MULTIDISCIPLINARY COURSES OF MECHANICAL ENGINEERING OFFERED TO OTHER DEPARTMENTS										
Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
MDM	BTME25MD304B	Non-Conventional Energy Resources	3	0	0	20	20	60	100	3
MDM	BTME25MD404B	Power Plant Engineering	3	0	0	20	20	60	100	3
MDM	BTME25MD505B	Energy Conversation and Audit	3	0	0	20	20	60	100	3
MDM	BTME25MD509L	Energy Conversation and Audit Lab.	0	0	2	50	0	50	100	1
MDM	BTME25MD606B	Innovation and Entrepreneurship	2	0	0	20	20	60	100	2
MDM	BTME25MD705B	Industrial Organisation & Management	2	0	0	20	20	60	100	2

Subject Code BTME25MD304B	Non-Conventional Energy Resources	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:-

1	To provide a comprehensive understanding of global energy trends and the strategic necessity of transitioning to non-conventional resources.
2	To impart fundamental knowledge on solar radiation physics and the engineering design of solar thermal collectors.
3	To analyze the principles, efficiency, and site-selection criteria for wind and tidal energy conversion systems.
4	To explore the thermodynamic cycles of geothermal power plants and the fundamental requirements for sustainable nuclear fusion.
5	To introduce biomass conversion technologies and the chemical processes involved in producing alternative biofuels.

Course Outcomes:-

CO1	Analyze the global and national energy scenarios to justify the transition toward non-conventional energy resources for sustainable development.
CO2	Calculate solar radiation geometry and design solar thermal systems (flat-plate/concentrating collectors) for specific thermal applications..
CO3	Evaluate the technical and structural performance of wind and tidal energy conversion systems based on site-specific criteria.
CO4	Examine the operational parameters of geothermal power cycles and the fundamental requirements for sustainable nuclear fusion energy.
CO5	Select appropriate thermochemical or biochemical conversion pathways for biomass to produce biogas and alternative liquid fuels.

Mapping: Course Outcomes to Program Outcomes

The table below indicates the strength of the correlation between Course Outcomes and the Program Outcomes (**3: High, 2: Medium, 1: Low, "-": No correlation**).

Course Outcome	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	-	-	-	3	2	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-
CO3	3	3	2	2	2	2	-	-	-	-	-
CO4	3	2	2	1	1	2	-	-	-	-	1
CO5	3	2	3	1	-	3	2	-	-	-	2

Course Content

UNIT I: Energy Scenario & Solar Energy [09 Hours]

Introduction: Global and National energy scenario, general energy problems, and the urgent need for non-conventional resources.

Solar Energy Engineering: Solar Radiation: Physics of solar radiation, radiation geometry, and estimation of solar flux on tilted surfaces. Solar Thermal Systems: Design and operation of Flat-plate collectors and Concentrating collectors (Paraboloidal and Heliostats).

UNIT - II: Wind Energy Conversion Systems [09 Hours]

Principles & Siting: Basic principles of wind energy conversion, conversion efficiency, and technical criteria for site selection. Wind Turbines: Structural components, comparison of Horizontal Axis (HAWT) and Vertical Axis (VAWT) wind turbines, towers, and generators..

UNIT - III: Geothermal and Tidal Energy [09 Hours]

Geothermal Energy: Exploration of geothermal fields and power estimates. Analysis of Steam power plants, Binary fluid cycles, and Preheat hybrid plants. Applications and prospects in the Indian subcontinent. Tidal Energy: Physics of tidal power, components of tidal power plants, and Double Basin arrangements. Technical limitations and site prospects in India.

UNIT - IV: Nuclear Fusion Energy [09 Hours]

Fusion Fundamentals: Comparison of Nuclear Fission vs. Fusion; requirements for achieving sustainable fusion. Future Trends: Advantages of fusion energy, Fusion-fission hybrids, and the concept of Cold Fusion.

UNIT - V: Biomass and Bio-fuels [09 Hours]

Biomass Resources: Classification of biomass categories, energy plantations, and bio-fuel types.
Conversion Technologies: Introduction to thermochemical and biochemical conversion processes;. Biogas Engineering:, Floating Gasholder,. Alternative Liquid Fuels: Production and utilization of Ethanol and Methanol as alternative fuels.

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References/TextBook:-

1. B. H. Khan, Non-Conventional Energy Resources, McGraw-Hill Education (India) Pvt. Ltd., 3rd Edition, 2017.
2. G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 6th Edition, 2017.
3. G. S. Sawhney, Non-Conventional Energy Resources, PHI Learning Pvt. Ltd., 2nd Edition, 2012.
4. Anand Tembulkar and S. P. Meher, Non-Conventional Energy Sources, S. K. Kataria& Sons, 3rd Edition, 2021.
5. John Twidell and Tony Weir, Renewable Energy Resources, Routledge / Taylor & Francis, 4th Edition, 2021
6. Aldo Vieira da Rosa, Fundamentals of Renewable Energy Processes, Academic Press (Elsevier), 4th Edition, 2022.
7. S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill Education, 4th Edition, 2017.
8. A.N.Mathur:Non-ConventionalResourcesofEnergy.2010
9. V.V.N.Kishore:RenewableEnergyEngineeringandTechnology,TERI.2006

Subject Code BTME25MD404B	Power Plant Engineering	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:-

1	To understand the fundamental operation and control of conventional power plants (Thermal, Hydro, Nuclear, and Gas).
2	To introduce the economic factors governing power systems, including load surveys and plant economics.
3	To analyze the site selection criteria and structural layouts of major power generating stations.
4	To explore the principles of renewable power generation including Solar, Wind, and Magneto Hydro Dynamic (MHD) systems.
5	To explain the concept of parallel operation, grid connectivity, and the economic distribution of load among interconnected systems.

Course Outcomes:-

CO1	Analyze the operational cycles and economics of conventional power plants using load duration curves and plant factors.
CO2	Explain the technical functions of thermal and hydro power plant components, including turbines, governors, and pumped storage units.
CO3	Examine nuclear, diesel, and gas power plant layouts, focusing on safety protocols, shielding, and waste disposal.
CO4	Evaluate the feasibility of renewable energy technologies (Solar PV, Wind, Biomass, MHD) as alternate power sources.
CO5	Formulate strategies for the parallel operation of power plants and determine appropriate tariffs for economic load sharing in a grid.

Mapping: Course Outcomes to Program Outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	1	-	-	-	3	-
CO2	3	2	2	1	-	1	-	-	-	-	-
CO3	3	2	2	1	-	3	2	-	-	-	1
CO4	2	3	3	2	1	3	2	-	-	-	2
CO5	3	3	2	2	2	2	-	1	-	2	2

Course Content

UNIT - I: Power Generation from conventional sources [09 Hours]

Introduction to conventional energy sources, Thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems; Alternate sources of power generation - solar, wind, geo-thermal, ocean-thermal, tidal, wave and MHD. Economic considerations in power systems-Load and Energy survey, load duration curve, plant factor and plant economics.

UNIT - II: Thermal and Hydro Power Plants [09 Hours]

Thermal Steam and Hydro Power Plants: Selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries. Hydro-electric Power Plants – selection of site, elements of power plant, classification, water turbines,
governor action, hydro-electric generator, plant layout, pumped storage plants.

UNIT -III: Nuclear Power Plants [09 Hours]

selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.
Diesel and Gas Power Plants: Advantage and limitations, types of diesel plants, general layout, and applications. Components of gas power plant, gas turbine, fuels, materials, working and applications.

UNIT - IV: Renewable power plants [09 Hours]

Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto hydro dynamic power generation, micro-hydel power plants, fuel cells.

UNIT - V: Combined operation of power plants [09 Hours]

Plant selection, choice of size and number of generator units, Concept of parallel operation of various generating sources and load sharing, interconnected systems, concept of Grid, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic
considerations – types of costs, tariff and consumers.

Text/Reference Books:

1. Wadhwa, C.L.,"Generation Distribution and Utilisation of Electrical Energy", New Age International Publishers, 3rd Edition, 2010.
2. J.B.Gupta, "A Course in Power Systems", S.K.Kataria and Sons, Reprint 2010-2011.
3. M. M. El-Wakil, "Power Plant Technology", Mcgraw Hill, Digitized on Dec 2000
4. B. G. A. Skrotzki& W. A. Vopat, "Power Station Engineering & Economy", McGraw Hill,
5. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., "A Text Book on Power Systems Engg", DhanpatRai and Sons, New Delhi.
6. Nag P. K., "Power Plant Engineering", Tata McGraw Hill Publications
7. R. K. Rajput, "Power Plant Engineering", Shree Laxmi Publications

Subject Code BTME25MD505B	Energy Conservation and Audit	Credits 03

Teaching Scheme	Examination Scheme
Theory: 3 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:-

1	To introduce the classification of energy resources and the legal frameworks of international climate agreements like the Paris Agreement.
2	To analyze energy utilization in the industrial sector and the principles of energy-efficient design for industrial apparatus.
3	To understand the patterns and forms of energy consumption across agricultural, commercial, domestic, and municipal sectors.
4	To impart the methodology of conducting energy audits, including data measurement, analysis, and interpretation.
5	To evaluate the economic feasibility of energy conservation projects through financial tools like the Time Value of Money.

Course Outcomes:-

CO1	Relate global energy resource conservation with international legal frameworks and climate change conventions.
CO2	Analyze the energy efficiency of industrial processes (heating, welding, motive power) to propose energy-efficient designs.
CO3	Assess the energy consumption patterns in non-industrial sectors to identify potential areas for conservation.
CO4	Conduct a systematic energy audit using appropriate measuring devices and analyze data to draw valid conclusions.
CO5	Evaluate the financial viability of energy conservation projects using investment techniques and numerical interpretation.

Mapping of Course Outcome with Program Outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	3	3	-	-	-	1
CO2	3	3	3	1	1	2	-	-	-	-	-
CO3	2	2	1	-	-	3	-	-	-	-	-
CO4	3	3	2	3	3	2	1	2	2	-	2
CO5	2	2	-	-	-	1	-	-	-	3	1

Course Content

UNIT I: Sources of Energy and International Agreements [09 Hours]

Energy resources, Stored & running resources, Non-conventional energy sources, Necessity of conserving resources. United Nation Framework Convention on Climate Change. International Agreements – History and Current Agreements – Paris Agreement.

UNIT II: Energy in Industries [09 Hours]

Energy inputs in industry, Comparison of various energy inputs, Use of electric energy in industries for motive power, Heating (Space, Furnace, Water), Lighting, Air conditioning, Welding, Energy efficiency of the apparatus in above energy conversion processes, Energy efficient design of above processes.

UNIT III: Energy in Non-industrial Sector [09 Hours]
Different forms of energy are used in agricultural, commercial, domestic & municipal sectors.

UNIT IV: Energy Audit [09 Hours]
Audit, A prerequisite for energy conservation, Principles of energy audit, Measurement & measuring devices, Analysis of data, Audit Case Studies.

UNIT V: Energy Conservation in Utilities and Energy Investment [09 Hours]
Energy conservation in generation, transmission, distribution & utilization, Demand side energy management, Energy efficient lighting system, Energy efficient drives-Critical study & analysis of certain case studies. Planning, Implementation & monitoring of energy conservation project, Time Value of money, Financial Investment. All calculations and numerical interpretation.

Texts/References Books:
1. Charles M Gottschalk , "Industrial Energy Conservation" , John Willey and Sons
2. Keth & Fecher, "Energy Efficiency Handbook", CRC Publication
3. Paul O Callagham,"Energy Management", Tata Mc Grawhill
4. S Rao and B Parulekar ,"Energy Technology", Khanna Publisher

Subject Code BTME25MD509L	Energy Conversation and Audit Lab	Credits 01

Teaching Scheme	Examination Scheme
Theory: Tutorial : Practical: 2 hr./week	Continuous Assessment: 50 Marks Mid-Semester Exam: - End Semester Exam: 50 Marks

Course Objectives:-

1	To introduce the classification of energy resources and the legal frameworks of international climate agreements like the Paris Agreement.
2	To analyze energy utilization in the industrial sector and the principles of energy-efficient design for industrial apparatus.
3	To understand the patterns and forms of energy consumption across agricultural, commercial, domestic, and municipal sectors.
4	To impart the methodology of conducting energy audits, including data measurement, analysis, and interpretation.
5	To evaluate the economic feasibility of energy conservation projects through financial tools like the Time Value of Money.

Course Outcomes:-

CO1	Relate global energy resource conservation with international legal frameworks and climate change conventions.
CO2	Analyze the energy efficiency of industrial processes (heating, welding, motive power) to propose energy-efficient designs.
CO3	Assess the energy consumption patterns in non-industrial sectors to identify potential areas for conservation.
CO4	Conduct a systematic energy audit using appropriate measuring devices and analyze data to draw valid conclusions.
CO5	Evaluate the financial viability of energy conservation projects using investment techniques and numerical interpretation.

Mapping of Course Outcome with Program Outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	3	3	-	-	-	1
CO2	3	3	3	1	1	2	-	-	-	-	-
CO3	2	2	1	-	-	3	-	-	-	-	-
CO4	3	3	2	3	3	2	1	2	2	-	2
CO5	2	2	-	-	-	1	-	-	-	3	1

Course Content (At least 5 need to do)

1. Study of Renewable Energy Systems (Solar PV, Wind, Biogas – working & diagrams)
2. Case Study on United Nations Framework Convention on Climate Change (UNFCCC)
3. Study on Energy Consumption Analysis in an Industry (Energy inputs & efficiency suggestions)
4. Study of Electrical Energy Use in Industrial Applications (Motors, Heating, Lighting, HVAC)
5. Mini Energy Audit of Classroom / Laboratory (Load calculation & recommendations)
6. Study of Energy Measuring Instruments (Energy meter, Clamp meter, Lux meter)
7. Energy Audit Case Study (Analysis & savings calculation)
8. Study of Demand Side Management (DSM) Techniques with case study
9. Study on Energy Conservation Project Planning (Design, Investment & Monitoring)
10. Classification of Energy Resources (Stored vs Running, Conventional vs Non-conventional)

Subject Code BTME25MD606B	Innovation and Entrepreneurship	CREDITS 02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks/ Internal Assessment:

Course Objective:

1	To develop an entrepreneurial mindset and understand the role of leadership in economic development.
2	To apply Design Thinking principles for identifying macro-problems and validating customer personas.
3	To master the iterative process of solution design, prototyping, and developing a Minimum Viable Product (MVP).
4	To conduct market sizing and competitive analysis to assess the scalability of a business opportunity.
5	To formulate a comprehensive business plan using the Lean Canvas model, including financial planning and Go-to-Market strategies.

Course Outcomes:

CO1	Examine the attributes of successful entrepreneurs and entrepreneurs to build a professional network and mindset.
CO2	Apply Design Thinking methodologies to identify societal problems and validate customer segments.
CO3	Create innovative solution prototypes (MVP) that map to "Customer Jobs-to-be-done" and provide a strong value proposition.
CO4	Analyze market trends and competition to determine the size, scale, and feasibility of a venture opportunity.
CO5	Design a complete business model using the Lean Canvas framework, incorporating financial plans and customer acquisition strategies.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	2	2	2	2	1	3
CO2	1	3	2	2	-	3	-	2	2	-	2
CO3	2	2	3	2	3	2	-	3	2	2	2
CO4	-	3	-	2	2	2	-	1	-	3	1
CO5	-	2	2	-	2	2	1	2	3	3	2

Course Content

UNIT-I: Entrepreneurship Fundamentals & Context: [06 Hours]

Entrepreneurship Fundamentals & Context Meaning and concept, attributes and mindset of entrepreneurial and entrepreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skillsets, attributes and networks while on campus.

UNIT-II: Problem & Customer Identification: [06 Hours]

Understanding and analyzing the macro-Problem and Industry perspective, technological, socio-economic and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problem using Design thinking principles. Analyzing problem and validating with the potential customer. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity.

UNIT-III: Solution design & Prototyping: [06 Hours]

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Developing Problem-solution fit in an iterative manner. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating value, features and benefits..

Unit –IV: Opportunity Assessment and Sizing: [06 Hours]

Assess relative market position via competition analysis, sizing the market and assess scope and potential scale of the opportunity. Core Teaching Tool: Class and Venture Activity

Unit-V: Business & Financial Model, Go-to-Market Plan: [06 Hours]

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build -Measure – Lean approach Business planning: components of Business plan Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance. Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy.

Texts/References:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGraw Hill, 11th Edition.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
3. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.
4. Chowdhry Ajay, (2023) Just Aspire: Notes on Technology, Entrepreneurship and the Future.
5. Simon Sinek (2011) Start With Why, Penguin Books limited.
6. BrownTim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business.
7. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited.
8. Collins Jim, Porras Jerry, (2004) Built to Last: Successful Habits of Visionary Companies.
9. Burlington Bo, (2016) Small Giants: Companies That Choose to Be Great Instead of Big
10. Saras D.Sarasvathy,(2008)Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd

Subject Code BTME25MD705B	Industrial Organization & Management	Credits 02

Teaching Scheme	Examination Scheme
Theory: 2 hr./week Tutorial : Practical:	Continuous Assessment: 20 Marks Mid-Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objective:

1	To introduce the fundamental functions of management and the professional roles of managers in an industrial setup.
2	To analyze different organizational structures and the dynamics of authority, responsibility, and departmentation.
3	To impart knowledge on production systems, plant layouts, and work-study techniques for operational efficiency.
4	To explain inventory control models and financial decision-making tools like break-even analysis.
5	To understand the principles of human resource development and the implementation of quality standards like ISO and SQC.

Course Outcomes:

CO1	Illustrate the functions of management and the roles of managers to coordinate industrial activities effectively.
CO2	Analyze various organizational structures to define clear lines of authority, responsibility, and departmentation.
CO3	Apply work-study techniques and production planning principles to optimize plant layouts and operational processes.
CO4	Determine optimal inventory levels and financial break-even points using quantitative management techniques.
CO5	Examine HR strategies and quality control standards (ISO/SQC) to ensure workforce productivity and product reliability.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	-	2	2	2	1
CO2	-	2	-	-	-	1	-	3	2	1	-
CO3	2	3	3	2	2	2	-	2	-	2	1
CO4	1	3	1	-	2	1	-	-	-	3	-
CO5	-	1	-	2	2	2	2	2	1	1	2

Course Content

UNIT-I: Introduction to Industrial Management [06 Hours]
Meaning and scope of management, Functions of management (Planning, Organizing, Staffing, Directing, Controlling), Role of managers in industry.

UNIT-II: Organization Structure [06 Hours]
Types of organization (Line, Functional, Line & Staff), Authority, responsibility, and accountability, Departmentation.

UNIT-III: Production/Operations Management [06 Hours]
Types of production systems, Plant location and layout, Work study (Method study & Time study), Production planning and control (PPC).

UNIT-IV: Material and Financial Management [06 Hours]

Material Management: Inventory control techniques (EOQ, ABC analysis), Purchasing and store management. Financial Management: Cost concepts, Break-even analysis,Budgeting.

UNIT-V: Human Resource & Quality Management [06 Hours]

Recruitment and selection, Training and development, Wage systems and incentives, Quality control, Statistical quality control (SQC) basics, ISO standards (basic idea)

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Texts/References:

1. J. L. Riggs, "Production Systems: Planning, Analysis and Control", John Wiley & Sons, New York, International Edition, 4th edition, 1987.
2. H. T. Amrine, J. A. Ritchey, C. L. Moodie, J. F. Kmec, "Manufacturing Organization and Management", Pearson Education, 6th edition, 2004.
3. International Labour Organization (ILO), "Introduction to Work Study", International Labour Office, Geneva, 3rd edition, 1987.
4. H. Koontz, H. Weirich, "Essentials of Management", Tata McGraw Hill book Co., Singapore, International Edition, 5th edition, 1990.
5. E. S. Buffa, R. K. Sarin, "Modern Production/Operations Management", John Wiley and Sons, New York, International Edition, 8th edition, 1987.
6. P. E. Hicks, "Industrial Engineering and Management: A New Perspective", Tata McGraw Hill Book Co., Singapore, International Edition, 2nd edition, 1994.