for speed reading.</p> <p>Apply the basic concepts of speed reading, skimming and scanning.</p>	<p>Understand</p> <p>Apply</p>	<p>Speed Reading session: Introduction to skimming and scanning; practice the same.</p>	<p>Theory and Practical</p>	<p>30 Minutes</p>
2		<p>Understand</p>	<p>SATORI – Join the dots- Participants to connect their learning gathered from AIP Unit-2 with their existing curriculum</p>	<p>Share the most important learning points</p>	<p>60 Minutes</p>
2			<p><b>Quiz Time</b></p>	<p>Summative Evaluation for Unit</p>	<p>60 Minutes</p>
<b>Unit 3</b>					
3	<p>Develop materials to create an identity for an organization dedicated to a social cause</p>	<p>Create</p>	<p>Ad campaign- Brain storming session- Students to discuss and explore the means of articulating and amplifying the social issue their NGOs are working for.</p>	<p>Discussion</p>	<p>60 Minutes</p>
		<p>Create</p>			

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
3	Create communication material to share concepts and ideas.		Design a skit- a) write the script articulating the message of their respective NGOs. Read out the script. (Skit time-5 minutes). Feedback of Theory.	Practical based learning. Formative evaluation by Theory	a) 30 Minutes b) 60 Minutes
3	Use electronic/social media to share concepts and ideas	Apply Apply	Promote the play through a social media and gather your audience. Enact the play. Capture the numbers of likes and reviews. Theory to assign grades to individual team.	Practical based learning Formative Evaluation	Lab Time: 90 Minutes Class Time:60 Minutes
3	Identify individual personality types and role in a team.	Understand	(1) Theory to find out from the participants their views, observations and experiences of working in a team(2) Intro of Dr. Meredith Belbin and his research on team work and how individuals contribute.	Discussion and Theory	60 Minutes
3	Identify individual personality types and role in a team.	Understand	Cont. (3) Belbin's 8 Team Roles and Lindgren's Big 5 personality traits.(4) Belbin's 8 team player styles	Practical based learning followed by a presentation	40 Minutes
3	Identify individual personality types and role in a team.	Understand	(1) Team Falcon Practical to identify individual personality traits with Belbin's 8 team player styles	Practical based learning followed by a presentation.	(1 &2) 40 Minutes
3	Recognize the concepts of outward behavior and internal behavior	Understand	(2) Similar personality types to form groups (3) Groups present their traits.	Presentation	(3) 60 minutes
3	Create communication material to share concepts and ideas.  Use the electronic/social	Create  Apply	Prepare and publish the third episode of the E Magazine.	Practical	60 Minutes

<b>Unit No</b>	<b>Objective</b>	<b>Bloom's Level</b>	<b>Content</b>	<b>Type of Class</b>	<b>Duration</b>
	media to share concepts and ideas				
<b>3</b>		Understand  Understand	SATORI – (join the dots with participants personal life) Participants share the personal take away acquired from working in teams, GD, learning about presentations, presenting their NGOs	Share the most important learning points from the activities done so far. Participants talk about the changes they perceive in themselves	60 Minutes
<b>3</b>			<b>Quiz Time</b>	Summative Evaluation for Unit	60 Minutes
<b>Unit 4</b>					
<b>4</b>	Understand the basic concepts of Morality and Diversity	Understand	Ten minutes of your time – a short film on diversity. Play the video (link to be attached in the FG)	Video & discussion	30 Minutes
<b>4</b>	Understand the basic concepts of Morality and Diversity	Understand	Discuss key take away of the film. Theory to connect the key take away of the film to the concept of empathy.	Practical	30 Minutes
<b>4</b>	Understand the basic concepts of Morality and Diversity	Understand	Touch the target (Blind man) - Debriefing of the Practical. Film: "The fish and I" by Babak Habibifar" (1.37mins)	Practical and discussion	60 Minutes
<b>4</b>	Create communication material to share concepts.	Create	Groups to create a story – 10 minutes of a person's life affected by the social issue groups are working on. Narrate the story in first person. Feedbacks to be shared by the other groups.	Practical, sharing and Practical	120 Minutes
<b>4</b>	Understand the basic concepts of Morality and Diversity	Understand	Research on a book, incident or film based on the topic of your respective NGO	Research and written Practical	120 Minutes

<b>Unit No</b>	<b>Objective</b>	<b>Bloom's Level</b>	<b>Content</b>	<b>Type of Class</b>	<b>Duration</b>
4	Create communication material to share concepts.	Create	Write a review in a blog on the topics they are covering in their research. Theory will give grades to each team.	Written Practical and Formative Evaluation	60 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Session on Diversity & Inclusion- Different forms of Diversity in our society.	PPT, Theory, discussion	60 Minutes
4	Create communication material to share concepts.	Create	Teams to video record interviews of people from diverse groups (Ask 5 questions). Share the recordings in FB	Practical	120 Minutes
4	Argue on a topic based on morality and diversity	Evaluate	Debate on the topic of diversity with an angle of ethics, morality and respect for individual (In the presence of an external moderator). Groups will be graded by the professor.	Practical and formative evaluation	60 Minutes
4	Articulate opinions on a topic with the objective of influencing others	Create	Prepared speech- Every student will narrate the challenges faced by a member of a diverse group in 4 minutes (speech in first person). Theory to give feedback to each student.	Practical and formative Evaluation	90 Minutes
4	Understand the basic concepts of Morality and Diversity	Understand	Discussion on TCS values, Respect for Individual and Integrity.	PPT, Theory, Practical and discussion	60 Minutes
4	Create communication material to share concepts and ideas.  Use the electronic/social media to share concepts and ideas	Create  Apply	Prepare and publish the final episode of the E Magazine.	Practical	120 Minutes

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
4		Understand	SATORI –Participants share the personal take away acquired from working in teams, GD, learning about presentations and understanding diversity inclusion.	Discussion	60 Minutes
4	Use tools of structured written communication	Apply	<b>Revisit your resume</b> Include your recent achievements in your resume.	Submit it to the Professor	Lab time-30 Minutes
4			<b>Quiz Time</b>	Summative Evaluation for Unit	60 Minutes
4	Organize an event to generate awareness and get support for a cause	Create	<p><b>Project-</b> 1) Each team to look for an NGO/ social group in the city which is working on the issue their college group is supporting.</p> <p>2) Spend <b>a day with the NGO/ social group</b> to understand exactly how they work and the challenges they face.</p> <p>3) Render voluntary service to the group for one day</p> <p>4) Invite the NGO/ social group to address their university students for couple of hours. Plan the entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with the NGO spokesperson</p> <p>5) The groups to present their experience of <b>a day with the NGO</b> and inspire students to work for the cause.</p>	Field work: Formative Evaluation	7 Hours
<b>TOTAL</b>					<b>61 hours</b>

<b>Unit No</b>	<b>Objective</b>	<b>Bloom's Level</b>	<b>Content</b>	<b>Type of Class</b>	<b>Duration</b>
	<b>Assessment</b>	Understand	Written Assessment of 20 marks		
		Create	Project of 20 marks (E-Magazine 4 editions)		
		Analyze, Create	Focus Group Discussion 10 marks		

## Semester 3

BCO412A	Formal Language and Automata Theory	Credits 3-0-0 3
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### Course Objectives(COB)

1. To understand the formal models of computation and the Chomsky hierarchy of languages.
2. To study finite automata, regular languages, and their properties.
3. To learn context-free languages, pushdown automata, and their applications.
4. To understand Turing machines, undecidability, and computability theory.
5. To introduce basic concepts of computational complexity and NP-completeness.

### Syllabus Theory

**Introduction:** Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

**Regular languages and finite automata:** 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, *Kleene's theorem*, pumping lemma for regular languages, *Myhill-Nerode theorem and its uses*, minimization of finite automata.

**Context-free languages and pushdown automata:** 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.

**Context-sensitive languages:** Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

**Turing machines:** 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.

**Undecidability:** Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

**Basic Introduction to Complexity:** Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP-completeness, Cook's Theorem, other NP-Complete problems.

### Course Outcomes(CO)

- **CO1:** Explain the fundamental concepts of formal languages, grammars, and the Chomsky hierarchy.
- **CO2:** Design finite automata, regular expressions, and apply properties of regular languages for problem-solving.
- **CO3:** Construct context-free grammars and pushdown automata, and analyze their applications and limitations.

- **CO4:** Describe the working of Turing machines and determine the decidability of computational problems.
- **CO5:** Analyze computational complexity classes, NP-complete problems, and fundamental results like Cook's theorem.

**Laboratory**

1. *YACC, the parser-generating tool*(Chapter 5 of *Introduction to Automata Theory, Languages, and Computation* John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman.)

**Text Books:**

2. *Introduction to Automata Theory, Languages, and Computation* John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman.

**Reference Books:**

1. *Elements of the Theory of Computation*, Harry R. Lewis and Christos H. Papadimitriou.
2. *Automata and Computability*, Dexter C. Kozen.
3. *Introduction to the Theory of Computation*, Michael Sipser.
4. *Introduction to Languages and the Theory of Computation*, John Martin.
5. *Computers and Intractability: A Guide to the Theory of NP Completeness*, M. R. Garey and D. S. Johnson.

## Semester 3

BCO413A	Computer Organization & Architecture	Credits 3-0-0 3
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### *Course Objectives(COB)*

1. To understand the basic building blocks and functional organization of a computer system.
2. To study CPU architecture, instruction set design, and data representation.
3. To learn computer arithmetic and control unit design approaches.
4. To understand memory organization, I/O subsystems, and pipelining concepts.
5. To introduce parallel processing, cache organization, and performance optimization techniques.

### **Syllabus Theory**

**Revision of basics in Boolean logic and Combinational/Sequential Circuits.**

**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit.

**Instruction set architecture of a CPU:** Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

**Data representation:** Signed number representation, fixed and floating point representations, character representation.

**Computer arithmetic:** Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

**Introduction to x86 architecture.**

**CPU control unit design:** Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU.

**Memory system design:** Semiconductor memory technologies, memory organization.

**Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB

**Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

**Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

### *Course Outcomes(CO)*

- **CO1:** Explain the fundamentals of Boolean logic, combinational/sequential circuits, and computer functional units.
- **CO2:** Describe CPU instruction sets, addressing modes, and execution cycles with examples from common architectures.
- **CO3:** Perform integer and floating-point arithmetic operations and explain hardware implementation methods.
- **CO4:** Compare hardwired and microprogrammed control unit designs, memory organization techniques, and I/O mechanisms.
- **CO5:** Analyze pipelining, parallel processing concepts, and cache organization for improving system performance.

### **Text Books:**

1. *Computer System Architecture* M. M. Mano., 3rd ed., Prentice Hall of India, New Delhi, 1993.

2. *Computer Organization and Design: The Hardware/Software Interface*, David A. Patterson and John L. Hennessy.
3. *Computer Organization and Embedded Systems*, Carl Hamacher.

**Reference Books:**

1. *Computer Architecture and Organization*, John P. Hayes.
2. *Computer Organization and Architecture: Designing for Performance*, William Stallings.
3. *Computer System Design and Architecture*, Vincent P. Heuring and Harry F. Jordan.

### Semester 3

<b>BCO414A</b>	<b>Computer Organization &amp; Architecture Lab</b>	<i>Credits 0-0-2 1</i>
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**Lab:**

1. Circuits on breadboard or simulators
  - (a) Implementation of Combinational Digital/Boolean Circuits: Adder, Subtractor, Multiplication Module, Division Module, Multiplexer, Demultiplexer, Encoder, Decoder.
  - (b) Implementation of Sequential Circuits: Counters, Linear Feedback Shift Registers (LFSR)
2. C/C++ programming to understand the formats of char, int, float, double, long etc.
3. Machine language programming on x86 or higher version kits or simulators:
  - (i) Add/subtract/multiplication/division/GCD/LCM
  - (ii) Accessing some specific memory locations/ports
  - (iii) Counting odd and even integers from a series of memory locations
  - (iv) Printing values of selected registers
  - (v) Handling interrupts

## Semester 3

BCO415A	Object Oriented Programming	Credits 3-0-0 3
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### Course Objectives(COB)

1. To understand procedural and object-oriented programming paradigms.
2. To learn the syntax, semantics, and features of C++ in comparison with C.
3. To study object-oriented concepts such as encapsulation, inheritance, and polymorphism.
4. To implement generic programming using templates and exception handling in C++.
5. To introduce object-oriented design principles using UML for software development

### Syllabus Theory

**Procedural programming, An Overview of C:** Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (C-way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive

**Some difference between C and C++:** Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, #define constant vs const, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

**The Fundamentals of Object Oriented Programming:** Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object.

**More extensions to C in C++ to provide OOP Facilities:** Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception)

**Essentials of Object Oriented Programming:** Operator overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling

**Generic Programming:** Template concept, class template, function template, template specialization

**Input and Output:** Streams, Files, Library functions, formatted output **Object Oriented Design and Modelling:** UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design

### Course Outcomes(CO)

- **CO1:** Demonstrate the use of C and C++ syntax, operators, control flow, and program structure.
- **CO2:** Apply object-oriented principles including classes, objects, encapsulation, and data abstraction in C++.
- **CO3:** Implement inheritance, polymorphism, operator overloading, and dynamic binding for code reusability and flexibility.
- **CO4:** Use templates, file handling, and exception handling to create robust and generic programs.
- **CO5:** Develop object-oriented designs using UML diagrams and translate them into C++ code.

### Text Books:

1. *The C++ Programming Language*, Bjarne Stroustrup, Addison Wesley.
2. *C++ and Object-Oriented Programming Paradigm*, Debasish Jana, PHI Learning Pvt. Ltd.

### Reference Books:

1. *Programming – Principles and Practice Using C++*, Bjarne Stroustrup, Addison Wesley.
2. *The Design and Evolution of C++*, Bjarne Stroustrup, Addison Wesley.

### Semester 3

<b>BCO443A</b>	<b>Object Oriented Programming Lab</b>	<b>Credits 0-0-2 1</b>
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#### Laboratory

1. Parameter passing: passing parameter by value vs by reference, passing array as constant pointer
2. Function overloading: writing string operations like strcat and strncat, strcpy and strncpy as overloaded functions.
3. Dynamically allocating space for a pointer depending on input and doing this repeatedly, depending on different inputs and finally de-allocating the pointer.
4. Define class complex with all possible operations: constructor, destructor, copy constructor, assignment operator with the data members stored as pointer to integers.
5. Define class vector of integers with all possible operations like constructor, destructor, copy constructor and assignment operators
6. Define class matrix of integers with all possible operations like constructor, destructor, copy constructor and assignment operators
7. Define class matrix of integers using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators
8. Define class stack, queue, linked-list, array, set using some data-type (int) with data members kept as private and functions kept in both protected and public sections.
9. Define class complex with all possible operators: constructor, destructor, copy constructor, assignment operator and operators >, <, >=, <=, ==, ++ (pre and post), +, +=, (), with the data members stored as pointer to integers.
10. Define class vector of integers with all possible operations like constructor, destructor, copy constructor and assignment operators >, <, >=, <=, ==, ++ (pre and post), +, +=, ()
11. Define class matrix of integers with all possible operations like constructor, destructor, copy constructor and assignment operators >, <, >=, <=, ==, ++ (pre and post), +, +=, ()
12. Define class matrix of integers using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators >, <, >=, <=, ==, ++ (pre and post), +, +=, ()
13. Define stack and queue inherited from array class, with standard functions and operators
14. Define a class called 'array' with data type passed as template type with constructor, destructor, copy constructor and assignment operators and index operator.
15. Define template functions for compare and use it in the algorithms like bubble sort, insertion sort, merge sort.
16. Formatted input-output examples
17. Input manipulators
18. Overriding operators <<, >>
19. Define class model for complex number, student class, book class and show it using UML diagram as well as concrete class.
20. Show behavioural modelling through sequence diagram and activity diagram for workflow in a typical log-in, log-out situation.

### Semester 3

BCO416A	Computational Statistics	Credits 3-0-0 3
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#### *Course Objectives(COB)*

1. To introduce fundamental concepts of multivariate statistical methods and their applications.
2. To apply classification techniques such as discriminant analysis for predictive modeling.
3. To explore dimensionality reduction methods including PCA and factor analysis.
4. To implement clustering techniques for pattern discovery in data.
5. To develop Python programming skills for data wrangling, analysis, and visualization.

#### **Syllabus Theory**

**Multivariate Normal Distribution:** Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.

**Discriminant Analysis:** Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties.

**Principal Component Analysis:** Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.

**Factor Analysis:** Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.

**Clustering:** Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters

#### *Course Outcomes(CO)*

- **CO1:** Explain the properties and applications of multivariate normal distribution and parameter estimation methods.
- **CO2:** Apply discriminant analysis for classification and evaluate the accuracy of classification models.
- **CO3:** Perform PCA and factor analysis for dimensionality reduction and interpret analytical results.
- **CO4:** Implement and analyze various clustering methods for grouping and profiling datasets.
- **CO5:** Use Python for data preprocessing, transformation, aggregation, and time-series analysis.
- **CO6:** Create effective data visualizations using Python's Matplotlib and related libraries.

### Semester 3

BCO417A	Computational Statistics Lab	Credits 0-0-2 1
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#### Laboratory

**Python Concepts, Data Structures, Classes:** Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing

**Data Wrangling:** Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions

**Data Aggregation, Group Operations, Time series:** GoupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting

**Visualization in Python:** Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches

#### Text Books:

1. *An Introduction to Multivariate Statistical Analysis*, T.W. Anderson.
2. *Applied Multivariate Data Analysis, Vol I & II*, J.D. Jobson.
3. *Statistical Tests for Multivariate Analysis*, H. Kris.
4. *Programming Python*, Mark Lutz.
5. *Python 3 for Absolute Beginners*, Tim Hall and J-P Stacey.

*Beginning Python: From Novice to Professional*, Magnus Lie Hetland. Edition, 2005

#### Reference Books:

1. *Regression Diagnostics , Identifying Influential Data and Sources of Collinearity*, D.A. Belsey, E. Kuh and R.E. Welsch
2. *Applied Linear Regression Models*, J. Neter, W. Wasserman and M.H. Kutner.
3. *The Foundations of Factor Analysis*, A.S. Mulaik.
4. *Introduction to Linear Regression Analysis*, D.C. Montgomery and E.A. Peck.
5. *Cluster Analysis for Applications*, M.R. Anderberg.
6. *Multivariate Statistical Analysis*, D.F. Morrison.
7. *Python for Data Analysis*, Wes Mc Kinney.

## Semester 3

BCO418A	Database Management Systems	Credits 3-0-0 3
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### Course Objectives(COB)

1. To introduce fundamental database concepts, models, and architectures.
2. To develop skills in designing and implementing relational databases using normalization techniques.
3. To provide proficiency in relational query languages including SQL and relational algebra.
4. To explain query processing, optimization, indexing, and storage structures for efficient data retrieval.
5. To discuss transaction management, concurrency control, recovery, and database security mechanisms

### Syllabus Theory

**Introduction:** Introduction to Database. Hierarchical, Network and Relational Models.

**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

**Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

**Relational database design:** Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

**Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

**Storage strategies:** Indices, B-trees, Hashing.

**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

### Course Outcomes(CO)

- **CO1:** Describe various database models, architectures, and the role of DBMS in data management.
- **CO2:** Design relational database schemas using ER modeling, functional dependencies, and normalization.
- **CO3:** Formulate and execute queries using relational algebra, relational calculus, and SQL.
- **CO4:** Explain and apply techniques for query optimization, indexing, and storage management.
- **CO5:** Implement transaction processing with concurrency control and recovery mechanisms

### Text Books:

1. Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.

### Reference Books:

1. *Principles of Database and Knowledge – Base Systems*, Vol 1 by J. D. Ullman.
2. *Fundamentals of Database Systems*. R. Elmasri and S. Navathe.
3. *Foundations of Databases*. Serge Abiteboul, Richard Hull, Victor Vianu.

### Semester 3

<b>BCO419A</b>	<b>Database Management Systems Lab</b>	<i>Credits 0-0-2 1</i>
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#### Laboratory

1. C implementation of a Database Editor.
2. Download standard data of reasonable size (Unit level data of various rounds of NSS surveys) from internet and implement various SQL commands

## Semester 4

BCO420A	Operating System (TCS)	Credits 3-0-0 3
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### Course Objectives(COB)

1. To understand the structure, functions, and services of operating systems.
2. To study process, thread management, and CPU scheduling techniques.
3. To learn synchronization, deadlock handling, and inter-process communication.
4. To explore memory, file, and I/O management techniques.
5. To gain practical exposure through UNIX system programming and shell scripting.

### Syllabus Theory

**Introduction:** Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

**Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

**Process Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

**Scheduling algorithms:** Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

**Inter-process Communication:** Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem, Barber's shop problem.

**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

**Concurrent Programming:** Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery.

**Memory Management:** Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction.

**Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

**I/O Hardware:** I/O devices, Device controllers, Direct Memory Access, Principles of I/O.

**File Management:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

**Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

**Case study:** UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls.

**Course Outcomes(CO)**

- **CO1:** Explain the architecture, functions, and services of operating systems.
- **CO2:** Apply CPU scheduling algorithms for process and thread management.
- **CO3:** Implement synchronization techniques and handle deadlock situations.
- **CO4:** Evaluate memory, file, and I/O management strategies.
- **CO5:** Develop programs using UNIX system calls and shell scripting.

**Text Books:**

1. *Operating System Concepts Essentials*. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.

**Reference Books:**

1. *Operating Systems: Internals and Design Principles*. William Stallings.
2. *Operating System: A Design-oriented Approach*. Charles Patrick Crowley.
3. *Operating Systems: A Modern Perspective*. Gary J. Nutt.
4. *Design of the Unix Operating Systems*. Maurice J. Bach.
5. *Understanding the Linux Kernel*, Daniel Pierre Bovet, Marco Cesati.

## Semester 4

<b>BCO421A</b>	<b>Operating system Lab (TCS)</b>	<i>Credits 0-0-2 1</i>
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### Laboratory

1. Unix commands (files directory, data manipulation, network communication etc), shell programming and vi editor
2. C program implementation of the following:
  - a. Scheduling Algorithms
  - b. Shared memory
  - c. Thread and Multi Thread
  - d. Inter Process Communication
  - e. Deadlock Avoidance and Deadlock Detection
  - f. Semaphore
  - g. Memory Management
  - h. Indexing and Hashing

## Semester 4

BCO422A	Design and Analysis of Algorithms	Credits 4-0-0 4
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### Course Objectives(COB)

1. To understand the characteristics and performance analysis of algorithms.
2. To learn various algorithm design strategies and their applications.
3. To develop efficient solutions for graph, tree, and combinatorial problems.
4. To study computational complexity classes and NP-complete problems.
5. To explore advanced algorithmic paradigms like approximation, randomized, and quantum algorithms.

### Syllabus theory

**Introduction:** Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

**Fundamental Algorithmic Strategies:** Brute-Force, Heuristics, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem.

**Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

**Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

### Course Outcomes(CO)

By the end of the course, students will be able to:

- **CO1:** Analyze the time and space complexity of algorithms using asymptotic notations.
- **CO2:** Apply algorithmic design strategies to solve real-world problems.
- **CO3:** Implement and evaluate graph and tree algorithms for various applications.
- **CO4:** Classify problems based on computational complexity and demonstrate NP-completeness proofs.
- **CO5:** Design solutions using advanced paradigms like approximation, randomized, and quantum algorithms.

#### Text Books:

1. *Fundamental of Computer Algorithms*, E. Horowitz and S. Sahni.
2. *The Design and Analysis of Computer Algorithms*, A. Aho, J. Hopcroft and J. Ullman.

#### Reference Books:

1. *Introduction to Algorithms*, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
2. *Computer Algorithms: Introduction to Design and Analysis*, S. Baase.
3. *The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3*, .D. E. Knuth.  
*Quantum Computation and Quantum Information*, Michael A. Nielsen and Isaac L. Chuang.

## Semester 4

<b>BCO423A</b>	<b>Design and Analysis of Algorithms Lab</b>	<b>Credits 0-0-2 1</b>
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Implementation of Different Algorithms based on various algorithmic strategies using C/C++

**Books:**

3. *Fundamental of Computer Algorithms*, E. Horowitz and S. Sahni.
4. *The Design and Analysis of Computer Algorithms*, A. Aho, J. Hopcroft and J. Ullman.

**Reference Books:**

4. *Introduction to Algorithms*, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
  5. *Computer Algorithms: Introduction to Design and Analysis*, S. Baase.
  6. *The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3*, .D. E. Knuth.
- Quantum Computation and Quantum Information*, Michael A. Nielsen and Isaac L. Chuang.

## Semester 4

BCO424A	Software Engineering	Credits 3-0-0 3
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### Course Objectives (COB)

1. Understand the need for software engineering and the engineering approach for building large, reliable systems.
2. Learn software project management fundamentals—life-cycle models, planning, estimation, risk management, and configuration management.
3. Study software quality and reliability—quality models, process/product quality, and basics of reliability estimation.
4. Develop skills in requirements engineering, modeling (decision/event/state tables, Petri nets, use cases, UML), and metrics-based control.
5. Learn object-oriented analysis/design (abstraction, modularity, encapsulation), design patterns, refactoring, construction principles, and testing concepts.

### Syllabus Theory

**Introduction:** Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline.

**Software Project Management:** Basic concepts of life cycle models – different models and milestones; software project planning – identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management.

**Software Quality and Reliability:** Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

**Software Requirements Analysis, Design and Construction:** Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics based control methods; measures of code and design quality.

**Object Oriented Analysis, Design and Construction:** Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object oriented construction principles; object oriented metrics.

**Software Testing:** Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value

tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

**Course Outcomes (CO)**

**CO1:** Explain software engineering principles, life-cycle models, and the role of SE in delivering quality software on time.

**CO2:** Prepare project plans with schedule/effort estimates, identify risks with mitigation strategies, and apply configuration management practices.

**CO3:** Apply software quality frameworks (e.g., McCall, Boehm, FURPS/FURPS+, ISO-9126/CMMI concepts) and basic reliability estimation to improve process and product quality.

**CO4:** Produce clear SRS documents and model requirements using decision/event/state tables, Petri nets, use cases, and UML; employ metrics for code/design quality control.

**CO5:** Design object-oriented solutions using CRC modeling, design patterns, and refactoring; and construct effective tests (black/white-box, coverage-based, use-case/transaction, and non-functional).

**Text Books:**

1. *Software Engineering*, Ian Sommerville

**Reference Books:**

1. *Fundamentals of Software Engineering*, Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino
  2. *Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices*, Michael Jackson
  3. *The Unified Development Process*, Ivar Jacobson, Grady Booch, James Rumbaugh
  4. *Design Patterns: Elements of Object-Oriented Reusable Software*, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides
  5. *Software Metrics: A Rigorous and Practical Approach*, Norman E Fenton, Shari Lawrence Pfleeger
  6. *Software Engineering: Theory and Practice*, Shari Lawrence Pfleeger and Joanne M. Atlee
  7. *Object-Oriented Software Construction*, Bertrand Meyer
  8. *Object Oriented Software Engineering: A Use Case Driven Approach* --Ivar Jacobson
  9. *Touch of Class: Learning to Program Well with Objects and Contracts* --Bertrand Meyer
- UML Distilled: A Brief Guide to the Standard Object Modeling Language* --Martin Fowler

## Semester 4

<b>BCO425A</b>	<b>Software Engineering Lab</b>	<i>Credits 0-0-2 1</i>
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### **Laboratory**

*Development of requirements specification, function oriented design using SA/SD, object-oriented design using UML, test case design, implementation using C++ and testing. Use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle.*

## Semester 4

<b>DBA006A</b>	<b>Introduction to Innovation IP Management and Entrepreneurship</b>	<i>Credits 3-0-0 3</i>
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### Course Objectives (COB)

1. Understand the concept, sources, and processes of innovation, and its role in business growth.
2. Learn how to build innovative organizations, create products/services, and leverage open innovation.
3. Explore entrepreneurship fundamentals, opportunity recognition, competitive advantage, and IPR protection.
4. Understand entrepreneurial financial planning, projections, valuation, and funding sources.
5. Gain knowledge of Intellectual Property Rights, their types, legal procedures, and their business/marketing applications.

### UNIT – I

#### **Innovation: What and Why?**

Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations.

Class Discussion- Is innovation manageable or just a random gambling activity?

### UNIT – II

#### **Building an Innovative Organization**

Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture

Class Discussion- Innovation: Co-operating across networks vs. 'go-it-alone' approach

### UNIT – III

#### **Entrepreneurship:**

- Opportunity recognition and entry strategies
- Entrepreneurship as a Style of Management
- Maintaining Competitive Advantage- Use of IPR to protect Innovation

### UNIT – IV

#### **Entrepreneurship- Financial Planning:**

- Financial Projections and Valuation
- Stages of financing
- Debt, Venture Capital and other forms of Financing

### UNIT – V

#### **Intellectual Property Rights (IPR)**

- Introduction and the economics behind development of IPR: Business Perspective
- IPR in India – Genesis and Development
- International Context
- Concept of IP Management, Use in marketing

### UNIT – VI

#### **Types of Intellectual Property**

- Patent- Procedure, Licensing and Assignment, Infringement and Penalty
- Trademark- Use in marketing, example of trademarks- Domain name
- Geographical Indications- What is GI, Why protect them?
- Copyright- What is copyright
- Industrial Designs- What is design? How to protect?

Class Discussion- Major Court battles regarding violation of patents between corporate companies

#### **Home Assignment:**

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be ready to discuss these topics (in groups) in class. Students are required to meet in groups before coming to class and prepare on the topic. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

Topic 1- Is innovation manageable or just a random gambling activity?

Topic 2- Innovation: Co-operating across networks vs. 'go-it-alone' approach

Topic 3- Major Court battles regarding violation of patents between corporate companies

### **Course Outcomes (CO)**

After completing this course, students will be able to:

- **CO1:** Explain the principles, sources, and strategic importance of innovation in business.
- **CO2:** Develop strategies for creating innovative products/services and evaluate open innovation vs. independent approaches.
- **CO3:** Apply entrepreneurial concepts to identify opportunities, maintain competitive advantage, and use IPR for innovation protection.
- **CO4:** Prepare financial plans, projections, and valuations, and identify appropriate funding sources for new ventures.
- **CO5:** Describe various types of Intellectual Property Rights, legal procedures for protection, and their implications in marketing and business strategy.

### ***Text Books:***

1. *Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change*
2. *Case Study Materials: To be distributed for class discussion*

## Semester 4

DME027C	Operation Research	Credits 2-0-0 2
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### Course Objectives (COB)

1. Understand the fundamentals, origin, and scope of Operations Research, along with its problem-solving approach.
2. Formulate and solve linear programming problems using graphical, simplex, and duality methods.
3. Apply optimization techniques to transportation, assignment, and network problems (PERT/CPM).
4. Analyze and design inventory control models under deterministic and probabilistic conditions.
5. Evaluate queuing systems and use simulation techniques for decision-making in operations research applications.

### Introduction to OR:

Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

### Linear Programming:

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP.

Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.

Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis.

Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.

Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

### Transportation and Assignment problems:

TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.

AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

### PERT – CPM:

Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

### Inventory Control:

Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

### Queuing Theory:

Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase).

Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.

**Simulation Methodology:**

Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

**Course Outcome(CO)**

**CO1:** Apply Operations Research principles to formulate and analyze decision-making problems.

**CO2:** Solve Linear Programming Problems using appropriate optimization algorithms.

**CO3:** Apply transportation, assignment, and project scheduling techniques for effective resource utilization.

**CO4:** Design inventory models to manage and control stock effectively.

**CO5:** Evaluate queuing models and implement simulation methods for operational problem-solving.

**Text Books:**

1. *Operations Research: An Introduction*. H.A. Taha.

**Reference Books:**

1. *Linear Programming*. K.G. Murthy.

2. *Linear Programming*. G. Hadley.

3. *Principles of OR with Application to Managerial Decisions*. H.M. Wagner.

4. *Introduction to Operations Research*. F.S. Hiller and G.J. Lieberman.

5. *Elements of Queuing Theory*. Thomas L. Saaty.

6. *Operations Research and Management Science, Hand Book*: Edited By A. Ravi Ravindran.

7. *Management Guide to PERT/CPM*. Wiest & Levy.

*Modern Inventory Management*. J.W. Prichard and R.H. Eagle.

## Semester 4

<b>DME028A</b>	<b>Operation Research Lab</b>	<i>Credits 0-0-2 1</i>
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### Laboratory

1. Formulation of linear programming problems.
2. Solution of linear programming problem using graphical method with:
  - i. Multiple constraints
  - ii. Unbounded solution
  - iii. Infeasible solution
  - iv. Alternative or multiple solution
3. Enumeration of all basic solutions for linear programming problem.
4. Solution of linear programming problem with simplex method.
5. Problem solving using Big M method.
6. Problem solving using two phase method.
7. Solution on primal problem as well as dual problem.
8. Solution based on dual simplex method.
9. Verification of weak duality, strong duality and complementary slackness property.
10. Solution of transportation problem.
11. Solution of assignment problem.
12. Solution of integer programming problem using Branch and Bound method.
13. Solution of integer programming problem using Gomory's cutting plane method.
14. Simulation: Random number generation.
15. Monte Carlo method.
16. Performance measures for M/M/1 queuing model.
17. ABC analysis.
18. Inventory model

## Semester 4

DBA005A	Marketing Research & Marketing Management	Credits 2-0-0 2
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### Course Objective(COB)

1. Understand fundamental concepts and strategies of marketing.
2. Analyze consumer behavior and market segmentation strategies.
3. Apply product, pricing, promotion, and distribution strategies effectively.
4. Utilize marketing research techniques and data analysis tools for decision-making.
5. Explore applications of internet marketing and business-to-business marketing strategies.

### UNIT – I

**Marketing Concepts and Applications:** Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.

**Marketing Planning & Environment:** Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social

**Understanding the consumer:** Determinants of consumer behavior, Factors influencing consumer behavior

**Market Segmentation:** Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

### UNIT – II

**Product Management:** Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging

### UNIT – III

**Pricing, Promotion and Distribution Strategy:** Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising

### UNIT – IV

**Marketing Research:** Introduction, Type of Market Research, Scope, Objectives & Limitations  
Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research

**Data Analysis:** Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

### UNIT – V

**Internet Marketing:** Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

### UNIT – VI

**Business to Business Marketing:** Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy

### Home Assignments:

1. **Written Analyses of Cases** – Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g. “Marketing Myopia”
2. Field visit & live project covering steps involved in formulating Market Research Project
3. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics

### Course Outcome(CO)

- **CO1:** Explain the concepts, scope, and importance of marketing in various sectors.
- **CO2:** Analyze factors influencing consumer behavior and apply segmentation, targeting, and positioning strategies.

- **CO3:** Develop product, pricing, promotion, and distribution strategies for different market scenarios.
- **CO4:** Apply marketing research tools and statistical analysis techniques to solve marketing problems.
- **CO5:** Formulate strategies for internet marketing and business-to-business marketing environments.

**Text Books:**

1. Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler
2. Fundamentals of Marketing – William J. Stanton & Others
3. Marketing Management – V.S. Ramaswamy and S. Namakumari
4. Marketing Research – Rajendra Nargundkar
5. Market Research – G.C. Beri
6. Market Research, Concepts, & Cases – Cooper Schindler

**Reference Books:**

1. Marketing Management – Rajan Saxena
2. Marketing Management – S.A. Sherlekar
3. Service Marketing – S.M. Zha
4. Journals – The IUP Journal of Marketing Management, Harvard Business Review
5. Research for Marketing Decisions by Paul Green, Donald, Tull
6. Business Statistics, A First Course, David M Levine et al, Pearson Publication

## Semester 4

<b>BCO487A</b>	<b>Design Thinking</b>	<i>Credits 2-0-0 2</i>
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### DESIGN THINKING

<u>TEACHING SCHEME:</u>	<u>EXAMINATION SCHEME:</u>	<u>CREDITS ALLOTTED:</u>
Theory: 1 Hr./Week	Semester Examination: 50 marks	2
Practical: 1 Hr. / Week	Continuous Assessment: Yes	
Activity: 1 Hr. / Week	Term Work: 50 marks	

	<b>Leadership Oriented Learning (LOL)</b>	
<b>Nature of Course</b>	Behavioral	
<b>Pre requisites</b>	Completion of all units from Semesters 1, 2, 3 and 4	
<b>Course Terminal Objectives:</b>		
1	Recognize the importance of DT	
2	Explain the phases in the DT process	
3	List the steps required to complete each phase in DT process	
4	Apply each phase in the DT process	
5	Use doodling and storytelling in presenting ideas and prototypes	
6	Create value proposition statements as part of their presentations	
7	Recognize how DT can help in functional work	
8	Recognize how Agile and DT complement each other to deliver customer satisfaction	
<b>Course Enabling Objectives:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
1	Recognize the importance of Design Thinking	[U]
2	Identify the steps in the DT process	[C]
3	Recognize the steps in the empathize phase of DT	[C]
4	Identify the steps required to conduct an immersion activity	[C]

5	Conduct an immersion activity and fill up the DT question template	[AP]
6	Recognize the steps to create personas in the define phase of DT	[C]
7	Create personas in the define phase of DT	[AP]
8	Recognize the steps to create problem statements in the define phase of DT	[AP]
9	Define the problem statements in the define phase of DT	[E]
10	Recognize the steps in the ideate phase of DT	[C]
11	Apply the steps in the ideate phase of DT	[AP]
12	Recognize how doodling can help to express ideas	[U]
13	Recognize the importance storytelling in presenting ideas and prototypes	[U]
14	Recognize the importance of the prototype phase in DT	[C]
15	Create a prototype	[AP]
16	Recognize the importance of service value proposition	[C]
17	Create a value proposition statement	[AP]
18	Recognize the best practices of the testing phase in DT	[U]
19	Test a prototype created through a DT process	[AP]
20	Recognize how DT can help in functional work	[E]
21	Recognize how Agile and DT complement each other to deliver customer satisfaction	[C]

<b>Course Contents:</b>	
<b>Total Hours:</b>	45 hours
<b>Textbooks:</b>	
	There are no prescribed texts for Semester 5 – there will be handouts and reference links shared.
<b>Reference Books:</b>	
1	Hooked by Nir Eyal
2	The Art of Creative Thinking by Rod Judkins
3	Start Up nation by Dan Senor and Saul singer
4	Start with Why by Simon Sinek
<b>Web References:</b>	
1	What is Design Thinking? Interaction Design Foundation
2	What are some of the good examples of design thinking? - Quora
3	Design thinking 101: Principles, Tools & Examples to transform your creative process
<b>Online Resources:</b>	
1	Understanding Design thinking WF NEN
2	Design Thinking and Innovation at Apple Wei Li

3	Stanford Webinar- Design Thinking = Method, Not Magic
4	Stanford Design Thinking Virtual Crash Course
5	So Many Uses- activity to spark creativity and design

**Semester 4**

<b>BCO488A</b>	<b>Design Thinking Lab</b>	<i>Credits 0-0-2 1</i>
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## Semester 5

BCO430A	Software Design with UML	Credits 2-0-0 2
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### Course Objective (COB)

1. Understand object-oriented technologies, UML methodology, and the software development process.
2. Apply UML models for requirements analysis, design, and documentation.
3. Develop logical and dynamic models using UML diagrams.
4. Design and represent system architecture through component and deployment models.
5. Implement design patterns and object-oriented principles in distributed systems.

### Introduction to on Object Oriented Technologies and the UML Method.

- Software development process: The Waterfall Model vs. The Spiral Model.
- The Software Crisis, description of the real world using the Objects Model.
- Classes, inheritance and multiple configurations.
- Quality software characteristics.
- Description of the Object Oriented Analysis process vs. the Structure Analysis Model.

### Introduction to the UML Language.

- Standards.
- Elements of the language.
- General description of various models.
- The process of Object Oriented software development.
- Description of Design Patterns.
- Technological Description of Distributed Systems.

### Requirements Analysis Using Case Modeling

- Analysis of system requirements.
- Actor definitions.
- Writing a case goal.
- Use Case Diagrams.
- Use Case Relationships.

### Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams.

- Description of goal.
- Defining UML Method, Operation, Object Interface, Class.
- Sequence Diagram.
- Finding objects from Flow of Events.
- Describing the process of finding objects using a Sequence Diagram.
- Describing the process of finding objects using a Collaboration Diagram.

### The Logical View Design Stage: The Static Structure Diagrams.

- The Class Diagram Model.
- Attributes descriptions.
- Operations descriptions.
- Connections descriptions in the Static Model.
- Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity.

### Package Diagram Model.

- Description of the model.
- White box, black box.

- Connections between packages.
- Interfaces.
- Create Package Diagram.
- Drill Down.

#### **Dynamic Model: State Diagram / Activity Diagram.**

- Description of the State Diagram.
- Events Handling.
- Description of the Activity Diagram.
- Exercise in State Machines.

#### **Component Diagram Model.**

- Physical Aspect.
- Logical Aspect.
- Connections and Dependencies.
- User face.
- Initial DB design in a UML environment.

#### **Deployment Model.**

- Processors.
- Connections.
- Components.
- Tasks.
- Threads.
- Signals and Events.

#### **Course Outcome(CO)**

- **CO1:** Explain the fundamentals of object-oriented technologies, UML method, and software development models.
- **CO2:** Analyze system requirements and model them using appropriate UML diagrams.
- **CO3:** Design static and dynamic views of software systems using class, package, state, and activity diagrams.
- **CO4:** Develop component and deployment diagrams to represent system architecture.
- **CO5:** Apply design patterns and object-oriented principles to model distributed software systems effectively.

#### **Text Books:**

1. *The Unified Modelling Language User Guide*. Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.
2. *Object-Oriented Software Engineering: using UML, Patterns, and Java*. Bernd Bruegge and Allen H. Dutoit.

#### **Reference Books:**

1. *Design Patterns: Elements of Reusable Object-Oriented Software*. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides.

## Semester 5

BCO431A	Software Design with UML Lab	Credits 0-0-2 1
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### Laboratory

UML include the following 9 diagrams:

1. Class Diagram
2. Object Diagram
3. Use Case Diagram
4. Sequence Diagram
5. Collaboration Diagram
6. State Chart Diagram
7. Activity Diagram
8. Component Diagram
9. Deployment Diagram

For the following Applications:

- ATM Systems
- Stock Maintenance System
- Remote Procedure Call Implementation

draw the UMLS diagrams.

## Semester 5

BCO428A	Compiler Design	Credits 3-0-0 3
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### Course Objective(COB)

1. Understand the phases of compilation and their roles in program translation.
2. Apply lexical, syntax, and semantic analysis techniques for source code processing.
3. Construct and manage symbol tables and run-time environments.
4. Generate intermediate code and apply code optimization strategies.
5. Implement target code generation considering architecture-dependent optimizations.

### Syllabus Theory

**Introduction:** Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

**Syntax Analysis (Parser):** Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

**Semantic Analysis:** Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

**Symbol Table:** Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.

**Intermediate Code Generation:** Translation of different language features, different types of intermediate forms.

**Code Improvement (optimization):** control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

**Architecture dependent code improvement:** instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

**Advanced topics:** Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

### Course Outcome(CO)

- **CO1:** Explain the phases of a compiler and their interaction in the compilation process.
- **CO2:** Design and implement lexical, syntax, and semantic analyzers using tools like Lex and Yacc.
- **CO3:** Construct and manage symbol tables and describe run-time memory organization.
- **CO4:** Generate intermediate code and apply various local and global optimization techniques.
- **CO5:** Develop target code with architecture-aware optimizations for efficient execution.

### Books:

1. *Compilers: Principles, Techniques and Tools*, V. Aho, R. Sethi and J. Ullman.
2. *Lex & Yacc*, Levine R. John, Tony Mason and Doug Brown

### Reference Books:

*The Design and Evolution of C++*, Bjarne Stroustrup.

**Semester 5**

<b>BCO429A</b>	<b>Compiler Design Lab</b>	<i>Credits 0-0-2 1</i>
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Assignments using Lex and Yacc

## Semester 5

DBA009A	Fundamentals of Management	Credits 2-0-0 2
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### Course Objective(COB)

1. Understand the evolution of management theories and contributions of management thinkers.
2. Apply the functions of management in organizational contexts.
3. Analyze human behavior in organizations and its impact on performance.
4. Evaluate organizational structures and design approaches.
5. Examine ethical practices, corporate governance, and social responsibility in management.
6. Assess leadership concepts, attributes, and development approaches.

#### UNIT – I

**Management Theories:** Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-on word). Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc.

#### UNIT – II

**Functions of Management-** Planning, Organizing, Staffing, Directing, Controlling

#### UNIT – III

**Organization Behavior:** Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making, Problems in Decision Making, Decision Making, Organizational Culture, Managing Cultural Diversity

#### UNIT – IV

**Organizational Design:** Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)

#### UNIT – V

**Managerial Ethics:** Ethics and Business, Ethics of Marketing & advertising, Ethics of Finance & Accounting, Decision – making frameworks, Business and Social Responsibility, International Standards, Corporate Governance, Corporate Citizenship, Corporate Social Responsibility

#### UNIT – VI

**Leadership:** Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid

### Course Outcome(CO)

- CO1:** Explain the evolution of management thoughts and contributions of key management thinkers.
- CO2:** Apply planning, organizing, staffing, directing, and controlling functions in organizational scenarios.
- CO3:** Analyze individual and group behavior to improve organizational effectiveness.
- CO4:** Evaluate different organizational structures and design principles.
- CO5:** Assess ethical issues, corporate governance, and social responsibility in business practices.
- CO6:** Demonstrate leadership skills and strategies for organizational growth.

**Text Books:**

1. Richard L. Daft, *Understanding the Theory and Design of Organizations*

**Reference Books:**

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, *Organizational Behavior*

## Semester 5

DBA010A	Business Strategy	Credits 2-0-0 2
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### Course Objective(COB)

1. Understand the fundamentals and importance of strategic management.
2. Analyze the internal environment of a firm for identifying core competencies and competitive advantage.
3. Evaluate external environmental factors to formulate competitive strategies.
4. Examine corporate strategies and growth strategies for business expansion.
5. Apply strategy implementation frameworks, control mechanisms, and governance principles.

### UNIT – I

#### Introduction to Strategic Management

- Importance of Strategic Management
- Vision and Objectives
- Schools of thought in Strategic Management
- Strategy Content, Process, and Practice
- Fit Concept and Configuration Perspective in Strategic Management

### UNIT – II

#### Internal Environment of Firm- Recognizing a Firm's Intellectual Assets

- Core Competence as the Root of Competitive Advantage
- Sources of Sustained Competitive Advantage
- Business Processes and Capabilities-based Approach to Strategy

### UNIT – III

#### External Environments of Firm- Competitive Strategy

- Five Forces of Industry Attractiveness that Shape Strategy
- The concept of Strategic Groups, and Industry Life Cycle
- Generic Strategies
- Generic Strategies and the Value Chain

### UNIT – IV

#### Corporate Strategy, and Growth Strategies

- The Motive for Diversification
- Related and Unrelated Diversification
- Business Portfolio Analysis
- Expansion, Integration and Diversification
- Strategic Alliances, Joint Ventures, and Mergers & Acquisitions

### UNIT – V

#### Strategy Implementation: Structure and Systems

- The 7S Framework
- Strategic Control and Corporate Governance

#### Home Assignment:

- Latest business events would be discussed in class and students should be ready to discuss these events (in groups). The topic will be mentioned beforehand. Students are required to meet in groups before coming to class and prepare on the topic.
- There will be periodic homework assignments relating to the course concepts or mini-cases. Specific instructions will be given separately.

#### Final Project:

Students (in groups) are required to work on a project and submit the project report and deliver presentation. The topic of the project will be given later.

#### Text Books:

1. Robert M. Grant (2012). *Contemporary Strategic Management*, Blackwell, 7th Edition.

#### Reference Books:

1. M.E. Porter, *Competitive Strategy*, 1980. M.E. Porter,

2. *Competitive Advantage*, 1985 Richard Rumelt (2011).  
*Good Strategy Bad Strategy: The Difference and Why It Matters*.

### Semester 5

<b>DENO12B</b>	<b>Business Communication &amp; Value Science – III</b>	<i>Credits 2-0-0 2</i>
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<u>TEACHING SCHEME:</u>	<u>EXAMINATION SCHEME:</u>	<u>CREDITS ALLOTTED:</u>
<b>Theory: 2.5 Hrs./Week</b>	<b>Semester Examination: 50 marks</b>	<b>4</b>
<b>Practical: 1.5 Hrs. / Week</b>	<b>Continuous Assessment: Yes</b>	
<b>Lab: 2 Hrs. / Week</b>	<b>Term Work: 50 marks</b>	

**Course ID:**

	<b>Leadership Oriented Learning (LOL)</b>	
<b>Nature of Course</b>	Behavioral	
<b>Pre requisites</b>	Basic Knowledge of English (verbal and written) Completion of all units from Semesters 1, 2 and 3	
<b>Course Objectives:</b>		
1	Develop technical writing skills	
2	Introduce students to Self-analysis techniques like SWOT & TOWS	
3	Introduce students to key concepts of: <ul style="list-style-type: none"> <li>a) Pluralism &amp; cultural spaces</li> <li>b) Cross-cultural communication</li> <li>c) Science of Nation building</li> </ul>	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C2.6.1	Apply & analyze the basic principles of SWOT & life positions.	[U]
C2.6.2	Understand, analyze & leverage the power of motivation in real life	[AP]
C2.6.3	Identify & respect pluralism in cultural spaces	[AP]
C2.6.4	Understand and apply the concepts of Global, glocal and translocational	[C]
C2.6.5	Analyze cross cultural communication	[U]
C2.6.6	Apply the science of Nation building	[AP]
C2.6.7	Identify the common mistakes made in cross-cultural communication	[E]
C2.6.8	Understand, apply & analyze the tools of technical writing	[U]
C2.6.9	Recognize the roles and relations of different genders.	[AP]
C2.6.10	Understand Artificial intelligence & recognize its impact in daily life	[U]
C2.6.11	Identify the best practices of technical writing	[AP]
C2.6.12	Differentiate between the diverse culture of India	[E]

<b>Course Contents:</b>	
<b>Objectives for Semester 4</b>	
After completing this semester, learners will be able to:	
<ul style="list-style-type: none"> <li>• Summarize the basic principles of SWOT and Life Positions.</li> <li>• Apply SWOT in real life scenarios.</li> <li>• Recognize how motivation helps real life.</li> <li>• Leverage motivation in real-life scenarios.</li> <li>• Identify pluralism in cultural spaces.</li> <li>• Respect pluralism in cultural spaces.</li> <li>• Differentiate between the different cultures of India.</li> <li>• Define the terms global, glocal and translocational.</li> <li>• Differentiate between global, glocal and translocational culture.</li> <li>• Recognize the implications of cross-cultural communication.</li> <li>• Identify the common mistakes made in cross-cultural communication.</li> <li>• Apply cross-cultural communication.</li> <li>• Differentiate between the roles and relations of different genders.</li> <li>• Summarize the role of science in nation building.</li> <li>• Define AI (artificial intelligence).</li> <li>• Recognize the importance of AI.</li> <li>• Identify the best practices of technical writing.</li> <li>• Apply technical writing in real-life scenarios.</li> </ul>	
<b>Total Hours:</b>	48 hours
<b>Text Books:</b>	
	There are no prescribed texts for Semester 4 – there will be handouts and reference links shared.
<b>Reference Books:</b>	
1	
2	
3	
4	
<b>Web References:</b>	
1	Examples of Technical Writing for Students <a href="https://freelance-writing.lovetoknow.com/kinds-technical-writing">https://freelance-writing.lovetoknow.com/kinds-technical-writing</a>
2	11 Skills of a Good Technical Writer <a href="https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/">https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/</a>
3	13 benefits and challenges of cultural diversity in the workplace <a href="https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/">https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/</a>
<b>Online Resources:</b>	
1	<a href="https://youtu.be/CsaTslhSDI">https://youtu.be/CsaTslhSDI</a>

2	<a href="https://m.youtube.com/watch?feature=youtu.be&amp;v=IIKvV8_T95M">https://m.youtube.com/watch?feature=youtu.be&amp;v=IIKvV8_T95M</a>
3	<a href="https://m.youtube.com/watch?feature=youtu.be&amp;v=e80BbX05D7Y">https://m.youtube.com/watch?feature=youtu.be&amp;v=e80BbX05D7Y</a>
4	<a href="https://m.youtube.com/watch?v=dT_D68RJ5T8&amp;feature=youtu.be">https://m.youtube.com/watch?v=dT_D68RJ5T8&amp;feature=youtu.be</a>
5	<a href="https://m.youtube.com/watch?v=7sLLEdBgYYY&amp;feature=youtu.be">https://m.youtube.com/watch?v=7sLLEdBgYYY&amp;feature=youtu.be</a>

## Semester 5

BCO489A	Machine Learning (Elective I)	Credits 2-1-0 3
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### Course Objective(COB)

1. Understand the fundamentals, models, and applications of Machine Learning.
2. Apply supervised learning techniques for classification and evaluate model performance.
3. Implement sequence modeling approaches such as HMM and CRF for real-world tasks.
4. Apply regression techniques for prediction and analysis.
5. Utilize unsupervised learning algorithms including clustering, association rule mining, and EM.

### Syllabus Theory

**Introduction to Machine Learning (ML);** Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML

**Classification:** Supervised Learning; The problem of classification; Feature engineering; Training and testing classifier models; Cross-validation; Model evaluation (precision, recall, F1-measure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces; Naive Bayes classification; Bayesian networks; Decision Tree and Random Forests; k-**Nearest neighbor classification;** Support Vector Machines; Artificial neural networks including backpropagation; Applications of classifications; Ensembles of classifiers including bagging and boosting

**Hidden Markov Models (HMM) with forward-backward and Viterbi algorithms;** Sequence classification using HMM; Conditional random fields; Applications of sequence classification such as part-of-speech tagging

**Regression:** Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression

Association rule mining algorithms including apriori

Expectation-Maximization (EM) algorithm for unsupervised learning

**Clustering:** average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbors clustering; BIRCH; CURE; DBSCAN

Anomaly and outlier detection methods

### Course Outcome(CO)

- CO1: Explain the concepts, models, and real-world applications of Machine Learning.
- CO2: Apply and evaluate classification algorithms including decision trees, SVM, Naive Bayes, neural networks, and ensemble methods.
- CO3: Implement sequence classification using Hidden Markov Models, Conditional Random Fields, and related algorithms.
- CO4: Apply regression techniques including multivariable regression, regularization, and LASSO to prediction problems.
- CO5: Implement and analyze unsupervised learning methods including clustering, association rule mining, and anomaly detection.

### References:

- [1] R.O. Duda, P.E. Hart, D.G. Stork, **Pattern Classification**, 2/e, Wiley, 2001.
- [2] C. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2007.
- [3] E. Alpaydin, **Introduction to Machine Learning**, 3/e, Prentice-Hall, 2014.
- [4] A. Rostamizadeh, A. Talwalkar, M. Mohri, **Foundations of Machine Learning**, MIT Press.
- [5] A. Webb, **Statistical Pattern Recognition**, 3/e, Wiley, 2011.

## Semester 5

<b>BCO490A</b>	<b>Machine Learning Lab</b>	<i>Credits 0-0-2 1</i>
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### **Lab Sessions:**

- (1) Introduction to WEKA and R
- (2) Classification of some public domain datasets in UCI ML repository

### **Mini projects in the Lab:**

- (1) Implementation of one clustering algorithm
- (2) Implementation of one association rule mining algorithm
- (3) Implementation of one anomaly detection algorithms
- (4) Implementation of EM algorithm for some specific problem

## Semester 6

BCO507A	Computer Networks	Credits 3-0-0 3
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### Course Objectives (COB)

1. To introduce the fundamentals, classifications, and layered architecture of computer networks.
2. To explain data communication components, topologies, protocols, and transmission media.
3. To familiarize students with LAN technologies, bandwidth utilization, and data link layer protocols.
4. To develop understanding of network layer addressing, switching, and routing protocols.
5. To provide knowledge of transport layer protocols, application layer services, and basics of network security.

**Introduction:** Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures.

**Data communication Components:** Representation of data and its flow, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media.

**LAN:** Wired LAN, Wireless LAN, Virtual LAN.

**Techniques for Bandwidth utilization:** Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

**Data Link Layer and Medium Access Sub Layer:** Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back-N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms.

**Application Layer:** DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.

**Network Security:** Electronic mail, directory services and network management, Basic concepts of Cryptography.

### Course Outcomes (CO)

- **CO1:** Explain the architecture, classification, and basic concepts of computer networks.
- **CO2:** Describe data communication methods, transmission media, and network topologies.
- **CO3:** Apply error detection, correction, and multiple access techniques in data link layer operations.
- **CO4:** Analyze network layer addressing, switching, and routing protocols for effective data delivery.
- **CO5:** Evaluate transport and application layer services, and apply basic cryptographic methods for network security.

## Semester 6

<b>BCO508A</b>	<b>Computer Networks Lab</b>	<i>Credits 0-0-2 1</i>
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### **Computer Networks Lab**

1. Socket Programming using C/C++
2. Network System Administration: Understanding switches and routers

#### **Books:**

1. *Computer Networks*, A. Tannenbaum.
2. *Data and Computer Communication*, William Stallings.

#### **Reference Books:**

3. *Network Security*, Kaufman, R. Perlman and M. Speciner.
4. *UNIX Network Programming*, Vol. 1,2 & 3, W. Richard Stevens

## Semester 6

<b>BCO509A</b>	<b>Information Security</b>	<b>Credits 3-0-0 3</b>
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### Course Objectives (COB)

1. To introduce fundamental security parameters, threats, policies, and assurance concepts.
2. To explain access control models, security policies, and international standards.
3. To develop understanding of secure systems design principles and assurance techniques.
4. To familiarize students with logic-based security, vulnerability analysis, and intrusion detection methods.
5. To explore practical applications of security in networks, operating systems, databases, and emerging areas.

### Syllabus Theory

**Overview of Security Parameters:** Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.

**Access Control Models:** Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.

**Security Policies:** Confidentiality policies, integrity policies, hybrid policies, non-interference and policy composition, international standards.

**Systems Design:** Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.

**Logic-based System:** Malicious logic, vulnerability analysis, auditing, intrusion detection.

Applications: Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification.

**Operating Systems Security:** Security Architecture, Analysis of Security in Linux/Windows.

**Database Security:** Security Architecture, Enterprise security, Database auditing.

### Course Outcomes (CO)

- **CO1:** Explain the core principles of information security, including confidentiality, integrity, and availability.
- **CO2:** Compare and apply different access control models and security policies in various environments.
- **CO3:** Design secure systems by incorporating identity management, access control, and assurance techniques.
- **CO4:** Analyze vulnerabilities, detect intrusions, and recommend countermeasures for secure operations.
- **CO5:** Evaluate and implement security solutions for networks, operating systems, and databases in real-world contexts.

## Semester 6

<b>BCO510A</b>	<b>Information Security Lab</b>	<i>Credits 0-0-2 1</i>
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### **Lab**

1. Analysis of security in Unix/Linux.
2. Administration of users, password policies, privileges and roles

### **Books:**

1. *Security Engineering*, Ross Anderson.
2. *Computer Security: Art and Science*, M. Bishop, Pearson Education.
3. *Information Security: Principles and Practice*, M. Stamp.

### **Reference Books:**

1. *Security in Computing*, C.P. Pfleeger, S.L. Pfleeger, J. Margulies.
2. *Secure Programming HOWTO*, David Wheeler.
3. *Browser Security Handbook*, Michael Zalewski.
4. *Handbook of Database Security*, M. Gertz, S. Jajodia.

## Semester 6

BCO511A	Artificial Intelligence	Credits 3-0-0 3
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### Course Objectives (COB)

1. To introduce the fundamental concepts, history, and scope of Artificial Intelligence.
2. To develop problem-solving skills using state space search and heuristic techniques.
3. To explore adversarial search, constraint satisfaction, and knowledge representation methods.
4. To understand probabilistic reasoning, planning, and decision-making in uncertain environments.
5. To familiarize students with the design and application of expert systems.

#### UNIT – I

**Introduction, Overview of Artificial intelligence:** Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

#### UNIT – II

**Problem Solving, Problems, Problem Space & search:** Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

#### UNIT – III

**Search techniques:** Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A\* search, AO\* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

#### UNIT – IV

**Constraint satisfaction problems:** Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

#### UNIT – V

**Knowledge & reasoning:** Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

#### UNIT – VI

**Probabilistic reasoning:** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

#### UNIT – VII

**Expert Systems:** Representing and using domain knowledge, expert system shells, and knowledge acquisition.

### Home Assignments:

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbors, decision trees, etc. can be included in home assignments.

**Course Outcomes (CO)**

- **CO1:** Explain AI fundamentals, intelligent agents, and their interaction with environments.
- **CO2:** Apply search strategies and heuristics to solve complex computational problems.
- **CO3:** Solve constraint satisfaction and game-based adversarial problems using appropriate algorithms.
- **CO4:** Represent and reason with knowledge using logic, rules, and probabilistic models.
- **CO5:** Design simple expert systems and apply AI planning techniques to real-world problems

**Text Books:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

**Reference Books:**

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS

## Semester 6

<b>BCO512A</b>	<b>Artificial Intelligence Lab</b>	<i>Credits 0-0-2 1</i>
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- a. Simulate a goal-based or utility-based agent for a simple environment.
- b. Implement a state space search for the Tic-Tac-Toe problem using minimax algorithm.
- c. Apply BFS and DFS to solve an example problem like the 8-puzzle or pathfinding.
- d. Solve the 8-puzzle problem or shortest path problem using A\* search.
- e. Implement local search algorithms for an optimization problem.
- f. Solve the N-Queens problem using backtracking and local search methods.
- g. Implement alpha-beta pruning for a two-player game (e.g., Connect Four or simplified chess).
- h. Write Prolog programs to represent and query knowledge bases.
- i. Implement probabilistic reasoning using a small Bayesian network.
- j. Build a rule-based expert system using an expert system shell (e.g., CLIPS, PyKnow).

## Semester 6

DBA011A	Financial & Cost Accounting	Credits 3-0-0 3
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### Course Objectives (COB)

1. Understand fundamental accounting concepts, conventions, and techniques for preparing and interpreting financial statements.
2. Develop skills in the accounting process including bookkeeping, journalizing, ledger posting, trial balance, and preparation of final accounts.
3. Analyze financial statements using various tools and apply relevant accounting standards.
4. Apply cash flow, fund flow, and costing techniques for effective financial decision-making.
5. Interpret company accounts, audit reports, and statutory requirements in compliance with corporate regulations.

### UNIT – I

**Accounting Concept:** Introduction, Techniques and Conventions, Financial Statements-  
Understanding & Interpreting Financial Statements

### UNIT – II

#### **Accounting Process:**

- Book Keeping and Record Maintenance
- Fundamental Principles and Double Entry
- Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts
- Cash Book and Subsidiary Books
- Rectification of Errors

### UNIT – III

**Financial Statements:** Form and Contents of Financial Statements, Analyzing and Interpreting  
Financial Statements, Accounting Standards.

*Class Discussion: Corporate Accounting Fraud- A Case Study of Satyam*

### UNIT – IV

**Cash Flow and Fund Flow Techniques:** Introduction, How to prepare, Difference between them

### UNIT – V

#### **Costing Systems:**

- Elements of Cost
- Cost Behavior, Cost Allocation, OH Allocation
- Unit Costing, Process Costing, Job Costing
- Absorption Costing, Marginal Costing, Cost Volume Profit Analysis
- Budgets
- ABC Analysis

*Class Discussion: Application of costing concepts in the Service Sector*

## **UNIT – VI**

### **Company Accounts and Annual Reports:**

- Audit Reports and Statutory Requirements
- Directors Report
- Notes to Accounts
- Pitfalls

### **Home Assignment:**

Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be prepared to discuss these topics in class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

1. Topic: Corporate Accounting Fraud: A Case Study of Satyam
2. Topic: Application of costing concepts in the Service Sector

### **Course Outcomes (CO)**

**CO1** – Prepare and interpret financial statements by applying fundamental accounting principles and conventions.

**CO2** – Execute the complete accounting process from journal entries to final accounts with accuracy.

**CO3** – Analyze corporate financial statements and identify red flags in accounting practices using case studies.

**CO4** – Apply costing techniques, cash flow, and fund flow analysis for managerial decision-making.

**CO5** – Evaluate company accounts, audit reports, and notes to accounts in line with statutory requirements.

### **Text Books:**

1. Robert N Anthony, David Hawkins, Kenneth Marchant, *Accounting: Texts and Cases*, McGraw-Hill
2. Case Study Materials: To be distributed for class discussion

### Semester 6

<b>DEN013A</b>	<b>Business Communication &amp; Value Science – IV</b>	<i>Credits 2-0-0 2</i>
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#### BUSINESS COMMUNICATION & VALUE SCIENCE – IV

<u>TEACHING SCHEME:</u>	<u>EXAMINATION SCHEME:</u>	<u>CREDITS ALLOTTED:</u>
Theory: 5 Hrs./Week	Semester Examination: 50	4
Practical: 2 Hrs. / Week	Continuous Assessment: Yes	
Lab: 1 Hr / Week	Term Work: marks	

	Leadership Oriented Learning (LOL)	
Nature of Course	Behavioral	
Pre requisites	Basic Knowledge of English (verbal and written) Completion of all units from Semesters 1, 2, 3, 4 and 5	
Course Objectives:		
1	Recognize the importance of diversity in workplace	
2	Recognize the best practices of communicative writing	
3	Understand the importance of emotional intelligence in personal and professional lives	
4	Apply emotional intelligence in real life scenarios	
5	Use the best practices of public speaking in real life scenarios	
6	Understand the importance of corporate social responsibility (CSR)	
7	Understand the importance of corporate etiquettes	
8	Practice corporate etiquettes in real life scenarios	
9	Recognize the best practices to share and receive feedback	
10	Use the basic guidelines required to manage conflicts	
11	Understand how stress impacts life and work	
12	Use the best practices to manage stress	
13	Practice the best time management practices	

Course Outcomes: Upon completion of the course, students shall have ability to		
	Understand the importance of diversity in workplace	[U]
	Apply emotional intelligence in real life scenarios	[AP]
	Recognize the best practices of communicative writing	[AP]
	Understand the importance of corporate social responsibility (CSR)	[C]
	Recognize the importance of time management	[U]
	Apply knowledge of multiple intelligences and learning styles in interpersonal interactions	[AP]
	Recognize the impact of stress in life and work	[E]
	Understand how stress impacts life and work	[U]
	Identify the best practices to manage stress	[AP]
	Recognize the attributes needed to function and grow in a corporate environment	[U]
	Recognize the best practices to share and receive feedback	[AP]
	Identify the best time management practices	[E]

Course Contents:	
Objectives for Semester 6	
<p>Understand the importance of diversity in workplace  Identify the key aspects of communicative writing  Apply communicative writing in real life scenarios  Use charts and graphs in communicative writing  Understand what is emotional intelligence  Recognize the importance of emotional intelligence in personal and professional lives  Understand why you would need public speaking at your workplace  Identify the best practices of public speaking  Apply public speaking in real life scenarios  Recognize the importance of corporate social responsibility (CSR)  Recognize the importance of corporate social responsibility (CSR)  Recognize the attributes needed to function and grow in a corporate environment  Recognize the best practices to share and receive feedback  Apply emotional intelligence in real life scenarios  Apply knowledge of multiple intelligences and learning styles in interpersonal interactions  Recognize the impact of conflicts  List the basic guidelines required to manage conflicts  Recognize the key features of corporate etiquette  Recognize the business idioms and corporate terms  Apply the business idioms and corporate terms  Recognize the impact of stress in life and work  Identify the best practices to manage stress  Recognize the importance of time management  Identify the best time management practices</p>	
Total Hours:	45 hours

		40 hours of must know + 5 hours of nice to know learning	
Text Books:			
	There are no prescribed texts for Semester 6 – there will be handouts and reference links shared.		
Reference Books:			
1	Emotional Intelligence: Why it Can Matter More Than IQ by Daniel Goleman		
2	Putting Emotional Intelligence To Work by Ryback David		
3	How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion by Dale Carnegie		
4	TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations		
Web References:			
1	<a href="https://www.tata.com/about-us/tata-group-our-heritage">https://www.tata.com/about-us/tata-group-our-heritage</a>		
2	<a href="https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms">https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms</a>		
Online Resources:			
1	<a href="https://youtu.be/reu8rzD6ZAE">https://youtu.be/reu8rzD6ZAE</a>		
2	<a href="https://youtu.be/Wx9v_J34Fyo">https://youtu.be/Wx9v_J34Fyo</a>		
3	<a href="https://youtu.be/F2hc2FLOdhI">https://youtu.be/F2hc2FLOdhI</a>		
4	<a href="https://youtu.be/wHGqp8lz36c">https://youtu.be/wHGqp8lz36c</a>		
5	<a href="https://youtu.be/hxS5He3KVEM">https://youtu.be/hxS5He3KVEM</a>		
6	<a href="https://youtu.be/nMPqsjuxDmE">https://youtu.be/nMPqsjuxDmE</a>		
Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment (Max. Marks:20)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C1.6.1			5
C1.6.2			4
Summative Assessment based on End Semester Project			
Bloom's Level			
Understand			
Apply			
Analyze			

Lesson Plan

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
1	NA – Recapitulation activity	Recall information	<p>Auld Lang Syne</p> <p>This will be a group activity in which lecturer will give some key words (from what they taught in the previous semesters). Each group will identify topics related to the key words and take 2 mins to share a summary of what they learnt in that topic.</p> <p>They can refer to their Satori books and finally note down these key learnings too.</p>	Activity	45 mins
1	Understand the importance of diversity in workplace	2	Introduce the concept of Diversity in corporate environments through an activity.	Activity	45 mins
1	Understand the importance of diversity in workplace	2	Discussion, role plays and sharing reference materials.	Discussion and Practical	60 mins
1	Identify the key aspects of communicative writing	2	<p>Communicative Writing</p> <p>Principles of Communicative Writing</p> <p>Formal and Business letters</p>	Lecture and practice	90 mins (30 mins lecture + 60 mins practice)
1	Apply communicative writing in real life scenarios	3	<p>Writing proposals</p> <p>This will be taught through a group activity in which students will be asked to create a business proposal to get funding to begin a start-up of their choice.</p> <p>After they share their presentations, lecturer will share the best practices and templates for writing proposals (will be provided to the lecturer as part of the Faculty guide) and ask students to review their proposal and update it.</p>	Lecture and activity	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Students should save this proposal for reference later in the sem.</p> <p>Students will have to continue in these groups for the rest of this sem.</p>		
1	Use charts and graphs in communicative writing	3	<p>How to tell a story with charts and graphs</p> <p>Session will begin with a couple of demo videos.</p> <p>This will be followed by an activity on how to visually represent information to tell a complete story. Students will be required to use the proposal for the start-up that they created in the previous class for this.</p>	Practical	60 mins
1	<p>Understand what is emotional intelligence</p> <p>Recognize the importance of emotional intelligence in personal and professional lives</p>	2	<p>Emotional Intelligence</p> <p>Begin with a short video/movie clip showing manifestations of EI.</p> <p>Introduce the concept of EI and give them the experience through a game/activity.</p> <p>Discuss the findings that students with higher EQ write better exam papers.</p> <p>Ref reading: 10 Ways to Build EI by Daniel Goleman</p> <p>Ask students to note down the names of at least two movies in their Satori slam book, in which the characters display EI.</p>	Lecture and activity	90 mins
1	Understand why you would need public speaking at your workplace	2	<p>Why do we need public speaking?</p> <p>Any two of the YouTube /IncTalks videos: Swami Vivekananda's Chicago speech Steve Jobs' first iPhone launch</p>	Lecture and discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Martin Luther King Jr (I have a dream...)            J K Rowling commencement speech address 2008            APJ Abdul Kalam            Any regional speakers</p> <p>Professors to ask what is common in these videos and lead them to the concept of public speaking (directions will be provided in the Facilitator's Guide).</p> <p>Session for students to re-visit the group discussion and value proposition sessions that they participated in during the previous semesters. (This will be integrated in the semester 6 content)</p>		
1	Identify the best practices of public speaking		<p>Public speaking – best practices</p> <p>Ask each group (formed earlier) to research and come up with a list of best practices along with examples (in the class).</p> <p>After each group presents their list of best practices, students will discuss and create a consolidated list of best practices by considering all common or overlapping ones and map it against the guidelines provided by the TCS team.</p> <p>Additional: Possible guest lecture or webinar (Dr Giri)</p>	Activity	60 mins
1	Apply public speaking in real life scenarios	3	<p>Get, Set, Go – sell your start-up ideas</p> <p>Each group to pitch their start-up idea to a panel consisting of external professors.</p> <p>They will use the presentation they created earlier and the best practices of public</p>	Formative assessment	120 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			speaking to tell their story leveraging the storytelling and doodling methods they learnt in the previous semester (Design Thinking). Their story should at least include: Name of their start-up Who is the target audience/end user? What problem will their start-up solve? How do they plan to run start up? How much money/budget would they need to begin their work? Professors to share the results of this formative assessment with the TCS Team so that we can use it for reference in GD post sem.		
1	NA		Let's relax  This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).	Activity	45 mins
2	Recognize the importance of corporate social responsibility (CSR)	1	Corporate Social Responsibility (CSR)  Ubuntu story – A story to introduce the concept of social responsibility.  The story will be played through an audio embedded in the PPT (similar to an audiobook).	Lecture	45 mins
2	Recognize some of the stalwarts in CSR	1	Hear CSR stories Meeting of JNT and Swami Vivekananda. Societal connect of JNT. Stalwarts in CSR (Led by Tatas) More Tata Group CSR stories --- from Titan and Tata Chemicals	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Initially, Professors will share any two of the above CSR stories. Thereafter, they will discuss the stories in the class and ask the students to share their thoughts.</p> <p>Lecturer to ask students why they need to conduct CSR activities? (Answers will be given in handouts provided by the TATA Team)</p> <p>Why do corporates need to engage in CSR? Is it for compliance only? The answers to these questions (given in the content) will refer back to the topics on TCS values, life skills and empathy taught in the earlier semesters.</p> <p>Lecturer to explain to the students how CSR connects to their values and how CSR activities can add value to their resumes.</p>		
2	Recognize the importance of corporate social responsibility (CSR)	1	<p>Tell a CSR story</p> <p>Activity - Groups will research in class, prepare and present CSR activity of Tata Steel, Microsoft, Google, TCS, Starbucks, Titan, Tata Chemicals and TOMS Shoes.</p>	Practice activity	90 mins
2	Recognize the attributes needed to function and grow in a corporate environment	1	<p>Attributes required for work and life</p> <p>Qualities of a good team member:</p> <ol style="list-style-type: none"> <li>Resilience</li> <li>Flexibility</li> <li>Strategic thinking and planning</li> <li>Decision making</li> <li>Resolving conflicts</li> </ol> <p>Professors to first show examples and non-examples and then the participants to identify the traits that set them apart.</p>	Lecture and discussion	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
	NA		Let's relax  This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).	Activity	45 mins
3	Recognize the attributes needed to function and grow in a corporate environment	1	Activity – Who am I? (Image Management. Building a perfect image)  This is an individual activity in which each participant needs to reflect upon the following questions (in the order given below) and jot down the answers. They will be given a handout with the questions printed on it for this activity.  What do I wish to be seen as? (aspirational state) How do I see myself now? (present state) How others see me? (perceptions) What is the gap between how others see me and how I see myself? How do I fill the gap?  Why is it important to fill the gap (connect to importance of personal branding to stay relevant). Professor to share examples of personal branding in the corporate world, as mentioned in the content.	Activity	60 mins
3	Recognize the best practices to share and receive feedback	1	Examination Result Activity - Locus of control (referring back to Emotional intelligence) One person from each group (to be decided through drawing lots) will be asked to step aside to act as teachers. The rest of the group members will participate as students. Each group will be given a scenario in which they will get	Activity	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>mock grades in an examination. They will be asked to react to their result. Their reactions will be noted. Examination Result Activity-Phase II –Role play on feedback.</p> <p>Now the teachers will be asked to have a discussion with each one to two people from each group sharing their feedback on their reactions.</p> <p>After the activity, tips to receive and give feedback will be shared. Handouts will be shared with lecturers.</p>		
3	Apply emotional intelligence in real life scenarios	3	<p>Applying emotional intelligence</p> <p>Activity for applying Emotional Intelligence using scenarios within each start-up group. There will be separate scenarios for each group.</p> <p>Professors will judge the groups based on guidelines provided by the TCS team.</p>	Lab Activity	60 mins
	NA		<p>Let's relax</p> <p>This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).</p>	Activity	45 mins
4	Apply knowledge of multiple intelligences and learning styles in interpersonal interactions	3	<p>Sensitivity to diversity - Quiz</p> <p>A scenario-based quiz on (handouts to refresh Sem-1 content on multiple intelligences and learning styles followed by scenario-based quiz) – awareness of multiple intelligences and learning styles in communication. The questions will be based on scenarios that</p>	Formative assessment	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			the students might face later in their work environment.		
4	Recognize the impact of conflicts		<p>Understanding conflicts</p> <p>This will be a group activity. Each group will be given a scenario of typical conflicts that occurs in a corporate office. In each group roles will be assigned to the group members who would be expected to play it.</p> <p>Each group will enact the situation while others watch and note down their observations on:</p> <p>What is the conflict?  What has caused the conflict?  What is the negative impact of the conflict?  What can be a positive impact of the conflict?</p> <p>Each group will be requested to draw up a list of tips to manage conflicts at work and share in the next class and post on their Fb/Insta page. They can compare it with handout provided to lecturers.</p> <p>Student needs to reflect upon lessons in empathy and active listening (taught in the previous semesters) while managing conflicts.</p> <p>Each person will be requested to capture at least one Satori moment from these enactments of real-life scenarios.</p>	Activity	90 mins
4	List the basic guidelines required to manage conflicts	1	<p>Tips to manage conflicts</p> <p>Each group will share their list of guidelines to manage conflicts, post which the lecturer can share the standard</p>	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>list provided (as a hand-out) and discuss the main points in the class.</p> <p>After that the lecturer will ask them to reflect on what are the changes they need to bring about in their behaviour, based on Belbin's Team Player roles (Sem 2 Unit 3).</p>		
4	Recognize the key features of corporate etiquette	1	<p>Corporate etiquette</p> <p>Mock interview rounds for each group with a prospective employer followed by discussions on corporate etiquette (leverage Interview Ready app)</p>	Activity	60 mins
4	<p>Recognize the business idioms and corporate terms</p> <p>Apply the business idioms and corporate terms</p>	1  3	<p>Business idioms and Corporate Terms</p> <p>This will begin with a quiz in which in the first four rounds each group needs to identify the business idioms and corporate terms from given excerpts. In the next four rounds they will be asked to supply the correct idiom or term in a given business scenario.</p> <p>After the quiz, the lecturer would share handouts of common business idioms and guide them to download the TCS BizVocab on their smartphones.</p>	Lab activity	60 mins
4	Recognize the impact of stress in life and work	1	<p>Managing Stress</p> <p>Participants will first watch a short YouTube video:</p> <p>Managing Stress - Brainsmart – BBC (2:24 mins)</p> <p>Then the lecturer will discuss stress and its impact through the following questions:</p>	Lecture	60 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>Have you ever felt stressed?            What are the situations that make you feel stressed?            Does the stress help you in overcoming the situation?            Do you know how stress affects your health?</p> <p>After this they will watch a video on how stress impacts health:</p> <p>YouTube: The Long-term Effects of Stress (5 mins)</p> <p>Finally, each group will be asked to create a poster with stress management tips to be presented in the next class and uploaded on their Fb/Insta pages.</p>		
5	Identify the best practices to manage stress	1	<p>Tips to manage stress</p> <p>Each group will present their posters and the class will come up with a list of stress management tips to be put up on the Fb/Insta page.</p> <p>They should also note this in their journals so that they can refer to it whenever they feel stressed.</p>	Discussion Activity	60 mins
	Recognize the importance of time management	1	<p>Time management</p> <p>Session begins with an introductory activity that establishes the fact that we often manage time poorly and as a result experience stress.</p> <p>After that participants will watch the YouTube video:</p> <p>Importance of Time Management For Better Life Style (3:33 mins)</p> <p>Now the lecturer will conduct an open house discussion,</p>	Lecture	45 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>where the participants will share their challenges to manage time.</p> <p>Now the lecturer will ask the participants to evaluate their ability to handle their daily task within 24 hrs on a scale of 10. This is a confidential rating which participants needs to note down in their satori book with date and time for future reference. ( this activity will be repeated at a later stage)</p>		
	Identify the best time management practices	1	<p>Managing your time better</p> <p>The class will start with the YouTube video:</p> <p>A valuable lesson for a happy life (2:33 mins)</p> <p>After viewing this, the facilitator will ask the participants to identify the rocks, pebbles and sands in their life.</p> <p>This will be followed by the</p> <p>Time Squared Activity: Each participant gets 3 pages with 24 squares representing the hours in a day.</p> <p>Participants need to fill out:</p> <p>The first page with the everyday activities in their day (example, brushing teeth, bathing, meals, travelling, etc)</p> <p>The second page with the non-productive work that they do every day (social media, mobile-games, etc)</p> <p>On the third page they can add everything from the first two pages to find out the empty spaces. That is their</p>	Activity	90 mins

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			<p>productive time when they can study. This gives them a view of what they can adjust in order to increase their study time.</p> <p>Reference video: Study Skills – Managing your time (4:29 mins)</p> <p>Participants to repeat the self-evaluation exercise. In this instant, the participants will evaluate their ability to plan their daily task on a scale of 1 to 10 with date and time. Lecturer to encourage participants to evaluate their time management skills on a regular basis.</p>		
	NA		<p>Let's relax</p> <p>This will be a short session in which students will participate in at least 2 Anubhaav Activities (to be specified in the Fac Guide).</p>	Activity	45 mins
		1	<p>Create memories</p> <p>Recap activity on the entire BCVS Course.</p>		30 mins
				Total	30 hours
			<p>Project</p> <p>Each group to create a POC (Proof of Concept) for their start-up applying their learnings from the CSBS course (core subjects + BCVS).</p> <p>The evaluation for this POC will be done as part of the Sem end assessment by the TCS team. During the assessment, students need to share the</p>		10 hours

Unit No	Objective	Bloom's Level	Content	Type of Class	Duration
			journey of creating their start-up: from inception to POC.		

## Semester 6

BCO513A	Data Mining and Analytics	Credits 3-0-0 3
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### Course Objectives (COB):

1. Introduce the fundamental concepts, processes, and techniques of data mining and its relationship with related technologies such as DBMS, OLAP, machine learning, and statistics.
2. Develop an understanding of data preprocessing, knowledge representation, and attribute-oriented analysis for effective data preparation and interpretation.
3. Familiarize students with data mining algorithms for association, classification, and prediction, along with practical experimentation using Weka.
4. Equip learners with advanced analytical techniques including regression models, forecasting, generalized linear models, and non-linear regression methods for descriptive and predictive analytics.
5. Apply time series analysis, optimization, and prescriptive analytics techniques to solve real-world decision-making and business intelligence problems.

### Syllabus Theory

#### UNIT – I

**Introduction to Data Mining:** What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications

#### UNIT – II

**Data preprocessing:** Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization

**Data mining knowledge representation:** Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques

**Attribute-oriented analysis:** Attribute generalization, Attribute relevance, Class comparison, Statistical measures

#### UNIT – III

**Data mining algorithms - Association rules:** Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis

**Data mining algorithms - Classification:** Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules

**Data mining algorithms – Prediction:** The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models

#### UNIT – IV

**Descriptive analytics:** Data Modeling, Trend Analysis, Simple Linear Regression Analysis

**Forecasting models:** Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of

parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models

**Generalized Linear model:** link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.

**Non Linear Regression (NLS):** Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods. Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods

#### **UNIT – V**

**Time Series Analysis:** Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing

**Linear time series models:** Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes, Forecasting using ARIMA models

**Prescriptive Analytics:** Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modeling, Decision and Risk analysis, Decision trees

#### **Home Assignments:**

**Experiments with Weka** – Visualization Techniques, using filters and statistics, mining association rules, decision trees rules, Prediction

**Mining real data:** Preprocessing data from a real domain (Medical/ Retail/ Banking); Applying various data mining techniques to create a comprehensive and accurate model of the data

**Analytics Assignment 1:** Conduct and Present a summary report on an End to end statistical model building exercise using sample data – Data preprocessing, Descriptive Analysis (Exploratory Data Analysis), Hypothesis building, Model Fitting, Model Validation and Interpretation of results

**Analytics Assignment 2:** Build statistical models using any two linear and non-linear regression techniques: Simple Linear Regression; Multiple Regression; Variable Selection Problem; Multicollinearity and Ridge Regression; Nonlinear regression; Non-parametric regression; Logistic regression (binary and multiple); Poisson/Negative binomial regression (Use sample data sets)

#### **Course Outcomes (CO):**

Explain the principles of data mining, its stages, techniques, and applications in various domains.

1. Perform data preprocessing tasks such as cleaning, transformation, reduction, and discretization using tools like Weka.
2. Implement and analyze data mining algorithms for association rule mining, classification, and prediction on real-world datasets.
3. Apply regression models, forecasting methods, and generalized linear models to conduct descriptive and predictive analytics.
4. Analyze and design time series models and prescriptive analytics approaches (optimization, risk analysis, decision trees) for effective decision support.

**Text Books:**

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010
3. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.

**Reference Books:**

1. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third Edition.
- Hosmer, D. W. and Lemeshow, S. (1989). Applied Logistic Regression (Wiley).

## Semester 6

<b>BCO514A</b>	<b>Data Mining and Analytics Lab</b>	<i>Credits 0-0-2 1</i>
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### Lab Experiments

1. Install and explore Weka 3 to understand dataset formats, filters, and classifiers.
2. Perform data cleaning and transformation on datasets using Weka filters.
3. Apply data reduction and feature selection techniques such as PCA and InfoGain.
4. Discretize continuous attributes and build concept hierarchies for data analysis.
5. Conduct attribute-oriented analysis (AOA) through generalization and class comparison.
6. Implement association rule mining (Apriori) to discover frequent itemsets and rules.
7. Analyze correlation and interestingness measures to validate mined association rules.
8. Build classification models using One-Rule (1R) and Decision Tree (J48) algorithms.
9. Compare Naïve Bayes and k-Nearest Neighbor classifiers on real-world datasets.
10. Develop linear regression models for descriptive and predictive analytics.
11. Implement logistic regression for binary/multiclass classification and hypothesis testing.
12. Perform time series forecasting using ARIMA and Holt-Winters methods.

## Semester 7

<b>BCO438A</b>	<b>Usability Design of Software Applications</b>	<b>Credits 2-0-0 2</b>
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### Course Objectives (COB):

1. Introduce the principles of User-Centred Design (UCD) and its importance in developing usable, functional, and aesthetic products.
2. Develop the ability to critically evaluate products, websites, and apps based on usability, heuristics, ergonomics, and user experience principles.
3. Familiarize students with UX research methods such as contextual enquiry, interviews, personas, and competitive analysis.
4. Apply design thinking, task flows, and prototyping techniques to create user-friendly digital interfaces.
5. Enable students to conduct usability testing and iterative design improvements leading to an effective redesign project.

<b>Introduction to User Centred Design</b>
Aspects of User Centred Design Product Appreciation Assignment – Evaluating the product from user centred design aspects such as functionality, ease of use, ergonomics, aesthetics.
Heuristic Evaluation: 10 Heuristic Principles, Examples Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.
<b>Group Assignment Presentations and reviews.</b>
Group Project identification Students will identify a project such as a website or mobile app to redesign. They will take this redesign project through the design lifecycle: Discovery Define Design Implement (Design Prototype) Usability Testing The below design methods and techniques will be imparted w.r.t. the group project selected by the students.
<b>UX Research</b> Understanding users, their goals, context of use, environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX
<b>Scenarios and Persona Technique</b>
Presentation of Personas for the group project
Design Thinking Technique Discovery and brainstorming

Concept Development
Task flow detailing for the Project
Prototyping Techniques Paper, Electronic, Prototyping Tools
Project Prototyping Iteration 1
Project Prototyping Iteration 2
Review and feedback
Final presentation of solution – Exam

**Course Outcomes (CO):**

1. Explain the key aspects of user-centred design, heuristic principles, and usability factors.
2. Evaluate products, websites, and apps using heuristic evaluation, severity ratings, and recommendations.
3. Conduct UX research through user interviews, contextual enquiry, and persona development for real projects.
4. Design and prototype user-friendly interfaces by applying design thinking, task flows, and iterative prototyping techniques.
5. Test and validate redesigned solutions through usability testing and present the final outcomes effectively.

**Text Books:**

1. Class Handouts
2. Online forum links, reference articles, blogs
3. Interaction Design: Beyond Human-Computer Interaction, 4<sup>th</sup> Edition, Jenny Preece, Helen Sharp and Yvonne Rogers
4. About Face, 4th Edition, Alan Cooper and Robert Reimann
5. Observing the User Experience, Second Edition: A Practitioner's Guide to User Research. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed
6. The Elements of User Experience: User-Centered Design for the Web and Beyond. 2nd Edition, Jesse James Garrett
7. Understanding Design Thinking, Lean, and Agile - [Jonny Schneider](#)

**Semester 7**

<b>BCO439A</b>	<b>Usability Design of Software Applications Lab</b>	<i>Credits 0-0-2 1</i>
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Semester 7

DBA002B	Financial Management	Credits 2-0-0 2
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**Course Objectives (COB):**

1. Introduce the fundamental concepts of financial management, the goals of the firm, and the financial environment.
2. Explain the concepts of time value of money, valuation of securities, and the risk-return trade-off.
3. Develop an understanding of leverage, cost of capital, and capital budgeting techniques for effective financial decision-making.
4. Analyze working capital management policies, including cash and receivables management strategies.
5. Enable students to apply financial tools and techniques for evaluating investment opportunities and managing corporate finances.

**UNIT – I**

**Introduction :** Introduction to Financial Management - Goals of the firm - Financial Environments.

**Time Value of Money :** Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.

**UNIT – II**

**Valuation of Securities :** Bond Valuation, Preferred Stock Valuation , Common Stock Valuation, Concept of Yield and YTM.

**Risk & Return:** Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM)

**UNIT - III**

**Operating & Financial Leverage:** Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study

**Cost of Capital :** Concept , Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital  
4L

**Capital Budgeting :** The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods

**UNIT – IV**

**Working Capital Management:** Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.

**Cash Management:** Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.

**Accounts Receivable Management:** Credit & Collection Policies, Analyzing the Credit Applicant, CreditReferences, Selecting optimum Credit period. 4L

**Course Outcomes (CO):**

1. Describe the scope, objectives, and environment of financial management.
2. Apply time value of money concepts to evaluate investment and financing decisions.
3. Evaluate bonds, stocks, and other securities, and assess risk-return relationships in a portfolio context.
4. Compute and analyze leverage, cost of capital, and use capital budgeting techniques for project evaluation.
5. Formulate working capital, cash, and receivable management policies to improve liquidity and profitability.

**Text Book**

Chandra, Prasanna - Financial Management - Theory & Practice, Tata McGraw Hill.

**References Books :**

Srivastava, Misra: Financial Management, OUP

Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/  
Pearson Education.

## Semester 7

BCO440A	IT Workshop Skylab/Matlab	Credits 2-0-0 2
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### Course Objectives (COB):

1. Introduce the history, features, and basic environment of MATLAB, emphasizing good programming practices.
2. Develop skills in creating, managing, and operating on MATLAB variables, matrices, arrays, and mathematical functions.
3. Familiarize students with MATLAB plotting capabilities for effective data visualization.
4. Enable students to write scripts, functions, and apply control flow constructs for problem-solving.
5. Train students to debug MATLAB programs systematically and manage computational workflows.

#### **Introduction to MATLAB**

History, basic features, strengths and weaknesses, good programming practices and plan your code

#### **Working with variables, workspace and miscellaneous commands**

Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands,

#### **Matrix, array and basic mathematical functions**

Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.

#### **Basic plotting**

Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours

#### **Introduction to programming**

Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands

#### **Control flow and operators**

``if ... end" structure, relational and logical operators, ``for ... end" loop, ``while ... end" loop, other flow structures, operator precedence, saving output to a file

#### **Debugging M-files**

Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file

### Course Outcomes (CO):

1. **Explain** MATLAB features, workspace management, and basic commands.
2. **Perform** matrix generation, array operations, and solve linear equations using MATLAB functions.
3. **Create and customize** plots with titles, labels, annotations, and multiple datasets.

4. **Write** MATLAB scripts and functions using control structures, operators, and input/output commands.
5. **Debug and correct** M-files effectively by using breakpoints, examining values, and applying structured debugging techniques.

**Text Books:**

1. *Digital Image Processing using MATLAB*. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Pearson Education, Inc., 2004.
2. *MATLAB: A Practical Introduction to Programming and Problem Solving*. Stormy Attaway, Butterworth-Heinemann.

**Reference Books:**

1. <https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/book.pdf>  
[https://www.mathworks.com/help/releases/R2014b/pdf\\_doc/matlab/getstart.pdf](https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf)

**Semester 7**

<b>BCO441A</b>	<b>IT Workshop Skylab/Matlab + Lab</b>	<i>Credits 0-0-2 1</i>
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Implementation of various Image Processing Algorithms

Semester 7

DBA001B	Human Resource Management	Credits 2-0-0 2
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**Course Objectives (COB):**

1. Introduce the fundamental concepts, challenges, and philosophies of Human Resource Management (HRM).
2. Develop understanding of HR system design, HR accounting, audits, and the role of HRIS in decision-making.
3. Familiarize students with functional areas of HRM including recruitment, compensation, training, compliance, and employee relations.
4. Enable learners to apply HR planning methods for forecasting, staffing, retention, succession planning, and workforce development.
5. Analyze strategic human resource management approaches and special HR considerations in the service sector.

**UNIT – I**

**Human Resource Management:** Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.

**UNIT – II**

**Human Resource System Design:** HR Profession, and HR Department, Line Management Responsibility in HRM, Measuring HR, Human resources accounting and audit; Human resource information system

**UNIT – III**

**Functional Areas of HRM:** recruitment and staffing, benefits, compensation, employee relations, HR compliance, organizational design, training and development, human resource information systems (H.R.I.S.) and payroll.

**UNIT – IV**

**Human Resource Planning:** Demand Forecasting, Action Plans– Retention, Training, Redeployment & Staffing, Succession Planning

**UNIT – V**

**Strategic Management of Human Resources:** SHRM, relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace

**UNIT – VI**

**Human Resource Management in Service Sector-** Special considerations for Service Sector including

- Managing the Customer – Employee Interaction
- Employee Empowerment and Customer Satisfaction
- Service Failure and Customer Recovery – the Role of Communication and Training
- Similarities and Differences in Nature of Work for the Frontline Workers and the Backend
- Support Services - Impact on HR Practices Stressing Mainly on Performance

- Flexible Working Practices – Implications for HR

**Home Assignment:**

Further, the topic for class discussion will be mentioned beforehand. Students are required to meet in groups before coming to class and prepare for the topic to be discussed. Instructor may ask the student groups to present their analysis and findings to the class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

1. Topic: Understanding the issues and challenges involved in managing a diverse workforce
2. Topic: Is The Only Purpose of a Corporation to Maximize Profit?
3. Topic: Similarities and Differences in Manufacturing and Service Sector - Impact on HR Practices

**Course Outcomes (CO):**

1. Explain the concepts, policies, procedures, and challenges in managing human resources.
2. Design and evaluate HR systems including HR audits, accounting, and HR information systems.
3. Apply HR practices in recruitment, compensation, employee relations, training, and payroll management.
4. Develop HR action plans for forecasting, staffing, retention, redeployment, and succession planning.
5. Critically analyze HR strategies for competitive advantage and apply HRM practices in the service sector for employee empowerment and customer satisfaction.

**Text Books:**

1. Gary Dessler, *Human Resource Management*

## Semester 7

BCO523A	Introduction to IoT	Credits 2-1-0 3
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### Course Objectives (COB):

1. Introduce the fundamental concepts of the Internet of Things (IoT), its building blocks, and use cases across consumer and industrial domains.
2. Explain IoT reference architectures, edge computing, gateways, and data processing pipelines.
3. Familiarize students with sensors, transducers, industrial control, and data acquisition systems used in IoT.
4. Develop understanding of networking and communication protocols for IoT, including proximity networks, industrial protocols, and cloud connectivity.
5. Enable learners to apply IoT data processing techniques such as time series storage, analytics, anomaly detection, and data cleaning.

#### UNIT – I

**Introduction to IoT and Use cases:** Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains,

#### UNIT – II

**Architecture:** IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing

#### UNIT – III

**Sensors and Industrial Systems:** Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions

#### UNIT – IV

**Networking and Communication for IoT:** Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers)

#### UNIT – V

**IoT Data Processing and Storage:** Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection,

#### IoT Seminars:

Selected topics in IoT should be handled via student seminars. Recommended that students form a group do research on at least one of the following topics and present it through seminars. They are expected to do a literature survey of the topic and present their survey paper to the class. The suggested topics are –

##### a) IoT Applications

- Smart Cities
- Connected Vehicles and Telematics
- Smart Grids
- Smart Homes

##### b) IoT data visualization

##### c) Survey of cloud based IoT platforms

- d) **Low power wide area networks for IoT**
- e) **IoT device management**
- f) **Survey of chips, embedded modules and development boards for IoT devices**
- g) **Embedded and real-time operating systems for IoT**
- h) **IoT Security**
  - Security risks in IoT
  - Securing IoT endpoint devices and secure communication protocols for IoT
  - Security and Privacy of IoT data

**Course Outcomes (CO):**

1. Describe IoT concepts, architectures, and industrial/consumer applications.
2. Analyze IoT reference architectures, gateways, and edge computing approaches for real-world scenarios.
3. Integrate sensors and industrial data acquisition/control systems into IoT solutions.
4. Apply networking protocols and communication technologies to design IoT-enabled applications.
5. Implement basic IoT data processing, storage, and analytics using time series data handling techniques.

**Text Books:**

4. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

**Reference Books / Links:**

1. Industrial Internet Reference Architecture - <http://www.iiconsortium.org/IIRA.htm>
2. World Economic Forum Report on Industrial Internet of Things - <https://www.weforum.org/reports/industrial-internet-things>
3. 50 Sensor Applications for a Smarter World - [http://www.libelium.com/resources/top\\_50\\_iot\\_sensor\\_applications\\_ranking/](http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/)
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzi, O Reilly Media
7. GSMA IoT Security Guidelines & Assessment - <https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/>

## Semester 7

<b>BCO524A</b>	<b>Introduction to IoT Lab</b>	<i>Credits 0-0-2 1</i>
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### Lab Exercises

1. Setting up the Arduino Development Environment, connecting analog sensors to an Arduino Boarding and reading analog sensor data
2. Digital Input and Output reading using and Arduino board and Arduino Development Environment
3. Integrate an Arduino Board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi
4. Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language
5. Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images and video
6. Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication
7. Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol
8. Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi via MQTT protocol. On receipt of the message , toggle the LED lights on the Arduino
9. Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file
10. Develop a mobile application to view the images captured by the R Pi camera

Semester 7

BCO525A	Mobile Computing	Credits 2-1-0 3
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**Course Objectives (COB):**

1. Introduce students to wireless and mobile communication fundamentals, cellular architecture, and design objectives.
2. Explain location and handoff management mechanisms, mobility models, and performance issues in mobile networks.
3. Provide an understanding of wireless transmission technologies including MIMO, OFDM, and multiple access control methods.
4. Explore mobile ad-hoc and wireless sensor networks, focusing on routing, energy efficiency, coverage, and connectivity.
5. Familiarize students with emerging technologies such as cognitive radio networks and device-to-device communication in 5G systems.

**Introduction:** Overview of wireless and mobile infrastructure; Preliminary concepts on cellular architecture; Design objectives and performance issues; Radio resource management and interface; Propagation and path loss models; Channel interference and frequency reuse; Cell splitting; Channel assignment strategies; Overview of generations:- 1G to 5G.

**Location and handoff management:** Introduction to location management (HLR and VLR); Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based); Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model); Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based); Terminal Paging (Simultaneous paging, Sequential paging); Location management and Mobile IP; Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical).

**Wireless transmission fundamentals:** Introduction to narrow and wideband systems; Spread spectrum; Frequency hopping; Introduction to MIMO; MIMO Channel Capacity and diversity gain; Introduction to OFDM; MIMO-OFDM system; Multiple access control (FDMA, TDMA, CDMA, SDMA); Wireless local area network; Wireless personal area network (Bluetooth and zigbee).

**Mobile Ad-hoc networks:** Characteristics and applications; Coverage and connectivity problems; Routing in MANETs.

**Wireless sensor networks:** Concepts, basic architecture, design objectives and applications; Sensing and communication range; Coverage and connectivity; Sensor placement; Data relaying and aggregation; Energy consumption; Clustering of sensors; Energy efficient Routing (LEACH).

**Cognitive radio networks:** Fixed and dynamic spectrum access; Direct and indirect spectrum sensing; Spectrum sharing; Interoperability and co-existence issues; Applications of cognitive radio networks.

**D2D communications in 5G cellular networks:** Introduction to D2D communications; High level requirements for 5G architecture; Introduction to the radio resource management, power control and mode selection problems; Millimeter wave communication in 5G.

**Course Outcomes (CO):**

1. Describe cellular system architecture, radio resource management, and propagation models in wireless communication.
2. Analyze location management schemes, mobility models, and handoff strategies for mobile networks.
3. Apply wireless transmission techniques such as MIMO, OFDM, and multiple access protocols in real-world scenarios.
4. Evaluate routing, coverage, connectivity, and energy efficiency issues in MANETs and wireless sensor networks.
5. Demonstrate understanding of advanced wireless technologies including cognitive radio, spectrum sharing, and 5G D2D communications.

**Text Books:**

1. Mobile Communications. Jochen Schiller, Pearson Education.
2. *Wireless Communications*. Andrea Goldsmith, Cambridge University Press.

**Reference Books:**

3. *Wireless Communications: Principles and Practice*. Theodore Rappaport, Pearson Education.
  4. *Wireless Communications*. Ezio Biglieri, MIMO, Cambridge University Press.
  5. *Handbook of Wireless Networking and Mobile Computing*. Ivan Stojmenovic, Wiley.
  6. *Dynamic Location Management in Heterogeneous Cellular Networks*. James Cowling,
  7. MIT Thesis. <http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov04.pdf>
  8. *Location Management in Wireless Cellular Networks*. Travis Keshav, [https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular\\_location.pdf](https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf)
  9. *Location Management in Wireless Data Networks*. Fahd A. Batayneh, [https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless\\_location.pdf](https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_location.pdf)
  10. *Principles of Mobile Communication*. Gordon L. Stber, Springer.
  11. *Wireless Device-to- Device Communications and Networks*. Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, Cambridge University Press.
  12. *Principles of Cognitive Radio*. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, Cambridge University Press.
  13. *Wireless Sensor Networks: Architectures and Protocols*. Edgar H. Callaway, Jr. and Edgar H. Callaway, CRC Press.
- A Discrete-Event Network Simulator*. <https://www.nsnam.org/docs/manual/html/index.html>

Semester 7

<b>BCO526A</b>	<b>Mobile Computing Lab</b>	<i>Credits 0-0-2 1</i>
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**Laboratory**

Development and implementation of different network protocols using network simulators such as NS-3 and OMNET++.

## Semester 7

DBA012A	Services Science & Service Operational Management	Credits 3-0-0 3
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### Course Objectives (COB):

1. Introduce students to the fundamentals of service operations, the role of services in the economy, and the Indian service sector.
2. Explain the nature of services, service encounters, and service-dominant logic emphasizing value co-creation.
3. Develop strategic understanding of service competitiveness, service design, facility location, and quality management.
4. Provide insights into service recovery, demand forecasting, capacity and demand management, inventory in services, and supply chain management.
5. Familiarize students with service innovation, productivity enhancement, and emerging challenges in service operations.

### UNIT – I

**Introduction:** Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector

**Nature of Services and Service Encounters:** Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters

**Service-Dominant Logic:** From Goods-Dominant logic to Service-Dominant logic, Value Co-creation

### UNIT – II

**Service Strategy and Competitiveness:** Development of Strategic Service Vision (SSV), Data Envelopment Analysis

**New Service Development:** NSD cycle, Service Blueprinting, Elements of service delivery system

**Service Design:** Customer Journey and Service Design, Design Thinking methods to aid Service Design

**Locating facilities and designing their layout:** models of facility locations (Huff's retail model), Role of service-scape in layout design

**Service Quality:** SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools

### UNIT – III

**Service Guarantee & Service Recovery:** How to provide Service guarantee? How to recover from Service failure?

### UNIT – IV

**Forecasting Demand for Services:** A review of different types of forecasting methods for demand forecasting.

**Managing Capacity and Demand:** Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services.

**Managing Facilitating Goods:** Review of inventory models, Role of inventory in services

**Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service

**Vehicle Routing Problem:** Managing after sales service, Understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes

### UNIT – V

**Service Innovation:** Services Productivity, Need for Services Innovation

### Course Outcomes (CO):

1. Differentiate between goods and services, and analyze the importance of service encounters in value creation.

2. Apply frameworks such as service blueprinting, SERVQUAL, and service design thinking for developing and improving service delivery systems.
3. Evaluate strategies for service guarantee, service recovery, capacity-demand matching, and waiting line management.
4. Analyze service supply chain issues including inventory, supplier relationships, and vehicle routing problems in after-sales services.
5. Demonstrate understanding of service productivity and innovation to improve competitiveness and customer satisfaction in service organizations.

**Student Project:**

Option 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.

Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

**Text Books:**

1. Fitzsimmons & Fitzsimmons, *Service Management: Operations, Strategy, Information Technology*, McGraw Hill publications (7th edition)

**Reference Books:**

1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). *Services marketing: Integrating customer focus across the firm*. McGraw Hill.
2. Lovelock, C. (2011). *Services Marketing, 7/e*. Pearson Education India
3. Reason, Ben, and Lovlie, Lavrans, (2016) *Service Design for Business: A Practical Guide to Optimizing the Customer Experience*, Pan Macmillan India,
4. Chesbrough, H. (2010). *Open services innovation: Rethinking your business to grow and compete in a new era*. John Wiley & Sons.

**Reference Papers:**

1. Karmarkar, U. (2004). Will you survive the services revolution? *Harvard Business Review*, 100-107.
2. Vargo, S. L., & Lusch, R. F. (2008). From goods to service (s): Divergences and convergences of logics. *Industrial marketing management*, 37(3), 254-259.
3. Vargo, S. L., & Lusch, R. F. (2008). "Service-Dominant Logic: Continuing the Evolution," *Journal of the Academy of Marketing Science* (36:1), pp. 1-10
4. Silvestro, R., Fitzgerald, L., Johnston, R., & Voss, C. (1992). Towards a classification of service processes. *International journal of service industry management*, 3(3), 62-75.
5. Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European management journal*, 26(3), 145-152.
6. Shostack, G.L., (1984), "Designing Services That Deliver," *Harvard Business Review*, January-February 1984, pp. 132-139
7. Evenson, S., & Dubberly, H. (2010). Designing for service: Creating an experience advantage. *Introduction to service engineering*, 403-413.
8. Edvardsson, B., & Olsson, J. (1996). Key concepts for new service development. *Service Industries Journal*, 16(2), 140-164.
9. Goldstein, S. M., Johnston, R., Duffy, J., & Rao, J. (2002). The service concept: the missing link in service design research? *Journal of Operations management*, 20(2), 121-134.
10. Kumar, A., Zope, N. R., & Lokku, D. S. (2014, April). An approach for services design by understanding value requirements, identifying value carriers, developing value proposition, and subsequently realizing value. In *Global Conference (SRII), 2014 Annual SRII* (pp. 298-304). IEEE.

11. Parasuraman, A., Zeithaml, V.A., and Berry, L.L., (1985), "A Conceptual Model of Service Quality and Its Implications for Future Research," *The Journal of marketing*, Vol. 49, No. 4, pp. 41-50
  12. Cronin, J.J., and Taylor, S.A., (1992), "Measuring Service Quality: A Reexamination and Extension," *The Journal of Marketing*, Vol. 56, No. 3, pp. 55-68
  13. Van Ree, H. J., (2009), *Service Quality Indicators for Business Support Services*, Ph.D. Thesis, University College London, London.
  14. Zope, N. R., Anand, K., & Lokku, D. S. (2014, April). Reviewing Service Quality for IT Services Offerings: Observations in the Light of Service Quality Models & Determinants. In *Global Conference (SRII), 2014 Annual SRII* (pp. 43-49). IEEE.
  15. Heskett, J.L., Jones, T.O., Loveman, G.W., Sasser, W.E., and Schlesinger, L.A., (2008), "Putting the Service-Profit Chain to Work," *Best of HBR, Harvard Business Review*, July-August 2008, pp. 118-128
  16. Clatworthy, S. (2011). Service innovation through touch-points: Development of an innovation toolkit for the first stages of new service development. *International Journal of Design*, 5(2).
  17. Barras, R. (1986). "Towards a Theory of Innovation in Services," *Research Policy* (15), pp. 161-173.
  18. Gustafsson, A., and Johnson, M. (2003). *Competing in a Service Economy: How to Create a Competitive Advantage Through Service Development and Innovation*, San Francisco: Jossey-Bass.
  19. Barrett, M., Davidson, E., Prabhu, J., & Vargo, S. L. (2015). "Service innovation in the digital age: key contributions and future directions". *Mis Quarterly*, 39(1), 135-154.
- Lusch, R. F., and Nambisan, S. (2015). "Service Innovation; A Service-Dominant Logic Perspective," *MIS Quarterly* (39:1), pp.155-175

## Semester 7

<b>DBA012B</b>	<b>Services Science &amp; Service Operational Management Lab</b>	<i>Credits 0-0-2 2</i>
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### Lab Experiments

1. Case Study Analysis of Indian Service Sector – Study and present the operations strategy of a chosen service company (e.g., banking, healthcare, IT services).
2. Service Encounter Observation – Observe a real service encounter (restaurant, hospital, call center) and evaluate using service package framework.
3. Service Blueprinting Exercise – Develop a blueprint for a selected service (e.g., online food delivery, salon service).
4. SERVQUAL Analysis – Conduct a small survey to measure service quality dimensions and identify service gaps.
5. Walkthrough Audit – Perform an audit of a physical service location (bank branch, retail store, clinic) and suggest improvements.
6. Facility Location Analysis – Solve a service location problem using Huff's retail location model with given data.
7. Waiting Line Simulation – Use queuing models to analyze customer waiting times and suggest service capacity improvements.
8. Service Guarantee & Recovery Role Play – Design a service guarantee for a selected company and simulate a service failure with recovery strategies.
9. Inventory in Services Case Study – Analyze how inventory of facilitating goods (e.g., spare parts in after-sales service) impacts service delivery.
10. Service Innovation Project – Identify an existing service, redesign it using design thinking tools, and present a prototype/service improvement plan

## Semester 7

BCO521A	IT Project Management	Credits 3-0-0 3
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### Course Objectives (COB)

1. To provide fundamental knowledge of project management concepts, feasibility studies, scheduling, and cost estimation.
2. To develop skills in applying project scheduling techniques such as PERT, CPM, crashing, and resource leveling.
3. To enhance understanding of project monitoring, risk analysis, cost control, and audit mechanisms.
4. To introduce Agile methodologies, Scrum framework, and DevOps practices for modern project management.
5. To cultivate teamwork and problem-solving skills through case studies, workshops, and practical applications of Agile and DevOps.

### UNIT – I

**Project Overview and Feasibility Studies-** Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal

### UNIT – II

**Project Scheduling:** Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.

### UNIT – III

**Cost Control and Scheduling:** Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling

### UNIT – IV

**Project Management Features:** Risk Analysis, Project Control, Project Audit and Project Termination

### UNIT – V

**Agile Project Management:** Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).

### UNIT – VI

**Scrum:** Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum.

### UNIT – VII

**DevOps:** Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring.

### UNIT – VIII

**Other Agile Methodologies:** Introduction to XP, FDD, DSDM, Crystal

### Workshop:

Workshops will be conducted as a part of this course which is mandatory for students to attend. The primary objective of the workshops is to teach the students the agile project management including Scrum and DevOps through group activities.

### Home Assignment:

Case studies will be distributed to students beforehand and students should prepare and try to solve these cases before coming to class. Students will be asked submit and present their understanding of the cases and solutions before the class.

### Course Outcomes (COs)

**CO1:** Explain the concepts of project feasibility, market analysis, project cost estimation, and financial appraisal.

**CO2:** Apply PERT and CPM techniques for project scheduling, calculate critical paths, floats, and perform activity crashing for cost reduction.

**CO3:** Analyze project risks, resource scheduling, and apply cost control methods for effective project management.

**CO4:** Demonstrate knowledge of Agile principles, methodologies, and the relationship between Agile, Scrum, Lean, DevOps, and ITIL.

**CO5:** Implement Scrum framework by defining roles, artifacts, sprint cycles, and best practices in project execution.

**Text Books:**

1. Mike Cohn, *Succeeding with Agile: Software Development Using Scrum*
2. Notes to be distributed by the course instructor on various topics

**Reference Books:**

1. Roman Pichler, *Agile Product Management with Scrum*
2. Ken Schwaber, *Agile Project Management with Scrum (Microsoft Professional)*

Semester 7

BCO522A	IT Project Management Lab	Credits 0-0-2 1
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**Lab Experiments**

1. Conduct feasibility study and financial appraisal of a project.
2. Construct PERT/CPM network and identify the critical path.
3. Perform project crashing for time–cost trade-off.
4. Apply resource allocation and leveling techniques.
5. Implement project cost control using Earned Value Management.
6. Prepare a risk register and analyze project risks.
7. Design project control, audit, and closure process.
8. Simulate Scrum process through sprint planning and review.
9. Create product backlog with estimation and prioritization.
10. Set up CI pipeline with Git for automated builds and testing.
11. Containerize an application using Docker and config management.
12. Demonstrate continuous deployment with monitoring setup.

Semester 8

<b>BCO 034C</b>	<b>Industrial Project/Dissertation</b>	<i>Credits 0-0-32 16</i>
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