

<b>Third Semester</b>				
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L-T-P</b>	<b>Credit</b>
1	VLM351	<b>Program Elective - V</b> Communication Network	3-0-0	3
	VLM352	Selected Topics in Mathematics		
	VLM353	Nano materials and Nanotechnology		
2	VLM361	<b>Open Elective</b> Business Analytics/	3-0-0	3
	VLM362	Industrial Safety/		
	VLM363	Operations Research/		
	VLM364	Cost Management of Engineering Projects/		
	VLM365	Composite Materials/		
	VLM366	Waste to Energy		
3	VLM301	Dissertation-I / Industrial Project	0-0-20	10
<b>Total Credits</b>				<b>16</b>

<b>VLM351</b>	<b>Communication Networks (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Introduction: - Network Architecture, Performance

**Module-2:** Connecting nodes: - Connecting links, Encoding, framing, Reliable transmission, Ethernet and Multiple access networks, Wireless networks

**Module-3:** Queuing models - For a) one or more servers b) with infinite and finite queue size c) Infinite population

Internetworking: - Switching and bridging, IPv4, Addressing, Routing Protocols, Scale issues, Routers - Architecture, IPv6

**Module-4:** End-to-End Protocols: - Services, Multiplexing, De-multiplexing, UDP, TCP, RPC, RTP

**Module-5:** Congestion control and Resource Allocation - Issues, Queuing disciplines, TCP congestion control, Congestion Avoidance, QoS Applications: - Domain Name Resolution, File Transfer, Electronic Mail, WWW, Multimedia Applications

**Module-6:** Network monitoring - Packet sniffing tools such as Wireshark Simulations using NS2/OPNET

**Text Books:**

1. Larry L. Peterson, Bruce S, Devie, "Computer Networks", MK, 5th Edition
2. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", MGH, International Edition 1993.
3. Vijay Ahuja, "Communications Network Design and Analysis of Computer Communication Networks", MGH, International Editions.
4. Douglas E. Comer, "Internetworking with TCP/IP", Pearson Education, 6th Edition

<b>VLM352</b>	<b>Selected Topics in Mathematics (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Probability and Statistics: - Definitions, conditional probability, Bayes Theorem and independence. - Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev inequality.

**Module-2:** Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. - Pseudo random sequence generation with given distribution, Functions of a Random Variable

**Module-3:** Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bi-variate normal distribution. - Stochastic Processes: Definition and classification of stochastic processes, Poisson process - Norms, Statistical methods for ranking data

**Module-4:** Multivariate Data Analysis - Linear and non-linear models, Regression, Prediction and Estimation - Design of Experiments – factorial method - Response surface method

**Module-5:** Graphs and Trees: - Graphs: Basic terminology, multi graphs and weighted graphs, paths and circuits, shortest path Problems, Euler and Hamiltonian paths and circuits, factors of a graph, planar graph and Kuratowski’s graph and theorem, independent sets, graph colouring

**Module-6:** Trees: Rooted trees, path length in rooted trees, binary search trees, spanning trees and cut set, theorems on spanning trees, cut sets , circuits, minimal spanning trees, Kruskal’s and Prim’s algorithms for minimal spanning tree.

**Text Books:**

1. Henry Stark, John W. Woods, “Probability and Random Process with Applications to Signal Processing”, Pearson Education, 3rd Edition
2. C L. Liu, “Elements of Discrete Mathematics”, Tata McGraw-Hill, 2nd Edition
3. Douglas C. Montgomery, E.A. Peck and G. G. Vining, “Introduction to Linear Regression Analysis”, John Wiley and Sons, 2001.
4. Douglas C. Montgomery, “Design and Analysis of Experiments”, John Wiley and Sons, 2001.
5. B A. Ogunnaike, “Random Phenomena: Fundamentals of Probability and Statistics for Engineers”, CRC Press, 2010

<b>VLM353</b>	<b>Nano materials and Nanotechnology (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Nanomaterials in one and higher dimensions,

**Module-2:** Applications of one and higher dimension nano-materials.

**Module-3:** Nano-lithography, micro electro-mechanical system (MEMS) and nano-phonics.

**Module-4:** carbon nanotubes – synthesis and applications

**Module-5:** Interdisciplinary arena of nanotechnology.

**Text Books:**

1. Nanoscale Materials in Chemistry edited by Kenneth J. Klabunde and Ryan M. Richards, 2nd edn, John Wiley and Sons, 2009.
2. Nanocrystalline Materials by A I Gusev and A A Rempel, Cambridge International Science Publishing, 1st Indian edition by Viva Books Pvt. Ltd. 2008.
3. Springer Handbook of Nanotechnology by Bharat Bhushan, Springer, 3rd edn, 2010.
4. Carbon Nanotubes: Synthesis, Characterization and Applications by Kamal K. Kar, Research Publishing Services; 1st edn, 2011, ISBN-13: 978-9810863975

<b>VLM361</b>	<b>Business Analytics (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

**Module-2:** 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.

**Module-3:** 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.

**Module-4:** 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.

**Module-5:** Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

**Module-6:** Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

**Text Books:**

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.

<b>VLM362</b>	<b>Industrial Safety (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** 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.

**Module-2:** 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.

**Module-3:** 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.

**Module-4:** Fault tracing: Fault tracing-concept and importance, decision treeconcept, 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.

**Module-5:** 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

**Text Books:**

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

<b>VLM363</b>	<b>Operations Research (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

**Module-2:** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

**Module-3:** Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Module-4:** Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**Module-5:** Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**Text Books:**

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 Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

<b>VLM364</b>	<b>Cost Management Of Engineering Projects (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Introduction and Overview of the Strategic Cost Management Process

**Module-2:** 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.

**Module-3:** Project: meaning, Different types, why to manage, cost overruns centres, 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

**Module-4:** 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.

**Module-5:** 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.

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

**Text Books:**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

<b>VLM365</b>	<b>Composite Materials (3-0-0)</b>	<b>3 Credits</b>
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**Module-1: 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.

**Module-2: 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.

**Module-3: 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.

**Module-4: 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.

**Module-5: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.**

**Text Books:**

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.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials - K.K.Chawla.
5. Composite Materials Science and Applications - Deborah D.L. Chung.
6. Composite Materials Design and Applications - Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

<b>VLM366</b>	<b>Waste To Energy (3-0-0)</b>	<b>3 Credits</b>
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**Module-1:** Introduction to Energy from Waste: Classification of waste as fuel - Agro based, Forest residue, Industrial waste - MSW - Conversion devices - Incinerators, gasifiers, digestors

**Module-2:** Biomass Pyrolysis: Pyrolysis - Types, slow fast - Manufacture of charcoal - Methods - Yields and application - Manufacture of pyrolytic oils and gases, yields and applications.

**Module-3:** Biomass Gasification: Gasifiers - Fixed bed system - Downdraft and updraft gasifiers - Fluidized bed gasifiers - Design, construction and operation - Gasifier burner arrangement for thermal heating - Gasifier engine arrangement and electrical power - Equilibrium and kinetic consideration in gasifier operation.

**Module-4:** Biomass Combustion: Biomass stoves - Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**Module-5:** Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants - Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

**Text Books:**

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.