

**Course Code R4CO4602S**  
**Prerequisite: NIL**

**Course Title: Data Structure**

**COURSE OUTCOMES**

Students will be able to

1. Analyze the problem while organizing data.
2. Design a suitable structure for organization of data and Analysis of Algorithms to access it.
3. Apply the appropriate data structure for the given application.
4. Implement efficient data structure and different Searching and Sorting Methods.

**COURSE CONTENTS:**

<b>Module I</b>	Introduction to data structures: Need of data structures, Types of data structures, recursion, ADT (Abstract Data Types). Basics of algorithm and Analysis of Algorithms
<b>Module II</b>	Stack and Queue: Stack: The stack as an ADT, Representation, Stack operation, Application: Expression Evaluation, Conversion of Infix expression to Postfix expression. Queue: The Queue as an ADT, Representation, Queue operation, Circular and Priority queue, Applications: Implementing stacks using queue.
<b>Module III</b>	Linked list: Linked list as an ADT, Operation on linked list, Linked stacks and Queues, Array implementation of Linked List, Linked list using Dynamic Variable, Doubly, circular linked list. Applications for searching and sorting in a linked list.
<b>Module IV</b>	Binary Tree: Basic tree concept, Binary tree operations, Binary tree representation, Binary tree traversals, Binary search tree and operations on it, balanced tree: AVL trees and operations, applications of these binary trees and exercises on it. Implementing priority queue using binary heap data Structure.
<b>Module V</b>	Graphs: Basics concepts of graphs, representation of graphs, graph traversals BFS and DFS, minimum spanning tree algorithms: Kruskal's algorithm and Prim's algorithm, application and related exercises in brief.
<b>Module VI</b>	<b>Searching and Sorting Techniques:</b> Various sorting methods and their time complexity analysis: Insertion sort, Selection sort, Merge sort, Quick sort, Heapsort Linear Search and Binary Search, Hashing: Direct-address tables, Hash tables, open addressing, Perfect Hashing

<b>Text books</b>	<ol style="list-style-type: none"><li>1. Richard F. Gilberg and Behrouz A. Forouzan, —Data Structures: Pseudocode Approach with C, Second Edition, Cengage Learning Publication.</li><li>2. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, —Fundamental of Data Structure using C++, Galgotia Publication</li></ol>
<b>Recommended reading</b>	<ol style="list-style-type: none"><li>1. Goodrich and Tamassia, Data Structures and Algorithm in Java, John Wiley and Sons.</li><li>2. Y. Langsam, M. J. Augenstein and A. M. Tanenbaum —Data structures using C++, Pearson Education</li></ol>

**Course Code R4IT4601S**

**Course Title: Data Base Management System**

**Prerequisite: NIL**

**COURSE OUTCOME**

1. Demonstrate database management systems, architecture and database operations
2. Design data models for the real-life systems and logical database design.
3. Apply normalized database system.
4. Apply SQL queries for data and database operations and administrations and understand storage and data accessing methodologies, data recovery security transaction processing.

**COURSE CONTENTS:**

<b>Module I</b>	<b>Introduction:</b> Databases and Information Systems, Database System Architecture, Database system concepts: Data modeling, data definition, data dictionary, data manipulation, Database administration function, Levels of abstractions, Data Independence, views, Systems Comparison Of RDBMS, OODBMS, ORDBMS, Database System Applications.
<b>Module II</b>	<b>Relational Data Model:</b> Relational Model: Basic concepts. Attributes and domains, concept of integrity and referential constraints, schema diagram, keys, relational query languages, relational operations, relational algebra.
<b>Module III</b>	<b>Entity Relationship Model:</b> ER model concepts, Components: Strong & weak entities, relationship, attributes & its types, Integrity constraints, Key constraints, Participation constraints, Extended E-R features: Subclasses and inheritance, Specialization and Generalization, EER to Relational mapping.
<b>Module IV</b>	<b>Relational Database Design:</b> Basic concepts of normalization, Functional dependencies, Closure of FDs, Finding primary keys using FDs, Decomposition using Functional Dependencies: Normal forms: 1NF, 2NF, 3NF, Boyce-Codd Normal Form, 4NF, 5NF.
<b>Module V</b>	<b>Introduction to Basic, Intermediate and Advanced SQL:</b> SQL: DDL: Create Modify, Alter, Drop, View definition, etc. DML: SELECT, INSERT, DELETE, Update, Nested Query, SQL with SET operations: Union, Intersect, Except, etc, Aggregate Functions: Group By, Having, SUM, etc, SQL with Logical operations, Nested and Complex Queries, Join Queries. DCL: GRANT, REVOKE, etc DBA level query. PL/SQL Block: PL/SQL Variables and Data types: PL/SQL Control structures: PL/SQL Cursors and Triggers, PL/SQL Subprograms – Stored Procedures and Functions; Online Analytical Processing Tool (OLAP) - Study of Microstrategy
<b>Module VI</b>	<b>Transaction Processing &amp; Database Security:</b> Concepts; ACID Properties of Transaction; Serializability and Recoverability; Concurrency control: Lock-based Concurrency Control protocols; Database recovery: database backup, Recovery System, Database security: importance, issues, common threats and challenges, Best Practices: access control, authorization, Common database attacks, data protection tools and platforms.
<b>Module VII</b>	<b>Storage and Indexing Data:</b> Storage structures: Secondary storage devices, buffering of blocks, Basic file systems – File organization – Serial, Sequential, Indexed Sequential, Searching & Indexing. File Organization & Indexing: Clustered Indexing, Primary & secondary indexes. Advances in the domain
<b>Module VIII</b>	<b>Advances in the domain:</b> Introduction to NoSQL & NewSQL Databases

<b>Textbooks</b>	<ol style="list-style-type: none"> <li>1. Elmasri &amp; Navathe , Fundamentals of Database System, Pearson 7th Edition, 2016.</li> <li>2. Abraham Silberschatz, Henry Korth, Sudarshan, Database System Concepts, McGraw-Hill, 7thEdition, 2019.</li> </ol>
<b>Recommended reading</b>	<ol style="list-style-type: none"> <li>1. Michael Mannino, Database design, Application Development and Administration, Chicago BusinessPress, 6th Edition, 2017</li> <li>2. Peter Rob and Coronel, Database systems: Design, Implementation and Management, Thomson Learning,5th Edition, 2001</li> <li>3. C. J. Date, Introduction To Database Systems, Addison Wesley Longman, Seventh Edition, 2011.</li> <li>4. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill, Third Edition,2014.</li> </ol>

**COURSE OUTCOMES**

Students should be able to:

1. State the advanced automation system used in industrial level.
2. Outline the different parts of PLC and different languages used in PLC.
3. Illustrate PLC hardware configuration for given application.
4. Analyse the given application and prepare a ladder logic program.
5. Propose a scheme for trouble shooting a PLC system.

**COURSE CONTENTS**

<b>Module I</b>	<b>Introduction to Automation and PLC Fundamentals</b>
	Automation – Definition, Need, Benefits, Different tools for automation Evolution of PLC in automation, difference between relay control and PLC Control. Block diagram and description of different parts: CPU - Function, scanning cycle, speed of execution. Power supply- function, Block diagram. Memory – function & organisation of ROM & RAM. Input modules- function, diff. input devices used with PLC (only name & their uses)Output modules- function, diff. output devices used with PLC(only name & their uses)Fixed and Modular PLCs & their types. Specialty I/O modules: communication module, high speed encoder, RTD input module, stepper motor control module, Thermocouple module. Redundancy in PLC modules
<b>Module II</b>	<b>PLC Hardware</b>
	Discrete input modules: AC input modules- block diagram, description, typical wiring details, specifications. DC input modules- block diagram, description, typical wiring details, sinking and sourcing concept & specifications. Analog input modules- block diagram, description, typical interfacing of input devices & specifications. Discrete output modules: AC output modules- block diagram, description, typical wiring, and specifications. DC output modules- block diagram, description, typical wiring details, sinking and sourcing connections & specifications.Relay and Isolated o/p modules. (only description). Analog output modules- block diagram, description, typical wiring details & specifications.I/O module selection criterion.
<b>Module III</b>	<b>PLC Instruction Set</b>
	I/O addressing of PLC.Relay type instructions - NO, NC, One shot, Latch, and Unlatch.Timer instructions - On delay timer, off delay timer, Retentive timer, and Timer reset.Counter instructions - up counter, down counter, high speed counter, counter reset.Comparison instructions – Equal, Not equal, Greater, Greater than equal, Less, Less than equal.Data handling instructions – Move, Masked Move, and Limit test.Logical instructions – AND, OR, EX-OR, NOT.Miscellaneous instructions – Sequencer instructions, scale with parameter, subroutine and PID instructions.
<b>Module IV</b>	<b>Programming and Applications</b>
	Different PLC programming languages (only introduction) - FBD,Instruction list, structured text, sequential function chart, and ladder logic.Simple programming examples using ladder programming language based on relay, timer, counter, logical, comparison, Data handling and miscellaneous instruction.Application development based on description such as-Motor

	sequence control, Traffic light control, Elevator control, Tank level control, Reactor control, Conveyor system, Stepper motor control. (Any specific application can be considered in each above area to develop a ladder program). Speed Control of AC/ DC Motor using Programmable Drives
<b>Module V</b>	<b>Installation and Troubleshooting</b>
	PLC installation- enclosures, rack, master control relay, grounding, noise suppression, maintenance guidelines.PLC troubleshooting- input and output troubleshooting using module LED status, troubleshooting of ladder program.

<b>Text Books:</b>	<ol style="list-style-type: none"> <li>1. "Introductionto programmable logic control", byGary Dunning, Cenage Learning</li> <li>2. "Programmable logic controllers", by F.D. Petruzella (Third edition) Tata-McGraw-Hill</li> <li>3. "Programmable logic controllers", by John Hackworth and Federic Hackworth, Pearson education</li> </ol>
<b>Reference Books:</b>	<ol style="list-style-type: none"> <li>1. "Industrial automation and process Control", by Jon Stenerson,Prentice Hall</li> </ol>

**Course Code R4ET4601S**  
**Prerequisite: NIL**

**Course Title: Introduction to Nano Electronics**

**COURSE OUTCOME**

1. The student should be familiar with certain nano electronic systems and building blockssuch as: low-dimensional semiconductors, hetero structures, carbon nanotubes, quantumdots, nanowires etc.
2. Design of electronic nano systems like memory elements & Logic devices.
3. Finally, a goal is to familiarize students with the present research front in Nano electronicsand to be able to critically assess future trends.

**COURSE CONTENTS:**

<b>Module 1</b>	<b>Introduction</b>
	CMOS Scaling, Scaling Issues, Limit to Scaling, System Integration limit, Interconnect Issues, Shrink down approach, Strained Silicon, High k dielectric, Advance MOSFET concept, UTB – Ultra Thin Body, and Metal Gate
<b>Module 2</b>	<b>FINFET</b>
	Structure, working, power optimization, logic design using FINFET, modes of operation, TCMS circuit, logic design using TCMS, FINFET SRAM Design
<b>Module 3</b>	<b>Resonant Tunneling Diode (RTD)</b>
	Electron Tunneling, Coulomb blocked RTD Structure, working, V-I characteristics, equivalent circuit ,programmable logic gates, multi Valued logic gates and MOBILE circuit.
<b>Module 4</b>	<b>Single Electron Devices</b>
	Single Electron BOX, Single Electron Transistor (SET), and Application of Single Electron Devices for logic circuit
<b>Module 5</b>	<b>Module 5. Quantum dots</b>
	Electronics properties, structure, Quantum Cellular Automata (QCA) , and Circuit Design using QCA
<b>Module 6</b>	<b>Carbon Nano Tubes</b>
	Physical Properties, Band Structure, Band Modulation, Electrical properties of CNTs, CNT Transistor, CNT based Electronics Devices, Field Emission Devices, MEMS, Electrical Sensor, and SRAM Cells
<b>Module 7</b>	<b>Spintronics</b>
	Physical properties of Spintronic Devices, Spin Relaxation Mechanisms, Spin Injection, Spin Detection. Spintronic Devices, Spin Filter, Spin Valves, Spin Pumps, Spin Diodes, Spin Transistors, Spin-Based Optoelectronic Devices, Spintronic Computation
<b>Module 8</b>	<b>Molecular Electronics Devices</b>
	Electrical Conduction of Molecules, Molecular Electronics Devices, Molecular Architectures for Nano electronics, Molecular-Based Optic and Optoelectronics Devices, Molecular Computing Devices

<b>Text Books:</b>	<ol style="list-style-type: none"> <li>1. Introduction to nanotechnology, C.P.Poole JV, F.J.Owens, Wiley (2003).</li> <li>2. Nano electronics and information technology (Advanced electronic materials and Novel Devices Waster Ranior, Wiley VCH (2003)</li> </ol>
<b>References :</b>	<ol style="list-style-type: none"> <li>1. Nano electronics: Principles and Devices, 2nd Edition, M. Dragoman, D.Dragoman, Artech House – 2008</li> <li>2. Nano electronic Circuit Design, Niraj K. Jha, Deming Chen, Springer - 2010.</li> </ol>

**Course Code R4CE4106S**

**Course Title: Sustainable Development (Open Elective)**

**Prerequisite: NIL**

**COURSE OUTCOME**

After completion of course students will be able to

1. Describe sustainable development, development processes and relate impact of various levels of development
2. Formulate the methodology for assessment of sustainability of project using various indicators.
3. Apply environmental legislations to various development processes and projects

**COURSE CONTENTS:**

<b>Module I</b>	Development Goals and means of development, MDG's and SDG's sustainable development, Comparing levels of development, GDP, GNP, global development level
<b>Module II</b>	Industrialization and Post-industrialization era Major structural shifts, knowledge revolution, implications for development sustainability
<b>Module III</b>	Environmental episodes Ozone depletion, global warming, greenhouse effect, Bhopal gas tragedy etc.
<b>Module IV</b>	Pollutions Major sources, permissible standards and controls of urban air pollution, water pollution, Solid and hazardous waste disposals
<b>Module V</b>	Climate Change The Risk of Global Climate Change
<b>Module VI</b>	Environmental legislation Legislative provisions and measures towards sustainability
<b>Module VII</b>	Indicators of Development Sustainability Composition of National wealth, Accumulation of National Wealth as an Indicator of Sustainable Development, Development Goals and Strategies, Gross happiness index, Millennium Development Goals, Role of National Development Policies, Life cycle assessment, Carbon foot print

<b>Text Books:</b>	Tatyana P. Soubbotina, Beyond Economic Growth: An Introduction to Sustainable Development, World Bank Institute Learning Resources Series, 2nd edition, 2004. (ISBN: 0-8213-5933-99) P. P. Roger, F. J. Ja1a1 and J. A. Boyd, An Introduction to Sustainable Development, Earthscan Publications, 2nd edition, 2008. (ISBN: 9781844075201/1844075206)
<b>Reference Books:</b>	T. Strange and A. Bayley, Sustainable Development: Linking Economy, Society, Environment, 2008. (ISBN: 9789264047785) H. G. Brauch, Sustainable Development and Sustainability Transition Studies, Series: Springer Briefs in Environment, Security, Development and Peace, Series Ed. G. Marletto, S. Franceschini, C. Ortolani and C. Sillig, Mapping Sustainability Transitions: Networks of Innovators, Techno-economic Competences and Political Discourses, Springer Briefs in Business, 2016. (ISBN: 9783319422725/9783319422749)



**Course Code R4ME4603S**

**Course Title: Total Quality Management**

**Prerequisite: NIL**

**COURSE OUTCOMES**

The student should be able to –

1. Apply basic tools of TQM for achieving overall quality in organization
2. Develop a strategy for implementing TQM in an organization.
3. Implement the quality control tools for industrial problem
4. Analyze the voice of the customer for product/service development.
5. Evaluate the impact of quality on economic performance and long-term business success of an organization

**COURSE CONTENTS:**

<b>Module I</b>	Basic TQM Concepts Introduction, Development of the Importance of Quality Management, Quality and Public, Factors Affecting Quality, Total Quality Management: Introduction and Principles.
<b>Module II</b>	TQM Philosophies and Principles Approach to Quality: Deming, Juran, Crosby, Kaizen, Shigeo Shingo, Ishikawa, Taguchi. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.
<b>Module III</b>	Concept of Quality Circles Objective, Process of Operation of Quality Circles, Using the Concept, Fish Bone, Application in Organization.
<b>Module IV</b>	Six Sigma Deviation and Standard Deviation, Phases and Defective Units of Six Sigma, Its Importance, Overview of Master Black and Green Belt
<b>Module V</b>	Leadership Definition, Characteristics of Quality Leaders, Leadership Concepts, Role of TQM Leaders
<b>Module VI</b>	Customer Satisfaction Introduction, Customer Perception of Quality, Feedback, Service Quality, Customer Retention
<b>Module VII</b>	Performance Measures Quality Costs, Basic Concepts, Performance Measure Presentation, Appraisal Cost Category, Collection and Reporting, Analysis, Deming Prize
<b>Module VIII</b>	Tools and Techniques Pareto and Process Flow Diagram Check Sheets and Histograms, Control Charts, Quality Management Systems, Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.
<b>Module IX</b>	Case Studies Changing Company Culture, Xerox Corporation – Using TQM as a Competitive Strategy, Motorola’s Secret to TQC, Motorola’s Quest for Quality

<b>Text Books:</b>	<ol style="list-style-type: none"><li>1. Dale H. Besterfield, Total Quality Management, Pearson, Third Edition, 2011</li><li>2. N, Logothetis, Managing of Total Quality, Prentice Hall of India Private Limited, First Edition, 1992</li><li>3. J. Bicheno and M. R Gopalan, A Management Guide to Quality and Productivity, Wiley Dreamtech, New Delhi</li><li>4. Janakiraman, B and Gopal, R.K, Total Quality Management – Text and Cases, Prentice Hall (India) Pvt. Ltd., 2006</li></ol>
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**Course Code R4PE4601S**

**Course Title: Entrepreneurship Development**

**Prerequisite: NIL**

**Course outcomes**

On the completion of this course, the learner will able to

1. Describe what it takes to be an entrepreneur
2. Analyze business opportunities and the basics to create, launch and manage new businesses
3. Develop Business Model for their Idea/Problem
4. Create MVP (Minimum Viable Product).

**COURSE CONTENTS:**

<b>Module I</b>	<b>Introduction</b> Discover yourself – Find you Flow, Effectuation, Identify your entrepreneurial style
<b>Module II</b>	<b>Problem Identification and Idea generation</b> Identify Problems worth Solving, Introduction to Design Thinking, generate ideas that are potential solutions to the problem identified, GOOTB: Run problem interviews with prospects, Class Presentation: Present the problem you "love", Team Formation.
<b>Module III</b>	<b>Customer Study and Value Proposition</b> Identify Your Customer Segments and Early Adopters - Market Types, Segmentation and Targeting, Defining the personas; Understanding Early Adopters and Customer Adoption Patterns, Customer identification, Market, Creative solution; Craft Your Value Proposition - Come up with creative solutions for the identified problems, Deep dive into Gains, Pains and “Jobs-To-Be-Done” (using Value Proposition Canvas, or VPC), Identify the UVP of your solution using the Value Proposition section of the VPC, Outcome-Driven Innovation.
<b>Module IV</b>	<b>Business Model Canvas</b> Get Started with Lean Canvas - Basics of Lean Approach and Canvas; Types of Business Models (B2B; B2C), Sketch the canvas- "Document your Plan A", Intro to Risks; Identify and document your assumptions (Hypotheses); identify the riskiest parts of your Business Plan, Risk identification, Class Presentation: Present your Lean Canvas.
<b>Module V</b>	<b>Validation</b> Develop the Solution Demo - Build solution (mock-ups) demo, How to run solution interviews, GOOTB: Run Solution interviews, Does your solution solve the problem for your customers: The problem-solution test. Sizing the Opportunity - Differences between a Start-up venture and a small business; Industry Analysis: Understanding what is Competition and its role, Analyse competition; Building an MVP - Identification of MVP, Solution development, building products/services, Build-measure-learn loop for development
<b>Module VI</b>	<b>Money</b> Revenue streams, Pricing and cost, Financing Your New Venture - Venture financing, Investor expectations
<b>Module VII</b>	<b>Team building</b> Shared leadership, role of good team, how to pitch to candidates to join your startup Collaboration tools and techniques - Brainstorming, Mind mapping, Kanban Board, #Slack
<b>Module VIII</b>	<b>Marketing and sales</b> Positioning of Product/Services, Channels and strategies, Building Digital Presence and leveraging Social media, Budgeting and planning. Sales planning - Buying decisions, Sales planning, setting targets, Unique Sales Proposition (USP); Art of the sales pitch (focus on customers’ needs, not on product features), Follow-up and closing a sale; Asking for the sale.

<b>Module IX</b>	<p><b>Support</b>          Planning and tracking - Importance of project management to launch and track progress, Understanding time management, workflow, and delegation of tasks.          Business Regulation - Basics of business regulations of starting and operating a business; Importance of being compliant and keeping proper documentation; How to find help to get started.</p>
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<b>Text Books</b>	<ol style="list-style-type: none"> <li>1. Roy R.: Entrepreneurship, Oxford University Press.</li> <li>2. Maurya A.: Running Lean: Iterate from Plan A to a Plan That Works. O'Reilly Media</li> </ol>
<b>References</b>	<ol style="list-style-type: none"> <li>1. Jeffry A: New venture creation, Tata McGraw Hill</li> <li>2. Osterwalder, A and Pigneur Yves: Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers.</li> <li>3. Gupta T. S: Intellectual Property Law in India, Kluwer Law International.</li> <li>4. Saraswathi S.D: Effectuation: Elements of Entrepreneurial Expertise. Edward Elgar Publishing.</li> <li>5. Kim W. C. and Mauborgne R: Blue Ocean Strategy, Harvard Business School Press.</li> <li>6. Ries, E.: The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, The Crown Publishing Group</li> </ol>

**Course Code R4TT3602T**

**Course Title: Structural Composites**

**Prerequisite: Basic knowledge of Engineering Physics and Engineering Chemistry.**

### Course Outcome

After attending this course, students will be able to:

1. Understand the composite materials and impact of aggregation of constituent materials.
2. Depict the approach and methodology of fabrication of such aggregate.
3. School various models analyzing the design and performance of composite materials.
4. Understand the composite modulus, strength and fracture behaviour for structural applications.

### Course Content

<b>Module I</b>	Introduction: Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.
<b>Module II</b>	Performance of Structural Composites: Combination effects (Summation, Complementation and Interaction), Basic analytical concepts. Performance analysis by various models (Law of Mixtures, Shear lag model, Laminated plate model – the rmoelasticity, plasticity and creep), Strengthening mechanisms, Stress distribution in fibre and the matrix (shear stress and axial tensile stress in the fibre along its length), critical length of fibre for full strengthening, Analysis of uniaxial tensile stress-strain curve of unidirectional continuous and short fibre composites, Estimation of the required minimum amount of fibre and critical amount of fibre to gain a composite strength, Analysis of strength of a composite during loading at an angle to the fibres, Nano-structured composites.
<b>Module III</b>	Performance of Composite in Nonstructural Applications : Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices.
<b>Module IV</b>	Fabrication Composites : Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes. Fabrication of Polymer Matrix Composites – Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites.
<b>Module V</b>	Characterisation of Composites : Control of particle/fibre and porosity content, particle/fibre distribution, Interfacial Reaction of matrix-reinforcing component, Coating of reinforcing component, Strength analysis.
<b>Module VI</b>	Secondary Processing and Joining of Composite : Forging and extrusion of composites – critical issues, dynamic recovery and dynamic recrystallization, mechanical properties; Induction Heating, Fusion Bonding, Ultrasonic welding, Gas tungsten arc welding, Gas metal arc welding, Resistance spot & seam welding, Resistance brazing, Resistance spot joining, Resistant spot brazing, Resistance welding of thermoplastic graphite composite, Weld bonding, Brazing of MMC.
<b>Module VII</b>	Industrial Application of Composite Materials : Civil constructions of structures/panels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, House hold and sports components etc.

<b>Module VIII</b>	Fracture & Safety of Composite : Fracture behaviour of composites, Mechanics and Weakest link statistics, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite (Fracture toughness, COD and J-integral approaches, Fatigue crack growth rate), Fracture Mechanics of brittle matrix fibre composite, Fracture mechanics of metal matrix fibre composite, Experimental evaluation (composite), Elementary reliability analysis.
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<b>Recommended Readings:</b>	<ol style="list-style-type: none"> <li>1. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim.</li> <li>2. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK.</li> <li>3. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman &amp; Hall, London.</li> </ol>
<b>Reference Books:</b>	<ol style="list-style-type: none"> <li>1. Sanjay Mazumdar, Composites Manufacturing-Materials, Product and Process Engineering, 2002, CRC Press, ISBN 0-8493-0583-3.</li> <li>2. Fibrous and composite materials for civil engineering applications, edited by R. Figueiro, 2011, WPI, ISBN 978-1-84569-558-3.</li> <li>3. Textile advances in automotive industry, edited by R. Shishoo, Woodhead Publishing in Textiles: No. 79, ISBN 978-1-84569-331-2.</li> </ol>