DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Program: M.Tech VLSI
Regulations- R25
II Year I Semester - Course Structure

S.NO	Category	Course Code	Course Title	L	T	P	Credits
1	PE	R25D57301 R25D57302 R25D57303	**Professional Elective-V** 1. CMOS RF IC Design 2. Hardware Security in VLSI 3. Design Advanced Memory and Architectures	3	0	0	3
2	OE	R25MBA201 R25D03301 R25D03302 R25D03303 R25D03304	**Open Elective** 1.Business Analytics 2.Industrial Safety 3.Operations Research 4.Cost Management of Engineering Projects 5.Composite Materials	3	0	0	3
3	Dissertat-ion	R25D57304	**Dissertation** Dissertation Work Review–II	0	0	18	6
			Total Credits	**6**	**0**	**18**	**12**

Category	Courses	Credits
PE: Professional Elective	**01**	**03**
OE: Open Elective	**01**	**03**
Dissertation	**01**	**06**
Total	**03**	**12**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Program: M.Tech VLSI
Regulations- R25
II Year II Semester - Course Structure

S.NO	Category	Course Code	Course Title	L	T	P	Credits
1	Dissertation	R25D57401	**Dissertation** Dissertation Work Review-III	0	0	18	06
2	Dissertation	R25D57402	**Dissertation** Dissertation Viva-Voce	0	0	42	14
3			**Total Credits**	**0**	**0**	**60**	**20**

Category	Courses	Credits
Dissertation	**02**	**20**
Total	**02**	**20**

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L T P C

CMOS RF ID DESIGN

3 0 0 3

R25D57301

M.TECH II-I SEM

Course Objectives:

1. To introduce RF system fundamentals and CMOS RF circuit design concepts.
2. To analyze and design RF CMOS amplifiers including LNAs.
3. To understand CMOS oscillator principles, phase noise, and frequency control.
4. To study CMOS mixer circuits and frequency translation techniques.
5. To understand PLLs and frequency synthesizers for RF applications.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain RF system fundamentals and CMOS RF device modeling	3	2	-	-	-	-	-	-	L1,L2
CO2	Analyze and design RF CMOS amplifiers and LNAs	3	3	2	-	-	-	-	-	L2,L3
CO3	Analyze CMOS oscillators and phase noise characteristics	3	3	3	-	-	-	-	-	L2,L3
CO4	Design and analyze CMOS mixer circuits	3	3	2	-	-	-	-	-	L4,L5
CO5	Explain PLL-based frequency synthesizers and RF system integration	2	2	2	-	3	-	-	-	L4,L5

Unit I:

Introduction to RF Design and CMOS Technology: Review of RF system fundamentals – system gain, noise figure, nonlinearities, and link budget. Review of CMOS technology, basic MOSFET RF equivalent circuit model, advanced MOSFET RF equivalent circuit model, SPICE modeling of CMOS RF circuits – SPICE level 3 and BSIM parameters.

Unit II:

Small-Signal MOS Amplifier for RF: Basic amplifying structure, improvements to the basic amplifying structure, amplifier matching (LC and inductive), low-noise amplifiers (LNAs) – noise modeling for common source and common gate LNAs.

Unit III:

CMOS Oscillator Circuits: Review of general feedback principles, fixed-frequency oscillators, ring oscillator, voltage control of oscillators, oscillator phase noise and estimation.

Unit IV:

CMOS Mixer Circuits: General mixer concepts, single MOS mixer topologies, balanced MOSFET mixers, image rejection circuit topologies, I/Q mixer topologies.

Unit V:

CMOS PLLs and Frequency Synthesizers: Introduction to the phase lock loop – definitions and basic

operation, phase detection and phase-frequency detection, loop filters, PLL noise behaviour, PLL behavioural modeling. Frequency Synthesis – PLL-based synthesizers, direct digital synthesis.

TEXT BOOKS:

1. Robert H. Caverly, CMOS RFIC Design Principles, Artech House, 2016.

REFERENCE BOOKS:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press.
2. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation, Wiley IEEE Press, 3rd Edition.
3. David M. Pozar, Microwave Engineering, Wiley, 4th Edition.

Web References

1. https://nptel.ac.in/courses/117/106
2. https://www.allaboutcircuits.com/technical-articles
3. https://www.electronics-tutorials.ws/

E-Books:

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press
2. Behzad Razavi, RF Microelectronics, Pearson Education
3. Robert H. Caverly, CMOS RFIC Design Principles, Artech House

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L T P C

Hardware Security in VLSI Design

3 0 0 3

R25D57302

M.TECH II-I SEM

Course Objectives:

1. To understand the fundamentals of hardware security and threats in modern computing systems.
2. To study hardware Trojans, their design, insertion, detection, and prevention techniques.
3. To analyze side-channel and fault-based attacks on cryptographic hardware.
4. To understand physical attacks, countermeasures, and secure hardware design practices.
5. To study hardware security primitives such as PUFs, TRNGs, and secure FPGA/SoC designs.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain hardware security threats, vulnerabilities, and countermeasures	3	2	-	-	-	-	-	-	L1,L2
CO2	Analyze hardware Trojan attacks and defense mechanisms	3	3	2	-	-	-	-	-	L2,L3
CO3	Analyze side-channel, fault injection, and probing attacks	3	3	2	-	-	-	-	-	L2,L3
CO4	Explain physical attacks and secure hardware design techniques	2	2	3	-	-	-	-	-	L4,L5
CO5	Apply hardware security primitives in FPGA/SoC based systems	2	2	2	-	3	-	-	-	L4,L5

Unit I

Introduction to Hardware Security: Overview of a computing system, layers of a computing system, hardware security vs. hardware trust, attacks, vulnerabilities and countermeasures, conflict between security and test/debug, evolution of hardware security, overview of electronic hardware – nanoscale technologies, ASICs and FPGAs, printed circuit board, embedded systems, hardware- firmware-software interaction.

Unit II:

Hardware Trojans: Introduction, SoC design flow, hardware trojans, hardware trojans in FPGA designs, hardware trojans taxonomy, trust benchmarks, countermeasures against hardware trojans, hardware trojan attacks. Hardware IP Piracy and Reverse Engineering: Introduction, hardware intellectual property (IP), security issues in IP-based SoC design, security issues in FPGA, reverse engineering and tampering.

Unit III:

Side-Channel Attacks: Introduction, taxonomy of side-channel attacks, uncommon side-channel attacks, power analysis attacks, electromagnetic (EM) side-channel attacks, fault-injection attacks, timing attacks.Test-Oriented Attacks: Introduction, scan-based attacks, JTAG-based attacks.

Unit IV:

Physical Attacks and Countermeasures: Introduction, reverse engineering, probing attack.Attacks on PCB: Security challenges, attack models, bus snooping attack.

Unit-V:

Hardware Security Primitives: Introduction, physical unclonable functions (PUFs), true random number generator (TRNG), design of anti-counterfeit, existing challenges and attacks. Security and Trust Assessment: Security assets and attack models, pre-silicon and post-silicon security and trust assessment.

TEXT BOOKS:

1. Bhunia, Swarup, and Mark M. Tehranipoor. Hardware Security: A Hands-on Learning Approach. 1st ed., Academic Press, 2019.

REFERENCE BOOKS:

1. Tehranipoor, Mark, and Cliff Wang, editors. Introduction to Hardware Security and Trust. Springer, 2012.
2. Bhunia, Swarup, and Sandip Ray. Fundamentals of IP and SoC Security: Design, Verification, and Debug. Springer, 2017.

Web References

1. https://nptel.ac.in/courses/108/106
2. https://www.hardwaresecurity.org/

E-Books:

1. Mark Tehranipoor & Cliff Wang, Introduction to Hardware Security and Trust, Springer
2. Sheng Wei & Miodrag Potkonjak, Hardware Security and Trust, Springer
3. Christof Paar & Jan Pelzl, Understanding Cryptography, Springer

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L T P C

Advanced Memory Design and Architecture

3 0 0 3

R25D57303

M.TECH II-I SEM

Course Objectives:

1. To understand cache memory hierarchy and virtual memory concepts.
2. To analyze on-chip interconnection networks and routing mechanisms.
3. To study multicore systems and parallel programming issues.
4. To understand DRAM organization, operation, and performance issues.
5. To introduce emerging memory technologies and their architectural impact.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain cache hierarchy, cache coherence, and virtual memory	3	2	-	-	-	-	-	-	L1,L2
CO2	Analyze Network-on-Chip (NoC) architectures and routing techniques	3	3	2	-	-	-	-	-	L2,L3
CO3	Explain multicore systems and memory consistency models	3	3	2	-	-	-	-	-	L2,L3
CO4	Analyze DRAM organization, timing, and performance optimization	3	3	3	-	-	-	-	-	L4,L5
CO5	Explain emerging memory technologies and their applications	2	2	2	-	3	-	-	-	L4,L5

Unit I:

Caches: Memory hierarchy and the notion of caches, virtual memory, modeling and designing a cache, advanced cache design, trace caches, instruction prefetching, data prefetching.

Unit II:

The On-chip Network: Overview of an NoC, message transmission, routing, design of a router, non-uniform cache architectures, performance aspects.

Unit III:

Multicore Systems: Parallel programming, issues in parallel hardware, theoretical foundations of memory models, memory models, data races, transactional memory.

Unit IV:

DRAMs: DRAM cell, capacitors used in DRAM cells, array of DRAM cells, a computer system with DRAM arrays, design spaces of DRAMs, DDR generations and timing, buffered DIMMs, DRAM access protocols, DRAM timing, memory controller.

Unit V:

Emerging Memory Technologies: Flash memory, ferroelectric RAM (FeRAM), magnetoresistive RAM (MRAM), phase change memory (PCM), resistive RAM (ReRAM), 3D and embedded memory technologies.

TEXT BOOKS:

1. Sarangi, Smruti R. Next-Gen Computer Architecture: Till the End of Silicon. Version 3.1, Smruti R. Sarangi, 2023.

REFERENCE BOOKS:

1. Jacob, Bruce, Spencer W. Ng, and David T. Wang. Memory Systems: Cache, DRAM, Disk. Morgan Kaufmann, 2008.

2. Sharma, Ashok K. Semiconductor Memories: Technology, Testing, and Reliability. Wiley- IEEE Press, 1997.

Web References

1. https://www.nptel.ac.in/courses/106/102
2. https://www.allaboutcircuits.com/
3. https://www.geeksforgeeks.org/computer-architecture

E-Books:

1. John L. Hennessy & David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann
2. William Stallings, Computer Organization and Architecture, Pearson

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R25MBA201 **BUSINESS ANALYTICS** **L T P C**

(Open Elective.1) **3 0 0 3**

M.TECH II-I SEM

Course Objectives:

1. Understand the concepts, principles, and applications of Business Analytics in organizational decision-making.
2. Apply statistical methods, data visualization, regression, and forecasting techniques to analyze business data.
3. Develop predictive and prescriptive analytics models for solving real-world business problems.
4. Evaluate business decisions using optimization, simulation, and decision analysis techniques.
5. Interpret analytical results and communicate business insights effectively using modern analytics tools.

Course Code	Course Outcomes	Mapping with POs								
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain the fundamentals of business analytics, statistical methods, and business data analysis.	3	2	1	2	2	-	-	-	L1,L2
CO2	Apply regression analysis, trend analysis, forecasting, and predictive analytics models to business problems.	3	3	2	2	3	-	-	-	L2,L3
CO3	Analyze business processes using data mining, optimization, and prescriptive analytics techniques	3	3	3	3	2	-	-	-	L2,L3
CO4	Develop forecasting, simulation, and risk analysis models to support managerial decision-making.	2	3	3	3	3	-	-	-	L4,L5
CO5	Apply decision analysis, business intelligence, and data visualization techniques to generate actionable business insights.	3	3	3	3	3	-	-	-	L4,L5

UNIT-I:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality,

Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making. Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXTBOOKS:

1. "Business analytics Principles, Concepts, and Applications" by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. "Business Analytics by James Evans", persons Education.

Reference Books

1. Marc J. Schniederjans, Dara G. Schniederjans & Christopher M. Starkey, Business Analytics: Principles, Concepts and Applications, FT Press.
2. James Evans, Business Analytics, Pearson Education.
3. Foster Provost & Tom Fawcett, Data Science for Business, O'Reilly Media.

Web References

1. NPTEL – https://nptel.ac.in
2. MIT OpenCourseWare – https://ocw.mit.edu
3. Coursera – https://www.coursera.org

E-Books

1. Marc J. Schniederjans – Business Analytics: Principles, Concepts and Applications
2. James R. Evans – Business Analytics
3. Foster Provost & Tom Fawcett – Data Science for Business

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INDUSTRIAL SAFETY

L T P C

(Open Elective.2) **3 0 0 3**

R25D03301

M.TECH II-I SEM

Course Objectives:

1. Understand industrial safety principles, accident prevention methods, safety legislation, and hazard control techniques.
2. Explain maintenance engineering concepts, maintenance strategies, tools, equipment, and replacement economics.
3. Analyze wear, corrosion, lubrication methods, and preventive techniques for industrial equipment.
4. Apply fault tracing and troubleshooting methods for mechanical, electrical, hydraulic, pneumatic, and thermal systems.
5. Develop preventive and periodic maintenance schedules to improve equipment reliability, safety, and operational efficiency.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain industrial safety regulations, accident prevention techniques, hazards, and fire safety measures.	3	2	1	-	-	-	-	-	L1,L2
CO2	Analyze maintenance engineering principles, maintenance planning, maintenance cost, and equipment replacement decisions.	3	3	2	1	1	-	-	-	L2,L3
CO3	Apply lubrication techniques and corrosion prevention methods to enhance machine performance and service life.	2	3	3	2	1	-	-	-	L2,L3
CO4	Diagnose faults using fault tracing, decision trees, and troubleshooting techniques for industrial machinery and electrical equipment.	2	3	3	3	2	-	-	-	L4,L5
CO5	Design effective preventive and periodic maintenance programs for industrial systems to improve safety, reliability, and productivity.	2	3	3	3	3	-	-	-	L4,L5

UNIT-I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear

reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication
vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion.
Types of corrosion, corrosion prevention methods.

UNIT-IV:

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TEXTBOOKS

1. Maintenance Engineering, H. P. Garg, S. Chand and Company.
2. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
3. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

REFERENCE BOOKS

1. Higgins & Morrow, Maintenance Engineering Handbook, McGraw-Hill.
2. R.K. Jain, Industrial Safety, Health and Environment Management Systems, Khanna Publishers.

WEB REFERENCES

1. NPTEL – https://nptel.ac.in
2. SWAYAM – https://swayam.gov.in
3. MIT OpenCourseWare – https://ocw.mit.edu

E-BOOKS

1. Maintenance Engineering Handbook – Higgins & Morrow.
2. Industrial Safety and Health Management – C. Ray Asfahl & David W. Rieske.

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OPERATIONS RESEARCH L T P C

(Open Elective.3) **3 0 0 3**

R25D03302

M.TECH II-I SEM

Course Objectives:

1. Understand the fundamentals of Operations Research and optimization techniques for decision-making.
2. Formulate and solve Linear Programming Problems (LPP) using graphical and simplex methods.
3. Apply network optimization, nonlinear programming, and project management techniques to engineering problems.
4. Analyze inventory, queuing, scheduling, and sequencing models for industrial applications.
5. Apply dynamic programming, game theory, and simulation techniques to solve real-world optimization problems.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Formulate engineering optimization problems and solve Linear Programming Problems using graphical and simplex techniques.	3	2	2	1	2	-	-	-	L1,L2
CO2	Apply duality, sensitivity analysis, and parametric programming for decision-making.	3	3	2	2	2	-	-	-	L2,L3
CO3	Analyze nonlinear programming, network flow models, and CPM/PERT techniques for project planning.	3	3	3	2	2	-	-	-	L2,L3
CO4	Design and evaluate inventory, queuing, scheduling, and sequencing models for industrial systems.	2	3	3	2	2	-	-	-	L4,L5
CO5	Apply dynamic programming, game theory, graph theory, and simulation techniques to optimize complex engineering systems.	3	3	3	3	2	-	-	-	L4,L5

UNIT-I:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT-II:

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

UNIT-III:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT

UNIT-IV:

Scheduling and sequencing - single server and multiple server models –

deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXTBOOKS

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

Reference Books

1. H.A. Taha, Operations Research: An Introduction, Pearson/PHI.
2. H.M. Wagner, Principles of Operations Research, PHI.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers.
4. Hamdy A. Taha, Operations Research, Pearson Education.

Web Reference

1. NPTEL – https://nptel.ac.in
2. MIT OpenCourseWare – https://ocw.mit.edu
3. IIT Madras NPTEL Courses – https://onlinecourses.nptel.ac.in

E-Books

1. Hamdy A. Taha – Operations Research: An Introduction (Pearson eBook)
2. Frederick S. Hillier & Gerald J. Lieberman – Introduction to Operations Research
3. Panneerselvam R. – Operations Research

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COST MANAGEMENT OF ENGINEERING PROJECTS **L T P C**
(Open Elective.4) **3 0 0 3**

R25D03303
M.TECH II-I SEM
Course Objectives:

1. Understand the fundamentals of strategic cost management and various cost concepts used in engineering decision-making.
2. Explain project planning, execution, project cost control, contracts, scheduling techniques, and project management practices.
3. Apply cost behavior, marginal costing, standard costing, variance analysis, and pricing strategies for engineering projects.
4. Analyze modern cost management techniques such as Activity-Based Costing (ABC), Balanced Scorecard, Benchmarking, Value Chain Analysis, and Budgetary Control.
5. Apply quantitative techniques such as Linear Programming, PERT/CPM, Transportation, Assignment Models, Simulation, and Learning Curve Theory in project cost management.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain strategic cost management concepts and apply various costing methods in engineering decision-making.	3	2	1	-	-	-	-	-	L1,L2
CO2	Analyze project planning, execution, scheduling, contracts, and project cost control techniques.	2	3	2	2	1	-	-	-	L2,L3
CO3	Apply cost analysis tools including marginal costing, CVP analysis, standard costing, variance analysis, target costing, and life cycle costing.	3	3	2	2	1	-	-	-	L2,L3
CO4	Evaluate modern cost management tools such as ABC, Benchmarking, Balanced Scorecard, Value Chain Analysis, and Budgetary Control.	2	3	3	2	2	-	-	-	L4,L5
CO5	Apply quantitative techniques like Linear Programming, PERT/CPM, Transportation, Assignment, Simulation, and Learning Curve Theory for engineering project optimization.	2	3	3	3	3	-	-	-	L4,L5

UNIT-I:

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT-II:

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT-III:

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT-IV:

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V:

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXTBOOKS:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

REFERENCE BOOKS

1. Charles T. Horngren, George Foster & Srikant Datar, Cost Accounting: A Managerial Emphasis, Pearson Education.
2. M.N. Arora, Cost Accounting – Principles and Practice, Vikas Publishing House.
3. Jawahar Lal, Cost Accounting, Tata McGraw-Hill.

WEB REFERENCES

1. NPTEL – https://nptel.ac.in
2. SWAYAM – https://swayam.gov.in
3. IIT Bombay Spoken Tutorial – https://spoken-tutorial.org

E-BOOKS

1. Charles T. Horngren – Cost Accounting: A Managerial Emphasis
2. M.N. Arora – Cost Accounting
3. Ravi M. Kishore – Cost Management

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COMPOSITE MATERIALS L T P C

(Open Elective.5**)** **3 0 0 3**

R25D03304

M.TECH II-I SEM

Course Objectives:

1. Understand the fundamentals, classification, characteristics, advantages, and applications of composite materials.
2. Study different reinforcement materials, their properties, and mechanical behavior of composites.
3. Learn the manufacturing techniques of Metal Matrix, Ceramic Matrix, and Carbon-Carbon composites.
4. Understand the manufacturing methods of Polymer Matrix Composites and their industrial applications.
5. Analyze failure criteria, laminate strength, and design considerations of composite materials.

Course Code	Course Outcomes				Mapping with POs					
		PO1	PO 2	PO 3	P04	P05	P06	P011	PO12	Dok
CO1	Explain the classification, characteristics, constituents, and applications of composite materials.	3	2	1	-	-	-	-	-	L2
CO2	Analyze the properties and behavior of various reinforcement materials and predict composite performance using the rule of mixtures.	3	3	2	1	-	-	-	-	L4
CO3	xplain and compare different manufacturing techniques for Metal Matrix, Ceramic Matrix, and Carbon-Carbon composites.	3	2	3	2	1	-	-	-	L3
CO4	Apply suitable manufacturing techniques for Polymer Matrix Composites based on application requirements	3	3	3	2	2	-	-	-	L3
CO5	Evaluate laminate failure criteria and design composite laminates for engineering applications.	3	3	3	3	2	-	-	-	L5

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

MANUFACTURING OF METAL MATRIX COMPOSITES: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and

applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXTBOOKS

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books

1. R.W. Cahn, Materials Science and Technology, Vol. 13: Composites, VCH Publishers.
2. D. Callister Jr., Materials Science and Engineering: An Introduction, Wiley.
3. Lubin, Handbook of Composites, Springer.

Web References

1. MIT OpenCourseWare – https://ocw.mit.edu
2. NPTEL Courses – https://nptel.ac.in
3. Springer Materials – https://materials.springer.com

E-Books

1. K.K. Chawla – Composite Materials: Science and Engineering (Springer eBook).
2. Deborah D.L. Chung – Composite Materials: Science and Applications (Springer).
3. Daniel Gay et al. – Composite Materials: Design and Applications (CRC Press eBook).

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