Revised Scheme of Studies for MS and PhD
In
Engineering Management

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Revised Scheme of Studies for Masters and PhD in Engineering Management

FACULTY OF ENGINEERING AND TECHNOLOGY,
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PAKISTAN

Contents

1. Introduction

Engineering Management is a specialized form of management that is required to successfully run engineering organizations and personnel. Engineers typically require training and experience in both general management and the specific engineering disciplines. Engineers must have the skills necessary to manage and motivate technical professionals, which are different from the skills as compared to non-technical fields.

Our Graduate Program

Engineering Management graduate program specifically designed for engineers who want to add management and leadership skills in addition to their technical skills. This programs emphasizes on management-based approaches, written and oral communication skills and continuous improvement in management skills.

Why Engineering Management at IIUI

Effective and efficient management is one of the important aspects in career progression of every engineer, irrespective of his/her discipline of engineering organization of employment and position in organizational hierarchy. They need to apply the basic principles of management of planning, organizing, staffing, leading and controlling in their professional tasks. Sound decision making, information management, project management, quality engineering, design engineering, facility layout, production system and industrial costing management are some of the core issues being dealt as part of their career. Hence, basic and specialized knowledge in the field of engineering management is a dire need of the hour for every engineer and a profitable business through high productivity.

Now a days, the need for engineering management has been felt at all levels of managers, particularly in the professional management work environment. MS in Engineering Management shall enable an engineer to work as an effective and efficient manager at his/her assigned tasks. Pakistan Engineering Council (PEC) has stepped into the famous “Washington Accord” - which suggests that the need of trained engineering managers will get multifold in the coming years and managers with non-technical backgrounds will no more be a choice for employers of excellence.

Engineering Management focuses on optimization of resources while giving the engineers flexibility to work in variety of environments. It develops both qualitative and quantitative skills to enhance productivity of organization by emphasizing on both tactical and strategic level issues in an organization. This program will prepare engineers for eventual intermediate/senior management’s role in technical organizations. This is done by ensuring the students acquire a firm understanding and concept of engineering management topics.

Research in the Engineering Management focuses on understanding the problems involved in the engineering aspects of managing systems and technologies, creating appropriate problem formulations and solutions, and providing relevant decision support. This breadth of scope is complemented by potential areas such as, project management production and manufacturing management, productivity management, information systems management, supply chain management, operations management, quality management, ergonomics and work measurement, technology management of technologies and technological risks utilizing mathematical tools such as optimization and stochastic systems. Research in this program is a unique combination of real-time industrial problems and their optimization.

Objectives

The programs aim to achieve the following broader objectives:

- To understand the importance of organizational theory, behavior, human resource management issues and communications for successful business management.
- To familiarize the engineers with the concepts and applications of quantitative methods of analysis for improving production, supply and finances etc. in their organizations
- To provide an understanding of the systematic, integrated nature of organization and their impact on the development of business policy and strategy;
- To develop student's ability to communicate clearly, rationally and draw conclusions based on a rigorous, analytical and systematic approach to data.

The courses have been designed to facilitate the industrial understanding of engineers; including the strategic organizations. For making a right decision, knowledge of quantitative tools, effective utilization of human resources, understanding of economic decision making process, total quality management and project management, are essential. The courses included in this program form a balance to assist strategic level decision making and enhance the output. Each course consists of diversified topics that focusses on specialized management techniques.

2. Faculty

Full-time faculty members are available in the Department to teach and supervise research projects for MS/PhD students. In addition, a number of PhD Adjunct Faculty members (having specialized PhD degrees in Engineering Management/Industrial Management) are also contributing from industries, strategic organizations, public and private sector to make this program successful.

3. Eligibility Criteria

MS Engineering Management (2 years)

1. 16-year equivalent engineering degree duly recognized by HEC.
2. PEC registration is mandatory
3. Minimum CGPA 2.5/4.00 or 70% marks in annual system

Ph.D. Engineering Management (3-5 Years)

- 18-years equivalent degree in Engineering/Engineering Management or equivalent duly recognized by HEC
- Minimum CGPA 3.0 in MS
- PEC registration is mandatory

4. Course guidelines

4.1. **Course guideline for PhD EM Students**

1. Courses will be decided by the PhD committee before beginning of the first semester.
2. PhD scholar will have to take at least 6 courses to complete 18 credit hours course work.
3. PhD EM student has to do compulsory research thesis of 36 credit hours.
4. The PhD student will have to follow road map given in Table-1.

Table 1: Road Map for PhD EM program

1st Semester	**Course code**	**Course Title**	**Lec Hrs.**	**Credit Hours**
	EM XXX	Course-I	3	3
	EM XXX	Course-II	3	3
	EM XXX	Course-III	3	3
	Total Credit Hours		**9**	**9**
2nd Semester	**Course Code**	**Course Title**	**Lec Hrs.**	**Credit Hours**
	EM XXX	Course-IV	3	3
	EM XXX	Course-V	3	3
	EM XXX	Course-VI	3	3
	Total Credit Hours		**9**	**9**
3rd Semester onwards	**Course Code**	**Course Title**	**Lec Hrs.**	**Credit Hours**
	EM 899	Research Thesis	0	36
	Total Credit Hours		**18**	**36**
	Total Credit Hours of Degree		**54**	**54**

4.2. **Course guide lines for MS EM Students**

1. MSEM student will have to study 8 courses to complete 24 credit hours of course work.
2. MSEM student has to do compulsory research thesis of 6 credit hours.
3. The roadmap for MSME is given in Table 2.

Table 2: Road Map for MSEM program

1st Semester	**Course code**	**Course Title**	**Lec Hrs.**	**Credit Hours**
	EM 501	Research Methodology	3	3
	EM XXX	Elective Course-I	3	3
	EM XXX	Elective Course-II	3	3
	EM XXX	Elective Course-III	3	3
	Total Credit Hours		**12**	**12**
2nd Semester	**Course Code**	**Course Title**	**Lec Hrs.**	**Credit Hours**
	EM 610	Project Management	3	3
	EM XXX	Elective Course-IV	3	3
	EM XXX	Elective Course-V	3	3
	EM XXX	Elective Course-VI	3	3
	Total Credit Hours		**12**	**12**
3rd Semester	**Course Code**	**Course Title**	**Lec Hrs**	**Credit Hours**
	EM 699	Thesis	0	3
	Total Credit Hours		0	3
4th Semester	**Course Code**	**Course Title**	**Lec Hrs**	**Credit Hours**
	EM 699	Thesis	0	3
	Total Credit Hours		0	**3**
	Total Hours of Degree		**24**	**30**

5. Evaluation and Grading

A detailed account on evaluation criteria and grading policy can be found in Graduate Hand Book. This is in line with IIUI's policies and HEC's guidelines.

More details regarding course work, comprehensive, approval of synopsis, grading semester and thesis evaluation are available in "IIUI RULES, REGULATIONS AND PROCEDURES.

6. List of Courses & Codes

Course Code Methodology

EM = Engineering Management
First Numeric = Level of knowledge
Second & Third Numeric = Serial Number of EM Course

6.1. Core courses

1. Research Methodology (EM 501)
2. Project Management (EM 610)

6.2. List of All Courses for MS Engineering Management

Sr. #	Course Code	Course Title
1.	EM501	Research Methodology
2.	EM502	Procurement and Contract Management
3.	EM503	Professional & Business Ethics
4.	EM504	Management of Technical Organizations
5.	EM505	Human Resource Management
6.	EM506	Corporate Social Responsibility
7.	EM601	Marketing Management
8.	EM602	Fundamentals of Financial Management
9.	EM603	Problem Solving & Decision Making
10.	EM604	Project Risk Management
11.	EM605	Work Design and Measurement
12.	EM606	Concurrent Engineering
13.	EM607	Organizational Leadership
14.	EM608	Supply Chain Management

15.	EM609	Lean And Agile Manufacturing
16.	EM610	Project Management
17.	EM611	Total Quality Management
18.	EM612	Technology Management
19.	EM613	Operations Management
20.	EM614	New Products Development
21.	EM615	Entrepreneurship and Innovation for Engineers
22.	EM616	Financial Evaluation of Projects
23.	EM617	Special Topics in Engineering Management
24.	EM699	Research Thesis

6.3. **Course Outlines for MS Engineering Management**

EM 501	**RESEARCH METHODOLOGY**	**3 CREDIT HRS**
Pre-Requisite	Nil	
Course Objective	The students should be able to: understand some basic concepts of research and its methodologies, identify appropriate research topics, select and define appropriate research problem and parameters , prepare a project proposal (to undertake a project), organize and conduct research (advanced project) in a more appropriate manner, write a research report and thesis, write a research proposal (grants)	
Course Outline	The meaning of research, Research and academics, Research problems, Types of research, Research process and design, Characteristics of good research and choice of research topic, Components of research proposal, Literature review, Research strategies, Sampling analysis, Data collection, Research ethics, Research access, Data analysis and Report writing	
Recommended Books	1. Discovering Statistics Using IBM SPSS Statistics by Andy Field, 2018 3. Social Research Methods by Alan Bryman, 2019 4. Research Methods for Business: A Skill Building Approach (4th Edition by Uma Sekaran, 2018 **Reference Books:** 1. Research Methods for Business Students by Mark Saunders, Philip Lewis, Adrian Thornhill, 2015 2. Business Research Methods by William G. Zikmund, Jon C. Carr, Barry Babin, Mitch Griffin, 2016	

EM 502	PROCUREMENT AND CONTRACT MANAGEMENT	3 CREDIT HRS
Pre-Requisite	Nil	
Course Objective	This course provides participants with a systematic and interactive approach to procurement management primarily achieved through analysis of the Procurement Life Cycle (Plan Procurement Management, Conduct Procurements and Control Procurements) from the perspective of both Buyers and Sellers. Furthermore, the course is intended to provide participants with an understanding of the core principles of procurement management knowledge in addition to: (1) The processes required to prepare effective RFPs and those required to respond successfully to RFPs, (2) Contract types (e.g., Output Contracts, Option Contracts) and common contract clauses (e.g., the often misunderstood 'Terms Conditions' language), (3) pricing mechanisms (e.g., firm fixed fees, penalty clauses, time & materials) and their implementation and, (4) outsourcing methodologies At the end of the course, students will be able to: • Describe the fundamental elements of a contract, including basic terms and conditions • Develop appropriate selection criteria for vendor selection • Analyze RFP or ITB from supplier's perspective • Specify accurate and manageable contract scopes • Develop effective terms and conditions for contract review • Be able to choose the right contract type for a given situation • Students will demonstrate the foregoing by means of mini-case studies and exercises throughout the course.	
Course Outline	This course will cover: an overview of procurement and contract management, its processes and components, understanding and preparing RFP or ITB, process for supplier selection, developing terms and conditions for contract review, strategic supplier relationship, supply Management analysis, strategic sourcing methods and tools, ethical issues in procurement, financial skills for procurement management, contracts management for procurement, contract management and supplier relationship, supply chain management, e-sourcing and procurement management, bidding and evaluations, negotiations in contracting context, post-award contract management.	
Recommended Books	1. Strategic Supply Chain Management – Principles, theories and Practices by Cousins & lamming, 2017. Prentice Hall. 2. Project Management Body of Knowledge (PMBOK) by PMI, 2017. 3. Pakistan Procurement Code 4th edition by PPRA. 2015 Procurement Principles and Management 10th ed. by Baily & Farmer, 2015. Prentice Hall. **Reference Books:** 5. Contract Management; Organizational Assessment Tools 1st ed. by Gregory Garett & Rene Randon, 2014. NCMA. 6. Supply Chain Risk – Understanding Emerging Threats to Global Supply Chains 1st ed., 2014 by John Manners-Bell. Kogan Page Publishers.	

EM 503	PROFESSIONAL & BUSINESS ETHICS	3 CREDIT HRS
Pre-Requisite	Nil	
Course Objective	This course aims to educate the students with the basic concepts of ethics and ethical responsibilities they will be facing while working in any organization. The role of ethics is of utmost importance in everyone's routine and professional life. However, our education system misses this important aspect to be ingrained in its curriculum. That's the main reason behind introduction of this course in EM curriculum. The second objective of this course is to introduce a formalized sense of professional ethics in the students. This objective will be achieved by making explicit the normativity of ethics as the moral foundation at the core of professionalism.	
Course Outline	The Historical Overview and Definition of professional ethics. What are human values? What are engineering ethics? Engineering as social experimentation. The Ethics Gap in Contemporary Engineering. The Gap Between Education and Experience. What are Sociological and Ethical Preliminaries? Ethical Issues and Situational Factors Conducive to Misconduct. A Model of Ethics Reasoning. Concepts, Principles, and Norms within Professional Environments. Dealing with the conflict of interest. Fidelity, Honesty, and Role-Based Duties. Formal Justice, Bias, and Allocation of Resources.	
Recommended Books	1. The Ethically Responsible Engineer: Concepts and Cases for Students and Professionals by Robert McGinn. Wiley Publishers 2018. 2. The Professional Ethics Toolkit, First Edition by Christopher Meyers. John Wiley & Sons Ltd 2018. 3. A Text Book on Professional Ethics and Human Values by R.S. Naagarazan. New Age International Publishing 2012.	

EM 504	MANAGEMENT OF TECHNICAL ORGANIZATIONS	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	• Take an holistic approach to addressing issues facing an organization; understand and compensate for the effects of changes on all aspects of an organization • Identify and clearly define a problem/issue • Analyze and question data and information in a rigorous manner and generate and organize qualitative and quantitative evidence to support arguments and recommendations	
Course Outline	The Management Process Today, The Evolution of Management Theory, Managing Diverse Employees in a Diverse Environment, Managing the Organizational Environment, Managing Organizational Structure, Organization Control and Culture, Human Resource Management, Motivation, Leadership, Groups and Teams, Communication.	
Recommended Books	1. Information, Organization and Management by Reichwald, Ralf, Wigand, Rolf, 2018. 2. Management of Technology: Managing Effectively in Technology-Intensive Organizations by Hans J. Thamhain, 2016	

EM 505	HUMAN RESOURCES MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The HRM focuses on preparing students to impact the study of people, process and outcomes within the fields of human resources management. Through research, collaboration and dissemination of knowledge, students understand how to impact organizational effectiveness in a variety of different environments, industries and across multiple levels of analyses.	
Course Outline	HRM, equal opportunity, job analysis, personnel planning and recruitment, testing, performance management, careers, employees relations, Theories of Employee Motivation and Rewards Systems, Communications in Organizations, Group Dynamics, Team building and Decision Making, Organizational Conflict & Resolution Strategies, Organizational Change and Development, Organizational Culture, Organizational Structure and Design	
Recommended Books	1. Human Resource Management (16th Edition) by Gary Dessler, 2020 2. Organizational Behavior and Management by John M. Ivancevich, Robert, Micheal, Matteson, 2017. 3. Designing the Purposeful Organization: How to Inspire Business Performance Beyond Boundaries by Clive Wilson, 2014. 4. Human Resources Management by Wendell L. Frencch, 2006.	

EM 506	CORPORATE SOCIAL RESPONSIBILITY	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	Corporate social responsibility (CSR) is an evolving practice of organizations of varying size to integrate business activities with models that produce social and environmental outcomes. The course will rigorously explore the evolution and modalities of corporate social responsibility, with attention to cross-sector partnerships, the utility of social finance and its relationship with corporate responsibility, non-financial reporting, and other relevant trends. This course examines how CSR is currently practiced with particular consideration for interaction with government and the non-profit sector.	
Course Outline	The Evolution of Corporate Social Responsibility: Philanthropy to Sustainability, The Current Landscape: An Introduction to CSR Modalities, Discourse, & Strategies, The Importance of Context: Industry, Geographic, and Political Considerations for Practice, Operational Realities and Evolving Expectations: Challenges and Limitations to Corporate Social Responsibility, An Introduction to Cross-sector Partnerships, The Financial Services Industry and CSR: From Traditional Philanthropy to Social Finance, The Concept, Practice, and Proliferation of Social Finance, CSR Operations in Practice: Functions, Metrics, Evaluation and Quantification Efforts, Indicating Impact: Analytical and Reporting Practices, Public Sector Perspectives and Engagement, Non-profit Sector Perspectives and Engagement, The Future of Corporate Responsibility and Cross-sector Partnerships, Advance Thinking and Practice: Next Steps for the Field,	
Recommended Books	1. Carroll, A. B. (2019). A history of corporate social responsibility. Oxford Handbooks Online. 2. Moon, J., Kang, N., & Gond, J. (2019). Corporate social responsibility and government. Oxford Handbooks Online. 3. Moon, J., & Vogel, D. (2017). Corporate social responsibility, government, and civil society. Oxford Handbooks Online.	

EM 601	MARKETING MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The main objectives of this course are to improve your ability to: 1. Assess market opportunities by analyzing customers, competitors, collaborators, context, and the strengths and weaknesses of a company. 2. Develop effective marketing strategies to achieve organizational objectives. 3. Design a strategy implementation program to maximize its chance of success. 4. Communicate and defend your recommendations and critically examine and build upon the recommendations of your classmates both quantitatively and qualitatively.	
Course Outline	Overview of Marketing: Developing Customer Value, Satisfaction, Relationships and Experiences through Marketing, Developing Successful Marketing Strategies/ Understanding the Marketing Environment. The Consumer and Market Profile, The Marketing Strategy, The Marketing Plan Presentation, Marketing Communication Lecture and Tutorial:	
Recommended Books	1. Marketing Management (Hardcover) by Philip Kotler, 2018 2. Marketing Management: A Strategic Decision making Approach by John W. Mullins, 2019.	

EM 602	FUNDAMENTALS OF FINANCIAL MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The financial management is generally concerned with procurement, allocation and control of financial resources of a concern. The objectives can be: 1. To ensure regular and adequate supply of funds to the concern. 2. To ensure optimum funds utilization. Once the funds are procured, they should be utilized in maximum possible way at least cost. 3. To ensure safety on investment, i.e., funds should be invested in safe ventures so that adequate rate of return can be achieved. 4. To plan a sound capital structure. There should be sound and fair composition of capital so that a balance is maintained between debt and equity capital.	
Course Outline	5. What Is Financial Management and What Can It Do For Me? 6. How Can Financial Ratio Analysis Help Me Make Better Decisions? 7. How Can Financial Forecasting Improve the Planning and Performance of My Company? 8. What Is Working Capital and Why Is It Important? 9. How Can I Use Cost-Benefit Analysis to Manage My Working Capital Efficiently? 10. What is the Required Rate of Return on an Investment? 11. How Can I Evaluate Investment Choices 12. Applications in Capital Budgeting	
Recommended Books	1. Financial Management by C. Paramasivan and T. Subramanian, new age international publications, 2017. 2. Basic Financial Management by Khan & Jai., 2016.	

EM 603	PROBLEM SOLVING & DECISION MAKING	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	It is sub-discipline of operations research that explicitly considers multiple criteria in decision-making environments. Whether in our daily lives or in professional settings, there are typically multiple conflicting criteria that need to be evaluated in making decisions. Cost or price is usually one of the main criteria. Some measure of quality is typically another criterion that is in conflict with the cost.	
Course Outline	Introduction, Multi Criteria Decision Making Methods, WSM, WPM, AHP Methods, Quantification of Qualitative Data for MCDM problems, Deriving Relative Weights from Ratio Comparison and Difference Comparison, Decomposition Approach, Pairwise Comparison, Duality Approach, Sensitivity Approach,	
Recommended Books	1. Multi-criteria Decision Making Methods: A Comparative Study (Applied Optimization) 20th Edition by Evangelos Triantaphyllou, 2020. 2. Learning in Multiobjective Optimization. Greco, J. Knowles, K. Miettinen, E. Zitzler (eds), 2015.	

EM 604	PROJECT RISK MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The objective of this course is to teaches the students that how to identify, analyze, plan, and manage project-related risks. Course participants will learn the difference between real project risks and project areas that require more research. This course covers the area of risk management in the project context. It highlights the importance of risk management and the need for project managers to think ahead in this regard.	
Course Outline	Introduction to Project Risk Management, Plan Risk Management, Establishing and Planning Risk Management, Risk Identification, Roles and Responsibilities, Project Risk Assessment, Plan Risk Responses, Control Risks, Qualitative Risk Analysis and Evaluation, Risk Response, Treatment and Action Planning, Monitoring, Reviewing and Controlling Risks, Quantitative Risk Analysis and Evaluation, Reporting, Communication and Consultation, Risk Based Decision Making	
Recommended Books	1. Project Management Institute (2017) A Guide to the Project Management Body of Knowledge (PMBOK®Guide), 6th Edition, Newtown Square, Pa, Project Management Institute. 2. Chris Chapman and Stephen Ward (2011). How to Manage Project Opportunity and Risk: Why uncertainty management can be a much better approach than risk management. 3. Principles of Risk Management and Insurance (11th Ed.), Rejda, George E., Addison Wesley publishers, Boston, Mass, 2015.	

EM 605	WORK DESIGN AND MEASUREMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	▪ Calculate the time that a task or set of tasks should take to be performed. ▪ Apply predetermined time values to activities from memory or from a data card according to the rules of most basic work measurement system. ▪ Observe operator activities and write accurate method descriptions using the work measurement system. ▪ Analyze work on the basis of moving objects using the most basic work measurement system. ▪ Identify work measurement activities in terms of the basic sequence models for manual work: General Move, Controlled Move, Tool Use and Equipment Use.	
Course Outline	Understand the foundation of work measurement ▪ Learn why work measurement is important to an organization. ▪ Learn about the traditional work measurement techniques of time study and predetermined motion time systems. ▪ Application courses designed to teach and provide practice in completing sequence models. ▪ Video courses designed to guide the participant through the complete process of identifying objects and measuring work with MOST. Learn the four basic sequence models used in the basic most work measurement system ▪ General Move – work measurement sequence model for the movement of an object freely through the air. ▪ Controlled Move – work measurement sequence model for the movement of an object while it remains in contact with a surface or is attached to another object during movement. ▪ Tool Use – work measurement sequence model for the use of common hand tools. ▪ Equipment Use - sequence model for various administrative activities.	
Recommended Books	1. Work Measurement and Methods Improvement, by Lawrence S. Aft, 2000. 2. Motion and Time Study: Design and Measurement, by Ralph M. Barnes, 1980.	

EM 606	CONCURRENT ENGINEERING	
Pre-Requisite	NIL	**3 CREDIT HRS**
Course Objectives	By finishing the tasks in parallel, the product development can be obtained more efficiently and in substantial saving in costs. CE is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support, in parallel. By finishing the tasks in parallel, the product development can be obtained more efficiently and in substantial saving in costs. This approach is intended to cause the developers from the outset, to consider all elements of the product life cycle from conception to disposal, including quality, cost, schedule, and user requirements In this course the students will investigate engineering and management tools for concurrent product and manufacturing process development. Students will develop skills in team dynamics, management of concurrent engineering projects, including the voice of the customer, and design for manufacturing and design for assembly	

	methodologies. The class will analyze case studies from various industries and hear working engineers' commentaries on concurrent engineering as it is practiced in industry today.
Course Outline	History of Concurrent Engineering. Motivation, Definition, and Philosophy of Concurrent Engineering (CE), Product Development and Time-to-Market Concept, Operating Concurrent Engineering Teams and Team Dynamics, CE Development Strategies, CE Project Management Tools, Voice of the Customer, Interface Between Design and Manufacturing, JIT, The Taguchi method for robust design, Axiomatic design, Failure-mode and effects analysis, Value engineering, Quality function deployment, Design for Manufacture (DFM), Design for Assembly (DFA), Design for Environment (DFE)
Recommended Books	1. Design for Manufacturability: How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products for Lean Production, 2014 by David M. Anderson. 2. Concurrent Engineering: Shortening Lead Times, Raising Quality, and Lowering Costs by John R. Hartley, 1998.

EM 607	**ORGANIZATIONAL LEADERSHIP**	
Pre-Requisite		**3 CREDIT HRS**
Course Objectives	• To expertise the students on leadership and entrepreneurship. It will examine the entrepreneur from a personal, organizational, and multidimensional point of view. In addition, successful entrepreneurs from profit and not-for-profit firms, and from manufacturing and service firms joined with assistance providers, to bring a firmer understanding of the qualities that contribute to successful leadership in growth-oriented firms. It emphasizes what entrepreneurs actually do, how they do it, and what can be learned by examining the common themes or concepts that exist in the practice of entrepreneurship	
Course Outline	This course will cover the following: - Definition and nature of Leadership and Management - Comparison between management and leadership - Theories of leadership styles - Stages of growth of leadership and management - Courage and moral leadership - Developing leadership diversity skills - Strategic and diverse leadership in a small business - Decision making and leadership - Profiles of successful business entrepreneurs - Management skills (plan, organize, measure, control, and provide leadership)	
Recommended Books	1. Organizational Leadership by John Barraton, 2004. 2. The New Entrepreneurial Leader: Developing Leaders Who Shape Social and Economic Opportunity by Danna Greenberg, Kate McKone-Sweet, 2017. 3. Entrepreneurial Leadership: The Art of Launching New Ventures, Inspiring Others, and Running Stuff by Joel Peterson, 2020. **Reference Books:** 1. Leadership and Entrepreneurship: Personal and Organizational Development in Entrepreneurial Ventures (Entrepreneurship, Principles and Practices) 1996 by Jana Matthews.	

EM 608	SUPPLY CHAIN MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	• To introduce the major building blocks, major functions, major business processes, performance metrics, and major decisions (strategic, tactical, and operational) in supply chain networks • To provide an insight into the role of Internet Technologies and Electronic Commerce in supply chain operations and to discuss technical aspects of key ITEC components in supply chain management. • To bring out the role of stochastic models (Markov chains, queueing networks); optimization models (LP, ILP, MILP, GA, Constraint Programming); and simulation in supply chain planning and decision-making. This will provide the foundation for design and analysis of supply chains.	
Course Outline	The course will cover: Operations Management & Strategy, Forecasting, Capacity Management, Capacity Management, Process Design, Lean Thinking, Performance Measurement, Quality & Product Design, Quality & Product Design, Inventory & Resource Planning, Inventory & Resource Planning, Collaborative Supply Chains, Collaborative Supply Chains.	
Recommended Books	1. Logistics and Supply Chain Management (4th Edition) by Martin Christopher, 2016. 2. Essentials of Supply Chain Management, Third Edition by Michael H. Hugos, 2018.	

EM609	LEAN AND AGILE MANUFACTURING	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	• To design a globally competitive manufacturing organization using lean and agile manufacturing principles; • To develop the skills to implement lean manufacturing in industry and manage the change process to achieve continuous improvement of efficiency and productivity. • Identify and understand the key requirements and concepts in lean and agile manufacturing and to initiate a continuous improvement change program in a manufacturing organization; • Apply the tools in lean and agile manufacturing to analyze a manufacturing system and plan for its improvements; • Manage the manufacturing system to achieve six sigma quality and sustainability.	
Course Outline	Holistic understanding of manufacturing (systems approach, manufacturing strategy, quality systems, design for manufacture). Problem solving and decision making (analysis and synthesis, analytical and system thinking, intuition, judgement, result interpretation) Working in teams and professional networks (project management, conflict resolution, negotiation, professional networking, persuasion, organization, communication, interpersonal skills) Leadership (initiate and facilitate technological change and innovation, cross-discipline collaboration, cross-cultural communication) International and cultural awareness (ability to work in global teams and settings, ability to adapt to different work contexts). This course introduces to key concepts in lean and agile manufacturing such as continuous improvement, just-in-time production, "pull" philosophy, TQM. The course focuses on the methods and tools commonly used to analyze the existing state of a manufacturing environment, including value stream	

	mapping, Kaizen cycle, single minute exchange of dies (SMED), six sigma and capability index. Illustrated with case studies and worked examples, the course will examine the socio-technical interactions within a modern manufacturing organization and develop skills and processes for implementing changes for achieving agile manufacturing and global competitiveness
Recommended Books	1. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities by V. Sivakumar, S.R. Devadasan, 2012.

EM 610	**PROJECT MANAGEMNT**	
Pre-Requisite	NIL	**3 CREDIT HRS**
Course Objectives	• To understand the concepts of project definition, life cycle, and systems approach; • To develop competency in project scooping, work definition, and work breakdown structure (WBS); • To handle the complex tasks of time estimation and project scheduling, including PERT and CPM • To develop competencies in project costing, budgeting, and financial appraisal; • To gain exposure to project control and management, using standard tools of cost and schedule variance analysis; • To appreciate the elements of risk and quality in hi-tech projects; • To learn project management by "practice", through the medium of "study projects"; and • To appreciate and understand the use of computers in project management, especially a tool like MS Project..	
Course Outline	Project management growth: concepts and, definitions, organizational structures, organizing and staffing the project office and team, management functions, planning, network scheduling techniques, project graphics, pricing and estimating, cost control, trade-off analysis in a project environment, risk management	
Recommended Books	1. Project Management Institute (PMI). A Guide to the Project Management of Knowledge (PMBoK). Newton Square, PA. 2017. 2. Project Management, A system approach, planning, scheduling and control by Harold Kerzner, 2017. 3. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 2011. 4. Project Management for Engineering and Technology by by David Goetsch, 2013.	

EM 611	**TOTAL QUALITY MANAGEMENT**	
Pre-Requisite	NIL	**3 CREDIT HRS**
Course Objectives	• The course aims to impart knowledge on the quality management process and key quality management activities • Demonstrate how to design quality into product and services, describe the importance of developing a strategic plan for Total Quality Management.	
Course Outline	Introduction to TQM, ISO-9000 Quality Model, Quality in manufacturing and service, Principles of total quality management, Leadership and Strategic planning, A focus on the customer, Quality measurement, Method for continuous improvement, Participation and teamwork, Implementation issue and strategies, inspection & quality control. Control Charts and their applications. Economics & quality control, Life testing, reliability, reliability prediction and calculations, reliability enhancing techniques.	
Recommended Books	1. Total Quality Management by James R. Evans, American Management Assoc., 2010. 2. Total Quality Management by Johns Ornland Amriu S. Soha, Pacific Rim, 2014.	

EM612	TECHNOLOGY MANAGEMENT	3 CREDIT HRS
Pre-Requisite	**Nil**	
Course Objectives	• Understand the dynamics of technological innovation, • Be familiar with how to formulate technology strategies, • Know how to implement technology strategies. • To understand how to manage ideas in a technological based organization.	
Course Outline	1. Introduction and Overview of Technology Management 2. Sources and Types of Technological Innovation 3. Market Entry: Standards and Timing 4. Corporate and Technology Strategies 5. External Innovation: Collaboration and Intellectual Property 6. Structures and Processes for Innovation 7. Managing Technological Innovation 8. Idea Generation 9. Commercialization	
Recommended Books	1) Schilling, M. Strategic management of technological innovation by Melissa Schilling 6th ed, 2019. McGraw-Hill. 2. The Technology Management Handbook by Richard C. Dorf., 2019. 3. Management Of Technology by Khalil, 2006.	

EM 613	OPERATIONS MANAGEMENT	
Pre-Requisite	NIL	**3 CREDIT HRS**
Course Objectives	To provide students with a state-of-the-art overview of operations management. The goal is to teach the fundamental principles of operations and how they relate to making a firm more competitive. Operations Strategy for Competitive Advantage, designing operations, managing operations, and quantitative modules.	
Course Outline	This course covers topics related to operations management such the difference between manufacturing and services organizations, characteristics of operations managers, and the relationship between operations, productivity and competitiveness. This is extremely useful for anyone interested in a career in operations management. Introduction to Operations and Supply Management, Forecasting, Process Design, product/service, process, facility, waiting lines, work, systems and location, Quality Management, Capacity Planning and Inventory Control, - lean manufacturing,, inventory management, material, requirements planning, just-in-time, enterprise resource, planning, scheduling and control, Supply Chain Management	
Recommended Books	1. Operations Management by Barron, 2019. 2. Operations Management by Jay Heizer, Barry Render-, 12th Edition (2017).	

EM614	NEW PRODUCTS DEVELOPMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The aims of this course are to examine the activities and competencies associated with the development of new products in firms, and to provide students with technical and practical knowledge and skills required to engage in new product development projects.	
Course Outline	The course will cover the process of new product development in established firms. The content will broadly cover the following topics: the role of new forms of product & service innovations in firms and their contribution to the firm's competitive advantage;	

	and the activities involved in the development of new product starting with opportunity development and concept generation up to product testing. Product and service innovation, Opportunity identification and identifying customer needs, Concept generation & product specification, Concept selection & testing, Product architecture & prototyping, Product and service design, Design for 'x' approaches, Product development economics, "Best practices" in managing new products and services
Recommended Books	1. Ulrich, Karl & Eppinger, Steven (2017) Product Design and Development, Fifth edition, McGraw-Hill. (additional resources available at: http://www.ulrich-eppinger.net) Recommended additional readings: 2. Crawford, M. and Di Benedetto, A. (2016) New products management, McGraw Hill International 3. Verganti, R. (2018) Design driven innovation: Changing the rule of competition by radically innovating what things mean, Harvard Business Press, Boston 4. Von Stamm, B. (2017) Managing innovation, design and creativity, 2nd edition, Wiley

EM615	**ENTREPRENEURSHIP AND INNOVATION FOR ENGINEERS**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	Entrepreneurs have led economies out of downturns in the last 100 years and evidence points to this trend continuing into the future. In fact, regardless of country or economic conditions, entrepreneurial enterprises are on the rise. High-tech start-ups, where innovation, dedication, collaboration, and pure genius align into a successful enterprise, will likely see good times—if they start up right. However, many young researchers hesitate to set up their own company. The course will focus on the fundamentals of global economies, accounting, finance, and quantitative business analysis, because ordinary engineers usually lack these necessary survival skills. Outlining a systematic preparation process that will build a great reputation in the commercial marketplace. Students experience the process of creating value for technology, learning how to develop embryonic ideas, and how to bring them to the marketplace.	
Course Outline	• To start up a company • To create product lines • To collect venture capital • To write successful R&D proposals • To apply forward thinking • To keep cash flowing in a small firm	
Recommended Books	1. Entrepreneurship for Engineers by Kenji Uchino, 2019. 2. Entrepreneurship from Creativity to Innovation: Effective Thinking Skills for a Changing World by Edward Lumsdaine, Martin Binks, 2016.	

EM616	FINANCIAL EVALUATION OF PROJECTS	3 CREDIT HRS
Pre-Requisite	**Nil**	
Course Objectives	The course builds on and expands the students' skills in financial theory and applications, focusing on project evaluations. The course includes a description of technical and economic characteristics of project risk and an option-based valuation of flexibility in projects. The knowledge and theory is also applied to analysis of compound investment strategies, financial instruments, large-scale investments and project finance, and entrepreneurial finance and valuation of small projects. Students will understand to think about general projects as a collection of real options and acquire the skills necessary to analyze the projects under uncertainty.	
Course Outline	What is Project Finance? Development of Project Finance. Elements of a Project-Finance Structure. The Project-Finance Markets. Working with Lenders. Types of Project Agreement. Commercial Risks. Macro-Economic Risks. An Overview of the Evaluation and Financing of Capital Projects. Evaluation and Funding of Projects. What are Project Financials? The Theory and Practice of Decision-making Concerning Capital Projects. Cost-benefit Analysis, Engineering Economics and Capital Budgeting. Sources and Use of Funds. A Framework for Decision-making. The Practice of Decision-making for Capital Projects. Business Process and the Dual Nature of Transactions. Financial Statements. Relationship Between the Financial Statements and the Project Cash Flows. Cash Flows for a Project. Estimation Techniques for Capital Costs. Estimation of the Total Operating Costs. Evaluation of Capital Projects, Time Value of Money, Evaluation Criteria for Investment Decisions, Discounted and Non-discounted Cash Flow Techniques, Sensitivity, Scenario and Other Decision Analysis Techniques, Risk and Return, Cost of Capital, Risk in Engineering Projects, Decision Tree Analysis and Utility Theory, Real Options Analysis, Financing and Evaluating Engineering Projects.	
Recommended Books	1. The Principles of Project Finance by Rod Morrison, 2016 2. Principles of Project Finance 2nd ed. By E.R. Yescombe, 2013. Elsevier. 3. Finance for Engineers: Evaluation and Funding of Capital Projects by F.K. Crundwell. Springer, 2009.	

EM 617	SPECIAL TOPICS IN ENGINEERING MANAGEMENT	3 CREDIT HRS
Pre-Requisite	**Nil**	
Course Objectives	The purpose of this course is to introduce the students to the emerging concepts in Engineering Management.	
Course Outline	Will be provided at the start of the course	
Recommended Books	Will be suggested as per requirements	

EM 699	RESEARCH THESIS	6 CREDIT HRS
Pre-Requisite	**24 CREDIT HRS OF COURSE WORK**	
Course Objectives		
Course Outline		

6.5. List of All Courses for PhD EM

Sr. No.	Course Code	Course Title
1.	EM701	Advanced Statistical Concepts
2.	EM702	Organizational Behavior
3.	EM703	Business Process Reengineering
4.	EM704	Statistical Quality Control and Assurance
5.	EM705	Facility Planning and Layout
6.	EM706	System Engineering
7.	EM707	Product Life Cycle Management
8.	EM708	Advanced Marketing Management
9.	EM709	Advanced Project Management
10.	EM710	Strategic Management
11.	EM711	Technology Management in Engineering Organizations
12.	EM712	Entrepreneurship and Innovations for Engineers
13.	EM713	Change Management
14.	EM714	Productivity Management
15.	EM801	Qualitative and Quantitative Research Methods
16.	EM802	Design of Experimental Research Studies
17.	EM803	Industrial Cost Management
18.	EM804	Operations Research
19.	EM805	Industrial Psychology
20.	EM806	Knowledge Management
21.	EM807	Logistics Management
22.	EM808	Product Design & Development
23.	EM809	Manufacturing Planning & Control
24.	EM810	Engineering Optimization Techniques
25.	EM811	Modeling of System Dynamics

26.	EM812	Research Proposal Development Techniques
27.	EM813	Special Topics in Engineering Management
28.	EM899	Research Thesis

6.6. **Course Outlines for PhD Courses in EM**

EM701	ADVANCED STATISTICAL CONCEPTS	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The course is designed for acquiring professional skills and knowledge in the area of statistics. The students will be enabled to independent treatment of statistical research issues. Data analysis of typical research problems will be done in R or SPSS or Stata.	
Course Outline	Introduction to advanced statistics, Exploring Data with Graphs, The Beast of Bias, Review and t-tests, ANOVA, ANCOVA, Factorial ANOVA, RM ANOVA, MANOVA, Correlation and Simple Regression, Multiple Regression, Logistic Regression, Exploratory Factor Analysis, Causal Modeling: Path Analysis and Structural Equation Modeling.	
Reference Books	1) Field, A. (2017) Discovering Statistics Using SPSS, 5th ed. Thousand Oaks, CA: Sage Publications. 2) Ross, Sheldon M. (2014), Introduction to probability and statistics for engineers and scientists, 3rd ed., Amsterdam et al.: Elsevier Academic Press 3) Cronk, B. (2019). How to Use SPSS: A Step-by-Step Guide to Analysis and Interpretation. 8th ed 4) Mertler, C. A. & Vanatta, R. A. (2016). Advanced and Multivariate Statistical Methods. (3rd ed.) Glendale, CA: Pyrczak Publishing.	

EM702	ORGANIZATIONAL BEHAVIOR	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	• To facilitate a critical evaluation of organizational practices and their impact on work behaviors, attitudes and performance • To understand some of the main theories of Organizational Behavior • To be able to analyze how these theories and empirical evidence can help to understand contemporary organizational issues • To apply theories to practical problems in organizations in a critical manner	
Course Outline	Introduction, Motivation and Rewards, Organizational Justice, Performance and Counter Performance, Attitudes and Behavior, Job Redesign, Managing Stress and Emotion, Groups and Group Processes, Leadership and Ethics, Organizational Culture.	
Recommended Books	1. Organizational Behavior: Foundations, Theories, and Analyses By John B. Miner, 2002 2. Organizational Behavior: Managing People and Organizations by Ricky W. Griffin, Jean M. Phillips, et al., 2016 3. Organizational Behavior: A Skill-Building Approach by Dr. Christopher P. Neck, Jeffery D. Houghton, et al., 2019 4. Essentials of Organizational Behavior: An Evidence-Based Approach by Terri A. Scandura, 2018	

EM 703	BUSINESS PROCESS REENGINEERING	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	This course aims to introduce the students to the vast domain of business process improvement/management (BPM/BPI). The course will thoroughly discuss the process, steps and practical methodology of BPM and the design of a business process architecture. The course will enable the students to understand their organizational process and redesign the inefficient processes using process modelling tools.	
Course Outline	Introduction to Business Process Management, Process for Identification of Processes, Essentials of Process Modeling, Advanced Process Modeling, Process Discovery, Qualitative Process Analysis, Quantitative Process Analysis, Process Redesign, Process Implementation with Executable Models, Process Monitoring, Documentation of Processes, Developing the As-Is and To-Be diagrams,	
Recommended Books	1. A Guide to the Business Analysis Body of Knowledge, 2020 by IIBA. 2. Fundamentals of Business Process Management 2nd ed., 2018 by Marlon Dumas et al. Springer Publishers. 3. Business Process Management Cases: Digital Innovation and Business Transformation in Practice, 2018 by Jan vom Brocke and Jan Mendling eds. Springer Publications. **4.** The Business Process Management Guide: Practical Methodology and Guidelines to Successful BPM, 2018. **Reference Books:** 1. Business Process Management Systems, 2016 by James F. Change. Auerbach Publications. 2. Business Process Improvement Workbook: Documentation, Analysis, Design, and Management of Business Process Improvement by H. James Harrington et al., 1997 McGraw Hill Professional	

EM704	STATISTICAL QUALITY CONTROL AND ASSURANCE	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	This course is at the interface between statistics and quality improvement. Getting the most out of the course requires an understanding of the basic terminology of both fields. Quality Assurance from the viewpoint of Producer and Consumer. Much of this philosophy is credited to Taguchi. Quality systems, philosophy, history and practice. To provide a working framework within modern quality techniques.	
Course Outline	• Statistical Process Control • Acceptance Sampling • Process average and process variation • Attributes and variables data • Graphical methods • Control charts • Experimental design • Acceptance sampling	
Recommended Books	1. Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, Piotr Konieczka, Jacek Namiesnik, 2018 2. Statistical Methods of Quality Assurance by Hans-Joachim. Mittag, Horst Rinne, 2018	

EM 705	FACILITY PLANNING AND LAYOUT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	A model facility layout should be able to provide an ideal relationship between raw material, equipment, manpower and final product at minimal cost under safe and comfortable environment. An efficient and effective facility layout can cover following objectives: ▪ To provide optimum space to organize equipment and facilitate movement of goods and to create safe and comfortable work environment. ▪ To promote order in production towards a single objective ▪ To reduce movement of workers, raw material and equipment ▪ To promote safety of plant as well as its workers ▪ To facilitate extension or change in the layout to accommodate new product line or technology upgradation ▪ To increase production capacity of the organization	
Course Outline	Analysis, design and evaluation of manufacturing facilities and material handling systems. The topics covered include definition of facilities planning, role of product process and schedule design, flow analysis and activity relationship, capacity and space requirements planning, computer aided layout planning, material handling systems and equipment, storage and warehousing, mathematical approaches to location problems, and performance evaluation and selection among alternatives. Layout Strategies, Warehouse Management, Facility Planning & Layout, Multiple Facilities, Inventory Management, JIT and Lean Operations	
Recommended Books	1. Guidelines for Siting and Layout of Facilities by CCPS (Center for Chemical Process Safety) by 2018 2. Facilities Design by Sunderesh S. Heragu, 2018 3. Tiling: Planning, Layout & Installation (For Pros By Pros) by Joseph Truini, 2011 4. Manufacturing Facilities, Location, Planning and Design by D.R. Sule, 2008. **Reference Books:** 1. Production and Operation Management, 8th Edition by Norman Gaither and Greg Fazier, South-Western College Publishing, 1999	

EM706	SYSTEM ENGINEERING	3 CREDIT HRS
Pre-Requisite	Nil	
Course Objectives	This course in systems engineering examines the principles and process of creating effective systems to meet application demands. Concepts, problems, and methods of systems engineering are introduced in lectures and discussions and applied in assignments and through semester-long group projects.	
Course Outline	Definition of a system, structure of a complex system, the system life cycle, reliability engineering, maintainability engineering, advanced system quality planning, needs analysis, risk analysis, quality function deployment functional analysis, value/cost engineering.	

Recommended Books	1. Systems Engineering Principles and Practice by Kossiakoff, A. and Sweet, W, 2020. John Wiley and Sons, Inc: Hoboken, New Jersey. 2. System Engineering Analysis, Design, and Development: Concepts, Principles, and Practices (Wiley Series in Systems Engineering and Management), 2015. 3. Systems Engineering Fundamentals by United States Government US Army, 2013

EM 707	**PRODUCT LIFE CYCLE MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	• Product Lifecycle Management to reflect the many advances made in PLM. • It includes descriptions of PLM technologies and examples of implementation projects in industry. • *Product Lifecycle Management* will broaden the understanding of PLM, nurturing the skills needed to implement PLM successfully and to achieve world-class product performance across the lifecycle.	
Course Outline	Product Lifecycle Management explains what Product Lifecycle Management (PLM) is, and why it's needed. It describes the environment in which products are developed, realised and supported, before looking at the basic components of PLM, such as the product, processes, applications, and people. It addresses the implementation of PLM, showing the steps of a project or initiative, and typical activities. PLM is a mission-critical decision-making system leveraged by the world's most innovative companies to transform their process of innovation on a continuous basis. That is a powerful value proposition in a world where the challenge is to get better products to the market faster than ever before. That is the power of PLM	
Recommended Books	1. Product Lifecycle Management: 21st Century Paradigm for Product Realization (Decision Engineering) by John Stark, 2013. 2. Product Lifecycle Management: Driving the Next Generation of Lean Thinking by Michael Grieves, 2015 3. Product Lifecycle Management by Antti Saaksvuori, 2017.	

EM708	**ADVANCED MARKETING MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite		
Course Objectives	The aim of this course is to enable the students to understand nature of markets. How to analyze procurement strategy, product policy, pricing, distribution strategy, sales force management and key account selling strategies. To establish quantitative and qualitative strategic marketing objectives that is relevant to the changing dynamics of the different sector.	
Course Outline	Topics in this course include the nature and overview market, Marketing Strategy, Marketing Environment, Analysis of customer procurement strategy, product policy, pricing, distribution strategy, sales force management and key account selling strategies. Describing the purpose and contents of corporate and marketing strategy. To articulate a market-oriented corporate strategy. Analyze weaknesses of current marketing, Articulate a market-oriented marketing positioning, targeting, and segmentation statement and related marketing strategy. Establish quantitative and qualitative strategic marketing objectives that are relevant to the changing dynamics. Assess the strategic assets, resources and competencies required to address strategic customers' expectations, Examine the	

	changing marketplace and evolving business models; evaluate the developing customer propositions; and discuss how effective segmentation and customer engagement allow operators to maximize both B2C and B2B opportunities.
Books	1. Marketing Communications by Olujimi Kayod, 2018. 2. Marketing Management by Philip Kotler, 2017. 3. Marketing Management: A Strategic Decision making Approach by John W. Mullins, 2012

EM 709	**ADVANCED PROJECT MANAGEMNT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	• To understand the concepts of project definition, life cycle, and systems approach; • To develop competency in project scooping, work definition, and work breakdown structure (WBS); • To handle the complex tasks of time estimation and project scheduling, including PERT and CPM • To develop competencies in project costing, budgeting, and financial appraisal; • To gain exposure to project control and management, using standard tools of cost and schedule variance analysis; • To appreciate the elements of risk and quality in hi-tech projects; • To learn project management by "practice", through the medium of "study projects"; and • To appreciate and understand the use of computers in project management, especially a tool like MS Project..	
Course Outline	Project management, concepts and, definitions. Network scheduling techniques (PDM), Define Activities & Milestones, Sequence Activities, Estimate Resources, Estimate Activity Durations. Understanding and implementing project management using MS Project. Advanced project scheduling, control and monitoring using Primavera	
Recommended Books	1. Project Management Institute (PMI). A Guide to the Project Management of Knowledge (PMBoK). Newton Square, PA. 2017. 2. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 2012.. 3. Project Management, A system approach, planning, scheduling and control by Harold Kerzner, 2017. 4. MS Project Manual 5. Primavera Manual	

EM710	**STRATEGIC MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	Strategic management is about running the total business enterprise. It seeks to understand the challenges and the environment in which the business operates, the direction the management intends to head, the strategic plans to for getting the enterprise moving in the intended direction and the tasks of implementing the chosen strategy successfully. This course aims to equip students with the core concepts, frameworks, and techniques of strategic management, which will allow to	

	understand what managers must do to make an organization – be it a for-profit or a non-profit one – to achieve superior performance.
Course Outline	Various components of strategic management, such as tools of strategy analysis, sources of competitive advantage, strategies in different industry contents and the fundamentals of corporate strategy are to be discussed throughout the course. The breakdown of the basic structure is as follows: 1. Introduction 2. Strategic Management Concepts 3. Industry Analysis: An Overview of the External Environment and the Internal Environment, Competitive Positioning via Cost Leadership versus Differentiation, Value Chain Analysis 4. Game Theory Approach to Competitive Dynamics 5. Business Strategies in Different Industry Contexts: Technology-Based versus Mature Industries 6. Corporate-Level Strategy: Scope of the Firm and Vertical Integration, Multinational Corporations. Diversification 7. Current Trends and New Challenges in Strategic Management 8. Wrap-up
Recommended Books	1. Contemporary Strategy Analysis Grant, R.M. (2018) , 10th ed. By , Blackwell Publishing 2. Competitive Startegy: Competitiveness and Globalization by Hitt, M., Ireland, D., Hoskisson, R. (2016), 12th ed., Cengage Learning

EM711	**TECHNOLOGY MANAGEMENT IN ENGINEERING ORGANIZATIONS**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	• To take an holistic approach to addressing issues facing an organization; understand and compensate for the effects of changes on all aspects of an organization • Identify and clearly define a problem/issue • Analyze and question data and information in a rigorous manner and generate and organize qualitative and quantitative evidence to support arguments and recommendations	
Course Outline	The Management Process Today, The Evolution of Management Theory, Managing Diverse Employees in a Diverse Environment, Managing the Organizational Environment, Managing Organizational Structure, Organization Control and Culture, Human Resource Management, Motivation, Leadership, Groups and Teams, Communication.	
Recommended Books	1.Management of Technology: Managing Effectively in Technology-Intensive Organizations by Hans J. Thamhain ISBN: 978-0-471-41551-0, 2009 2. Information, Organization and Management by Reichwald, Ralf, Wigand, Rolf, 2019.	

EM712	ENTREPRENEURSHIP AND INNOVATION FOR ENGINEERS	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	Entrepreneurs have led economies out of downturns in the last 100 years and evidence points to this trend continuing into the future. In fact, regardless of country or economic conditions, entrepreneurial enterprises are on the rise. High-tech start-ups, where innovation, dedication, collaboration, and pure genius align into a successful enterprise, will likely see good times—if they start up right. However, many young researchers hesitate to set up their own company. The course will focus on the fundamentals of global economies, accounting, finance, and quantitative business analysis, because ordinary engineers usually lack these necessary survival skills. Outlining a systematic preparation process that will build a great reputation in the commercial marketplace. Students experience the process of creating value for technology, learning how to develop embryonic ideas, and how to bring them to the marketplace.	
Course Outline	• To start up a company • To create product lines • To collect venture capital • To write successful R&D proposals • To apply forward thinking • To keep cash flowing in a small firm	
Recommended Books	1. Engineering Entrepreneurship from Idea to Business Plan (A Guide for Innovative Engineers and Scientists) by Paul Swamidass, 2016. 2. Introduction to Social Entrepreneurship by Teresa Chahine, 2016. 3. New Venture Creation: Entrepreneurship for the 21st Century (Irwin Management) by Jeffry Timmons, Rob Adams, et al., 2015. 4. Entrepreneurship for Engineers by Kenji Uchino, 2009.	

EM713	CHANGE MANAGEMENT	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	The objectives of this course are to explore approaches to understanding and to managing the organizational change process, and to identify practical approaches to effective change implementation. The course will strike a balance between theory and research on the one hand, and practical management tools and techniques on the other. The course will consider management skills in change implementation as well as the organization's ability to encourage innovation, and to cope with change. One integrating theme of the course will be the expertise of the change agent, the nature of that expertise, and how it can be developed. A second integrating theme will concern the organizational attributes such as, culture that either encourage or stifle creativity, innovation, and change.	
Course Outline	Why change management matters? Metaphors and paradigms. The need for change. Change formula. Factors contributing to success in change management. Change and the individual. The impact of the 'change curve'. Change and the organization. Models of the change process. Types of organization change. Factors that help/hinder change. Key roles in organizational change. Lifecycle of a successful change. Team structures and change. Organizational culture and change. Key dimensions of culture. Leadership and culture. Leadership roles. Leadership style. The change kaleidoscope. Tichy's change levers. Shadow side of organizations. Embedding change.	

Recommended Books	1. Making Sense of Change Management: A Complete Guide to the Models, Tools and Techniques of Organizational Change by Esther Cameron and Mike Green, 2019. 2. The Effective Change Manager's Handbook: Essential guidance to the change management body of knowledge by Richard Smith et al., 2014. Kogan Page Limited 3. Change Management Masterclass: A Step by Step Guide to Successful Change Management by Mike Green, 2012. Kogan Page Limited

EM714	**PRODUCTIVITY MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	▪ To introduce students with modern productivity management skills and techniques.	
Course Outline	Introduction to Productivity Management, Operations management, Charting and Diagramming techniques for operations analysis, Direct time study, JIT and Lean production, Managing inventory, six sigma and quality programs, Use of quality management tools and techniques, Managing quality, Statistical process control, Process performance and quality, Constraint management.	
Recommended Books	1. Productivity Management in an Organization Measurement and Analysis by Kongkiti Phusavat, 2013. 2. Metrics-Based Process Mapping: Identifying and Eliminating Waste in Office and Service Processes by Karen Martin and Mike Osterling, 2012. 3. Productivity Management: A Practical Handbook by Joseph Prokopenko, 1998.	

EM801	**QUALITATIVE AND QUANTITATIVE RESEARCH METHODS**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objective	The main aim of the course is for students to develop an understanding of the engineering and business research process. By the end of this course, students will be able to Identify and adopt an appropriate philosophical position to a particular research question. Student will be also able to recognize and successfully address any ethical issues that can arise throughout the duration of a research project and use relevant quantitative and qualitative methodologies when writing-up the dissertation project. On completion of course student will be able to apply appreciate various analytical techniques during the research process.	
Course Outline	The course addresses a wide range of business research methods including various methods of data collection and analysis. Topics will include Research philosophy – the ontology, epistemology, axiology and rhetoric of research, Review of contemporary debates within the areas of social science and organizational studies, Literature review – definition and research objectives, Techniques of review, evaluation and critique of existing methodologies, Techniques for organizing, expressing, mapping and analyzing ideas, research planning, sampling, exploratory research, interviews, secondary data analysis, survey methodology, and quantitative analytical methods. Argumentation analysis, Approaches to research design, Gaining access to information sources, The ethnographic option, The ethics of research, Peer and tutor review, Reliability and validity, Sampling strategies, Quantitative methods, Quantitative data without surveys – content and network analysis, Advanced statistical techniques for the analysis of	

	quantitative data, Qualitative methods – theoretical positions in qualitative research, Coding and classifying qualitative data, Grounded theory, Qualitative methods – using computers to analyze qualitative data
Recommended Books	1. Creswell, J.W. (2017), Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Third Edition, Sage 2. Punch, K. F. (2016), Developing Effective Research Proposals, Second Edition, Sage. 3. Neuman, W.L. (2014), Social Research Methods: Qualitative and Quantitative Approaches Fifth Edition, Allyn and Bacon: Boston. (Earlier editions also appropriate)

EM802	**DESIGN OF EXPERIMENTAL RESEARCH STUDIES**	**3 CREDIT HRS**
Pre-Requisite	Nil	
Course Objectives	Experiments are considered advanced research methods, so a basic research methods class and a theory class are pre-requisites. The objective of this course is to introduce students to experimental research methods. The overall aim of the class is to equip students with the knowledge and capacity to conduct experimental research as well as interpret and critique others' experimental research.	
Course Outline	Introduction. History of Experiments, Overview of experiments. Theory and Literature, Reliability, Validity, and Bias, Research design and operationalization of concepts, Experimental and quasi-experimental research, Hypotheses, Effects Sizes. Randomization and Sampling, Survey research,, Qualitative field research, Manipulation checks, pretests, pilot studies, Measurement, Stimuli design, Random Assignment, Factorial Designs, , Ethics in research, Quasi Experiments, Data analysis, Repeated measures, Treatment issues, Writing up results,	
Reference Books	1. Shadish, W. R., Cook, T.D., & Campbell, D.T.(2012). Experimental and Quasi Experimental Designs for Generalized Causal Inference Belmont, CA: Wadsworth. 2. Bausell, R. B.(2014). Conducting Meaningful Experiments: 40 Steps to Becoming a Scientist. Los Angeles: Sage. 3. Wilson, T. D., Aronson, E., & Carlsmith, K. (2015). The art of laboratory experimentation. Handbook of social psychology.	

EM 803	**INDUSTRIAL COST MANAGEMENT**	
Pre-Requisite	NIL	**3 CREDIT HRS**
Course Objectives	1. Describe a cost management system, its objectives, and its major systems. 2. Identify the current factors affecting cost management. 3. Describe how management accountants function within an organization 4. Understand the importance of ethical behavior for management accountants. 5. Identify the three forms of certification available to internal accountants	
Course Outline	Introduction to Cost Management , Basic Cost Management Concepts, Cost Behavior, Activity-Based Costing, Product and Service Costing: Job-Order System, Product and Service Costing:A Process Systems Approach, Strategic Cost Management, The Balanced Scorecard: Strategic-Based Control, Cost-Volume-Profit Analysis	

Recommended Books	1. Cost Management, Accounting & Control by Hansen- Mowen Guan, 2016.

EM 804	**OPERATIONS RESEARCH**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	The objective is to provide students with • Mathematical models for analysis of real problems in Operations Research. • Model decision making problems using major modeling formalisms of artificial intelligence and operations research, including propositional logic, constraints, linear programs, • Evaluate the computational performance of search, satisfaction, optimization and learning algorithms. • Apply search, satisfaction, optimization and learning algorithms to real world problems • Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively; • Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry; • Skills in the use of Operations Research approaches and computer tools in solving real problems in industry	
Course Outline	Linear Programming. Multiple-objectives, Analytic Hierarchy Process (AHP), and Concepts in Game Theory, Concepts in stochastic processes, Markov Chains, Non-linear programming, Some case studies will be used to integrate these topics and thus demonstrate to students how the various techniques are interrelated and how they can be applied to real problems in industry.	
Recommended Books	1. Introduction to Management Science by Taylor, B. W. 2019, 13th ed., Prentice Hall 2. Operations Research by Taha, H. A. 2017, 10th Edition, Pearson 3. Deterministic Operations Research: Models and Methods in Linear Optimization by Rader, D. J. 2010, J. Wiley & Sons	

EM805	**INDUSTRIAL PSYCHOLOGY**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	In this course students will study the science of behavior and mental processes. The field of Industrial/Organizational (I/O) psychology embraces two broad, closely related, and overlapping scientific approaches to the psychology of work. Organizational psychologists work at the level of the organization. Some conduct research, others occupy staff positions, and still others serve as consultants on matters of leadership, job satisfaction, worker motivation, organizational communication, conflict management, organizational change, and group processes.	

	The focus in this course will be on industrial and organizational psychology, specifically job analysis, description, and evaluation; employee selection; performance evaluation; motivation; job satisfaction; leadership; and group and team development. The course will include reading, writing, discussion, exercises, and research.
Course Outline	Introduction to I/O Psychology & Research Review of Research Methods, What is Psychology? Relationship to talent management?, Talent Acquisition, Employee selection, Interviewing, Utilizing Questionnaires, Observational Analysis, Background Information Gathering, Learning and Development, Performance appraisal, Leadership, Employee Engagement, Work Motivation, Employee well-being at Work, Workplace Stress, Family Friendly Practices, Diversity and Advancement of Women, Employee Satisfaction, Work/Family Balance
Recommended Books	1. Aamodt, M. G. (2015). Industrial/organizational psychology: An applied approach (8th ed.). Belmont, CA: Wadsworth. ISBN: 978-1305118423 2. Muchinsky, P. M. and Culbertson, S. S. (2018). *Psychology applied to work* (12th Edition). Hypergraphic Press.

EM806	**KNOWLEDGE MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	Knowledge management is becoming more and more important in a changing business climate, as organizations are faced with tremendous competitive pressures. Technological developments such as e-commerce have made company strategies and customer interfacing more visible, so this resource-based view of strategy has become a key issue in gaining differentiation in the eyes of the customer and maintaining competitive advantage. Knowledge management skills and processes are crucial to this, as they leverage a company's renewable, reusable and accumulating assets. This course is about knowledge, how to capture it, how to transfer it, how to share it, and how to manage it. Course takes students through a process-oriented examination of the topic, striking a balance between the behavioral and technical aspects of knowledge management and uses it.	
Course Outline	• Understanding Knowledge, Knowledge Management system Life Cycle • Knowledge Creation and Knowledge Architecture • Capturing Tacit Knowledge • Knowledge Transfer and Sharing • Knowledge management and specifically highlights new developments such as Knowledge Management Systems. • Cutting edge theory and evidence about the use of information technology for the management of organizational knowledge. • Experiences in KMS Practice, featuring practical case studies taken from well-known companies and organizations Designing KMS Enterprise Architectures, explaining different structures for integrating and sharing knowledge within an organization	

	• Implementing KM Solutions, which demonstrates the fundamental principles to implementing systems, and the hurdles that must be faced
Recommended Books	1. Knowledge Management by Awad, Elias M. Awad, 2017. 2. Knowledge Management Systems: Theory and Practice by Stuart Barnes, 2012. 3. Essentials of Knowledge Management by Bergeron, 2015. 4. Knowledge Management in Theory and Pratice by Kimiz, 2020. 5. KM-Systems and Processes by Sabherwal, 2018. 6. Knowledge Management by North & Kumta, 2018.

EM807	**LOGISTICS MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	• Understand the "state-of-the-art" in logistics management and its implications for all levels in your organization – from CEO to Traffic Supervisor • Learn to better manage your transportation, distribution and inventory functions • Identify key elements of customer service and design the most profitable network • Collaborate with other managers in: supply chain and materials management, transportation and distribution, purchasing and inventory management	
Course Outline	Logistics Issues And Priorities, Setting Logistics Strategy, Inventory Management, Forecasting Sales Or Usage, Transportation Strategy, Outsourcing: The Third Party, Logistic Trends In Logistics Technology Perspective, Distribution Centre Management, Designing the Best Distribution, Network, Change Management	
Recommended Books	1. Logistics and Supply Chain Management (7th Edition), 2018 by Martin Christopher. 2. Logistics Management and Strategy: Competing through the Supply Chain (6th Edition), 2017 by Alan Harrison. 3. Supply Chain Management by Donald Waters, 2020.	

EM808	**PRODUCT DESIGN AND DEVELOPMENT**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	• To learn methods of reducing development costs and time necessary for commercialization. • To enable students to co-ordinate and schedule the activities involved in the design and development of products within the entire set of activities, taking into account time, tasks, resources and manufacturing.	
Course Outline	Design process, advanced technology for design process, idea generation and creative problem solving, Project-centered subject addressing transformation of new ideas into technology based products, attaining a proper match between product and marketplace. Product design specification, Product design issues: evaluation, market perception, aesthetics and human interfacing, Design for manufacturability, reliability, and repair ability, pricing and legal implications.	
Recommended Books	1. Handbook of New Product Development Management, 2017 by Christoph H. Loch. Elsevier. 2. Product Development: A Structured Approach to Consumer Product Development, Design, and Manufacture, 2017 by Anil Mital et al. Elsevier.	

	3. Design Thinking: New Product Development Essentials from the PDMA, 2016 by Michael G. Luchs. Wiley.

EM809	MANUFACTURING PLANNING AND CONTROL	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	• A systematic exposition of the design, planning and control problems that arise in the context of the aforementioned facilities. • A systematic introduction to inventory control theory and its application in the contemporary production and distribution networks. • A formal analysis of the dynamics of production processes, based on queueing theoretic concepts and models. • The integration of the results developed to the prevailing production planning and control framework(s).	
Course Outline	• Contemporary organizations and the role of Operations Management (OM) • The basic organizational structure and the scope of the OM issues addressed in this course • Corporate strategy and its connection to operations • The basic course structure Inventory Control Theory • The basic EOQ model and some of its variants • Replenishment coordinating approaches • Dynamic Lot Sizing • Statistical Inventory Control Models o The News Vendor Model o The Base Stock Model o The (QR) Model • An introduction to multi-echelon models (time permitting) Factory Physics: A queueing-theoretic analysis of serial production systems • Flow lines as the preferred layout for discrete-part, repetitive manufacturing • Flow line classification: Push vs. Pull, Synchronous vs. Asynchronous production lines, KANBAN and CONWIP-based production systems • Characterizing a flow line as a queueing system • Understanding the fundamental relationships between the line attributes and its performance indices • Analyzing the impact of the various operational detractors and the resulting operational variability Integrating the Factory Physics insights to the OM practice • Process Design, Capacity Planning and Line Balancing • Hierarchical Production Planning • The classical Hierarchical Planning framework • Forecasting • Aggregate Planning • Master Production Scheduling (MPS) and Material Requirement Planning (MRP), and their limitations • Shop floor scheduling • Just-in-Time (JIT) and Lean Manufacturing • The JIT philosophy • JIT practices and the KANBAN production authorization system • Shop-floor control based on the CONWIP production authorization model • Production Planning and Scheduling for CONWIP-controlled production systems	

Recommended Books	1. Bill Scott, *Manufacturing Planning Systems*, McGraw Hill: A more practical but nicely structured perspective on MRP-based production planning and control, 2020. 2. A.C. Hax and D. Candea, *Production and Inventory Management*, Prentice Hall: A classical reference for the Hierarchical Production Planning and Control framework, 2015. 3. R. G. Askins and Jeffrey B. Goldberg, *Design and Analysis of Lean Production Systems*, John Wiley & Sons: Another formal treatment of the production planning and control problem, with considerable emphasis on modern trends, 2015. 4. G. Cachon and C. Terwiesch, *Matching Supply with Demand*, McGraw Hill: A business-school version of the prevailing theory on (production) process design and analysis, 2017. 5. J. Buzacott and G. Shantikumar, *Stochastic Models of Manufacturing Systems,* Prentice Hall: A rigorous treatement of the queueing-theoretic modeling and analysis of many manufacturing systems layouts encountered in contemporary practice, 2018. 6. S. Gershwin, *Manufacturing System Engineering*, Prentice Hall: The production planning and control problem addressed as a stochastic optimal control problem, 2019 7. E. Silver, D. Pyke and R. Peterson, *Inventory Management and Production Planning and Scheduling,*Wiley: Maybe the most standard textbook on Inventory Control theory, 2015.

EM810	**ENGINEERING OPTIMIZATION TECHNIQUES**	**3 CREDIT HRS**
Pre-Requisite	NIL	
Course Objectives	To provide engineering students interested in CAE/CAD an engineering view of optimization as a tool for design. The course will concentrate on the mathematical and numerical techniques of optimization as applied to engineering problems Introduction to optimization techniques for engineering students. Minimization of unconstrained functions of several variables: steepest descent, Newton/Raphson, conjugate gradient, and quasi-Newton methods. Rates of convergence. Methods for constrained minimization: Introduction to linear programming and gradient projection methods. Lagrangian methods	
Course Outline	1. Introduction to the formulation of optimization problems. Unconstrained optimization. Zero order search. Random walk. 2. Adaptive creep. Powell's method. First order search. 3. Gradient, Conjugate gradient methods. 4. Second order search. Newton-Raphson, Davidon-Fletcher-Powell. 5. Constrained optimization. Penalty methods. Direct methods of constrained optimization. 6. Linear programming. 7. Sensitivity analysis. Multi-objective - pareto - optimization. Equality constraints, Cumulative constraints. 8. Law of diminishing returns and function approximation concepts. Sensitivity of objective function and Lagrange Multipliers. 9. Goal Programming. Primal Dual Methods. 10. Generalized Reduced Gradients. Dynamic Programming. Integer Programming. Sensitivity of optimum to problem parameters. 11. Multi-level optimization. Optimization of complex engineering problems. 12. Non-traditional tools of optimization - Genetic algorithms, Simulated annealing.	
Recommended Books	1. Belegundu A. and T. Chandrupatla Optimization Concepts and Applications in Engineering, Prentice Hall, 2015.	

	2. Gen, M. and R. Cheng, Genetic Algorithms and Engineering Optimization, Wiley, 2015. 3. Edgar, T.F., Himmelblau, D.M., and L.S. Lasdon, Optimization of Chemical Processes, McGraw Hill, 2016 4. Fletcher R., Practical Methods of Optimization Volumes 1,2, John Wiley 2020.. 5. Luenberger and Ye, Linear and Nonlinear Programming, Springer, 2017.

EM811	MODELLING OF SYSTEM DYNAMICS	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	This course will introduce the students to system dynamics modeling for the analysis of business policy and strategy. The students will learn to visualize a business organization in terms of the structures and policies that create dynamics and regulate performance. System dynamics allows us to create 'microworlds,' management flight simulators where space and time can be compressed, slowed, and stopped so we can experience the long-term side effects of decisions, systematically explore new strategies, and develop our understanding of complex systems. The principal purpose of modeling is to improve our understanding of the ways in which an organization's performance is related to its internal structure and operating policies as well as those of customers, competitors, suppliers, and other stakeholders. During the course students will use several simulation models to explore such strategic issues as fluctuating sales, production and earnings; the diffusion of new technologies; the rationality of business decision making; etc. Students will also learn to recognize and deal with situations where policy interventions are likely to be delayed, diluted, or defeated by unanticipated reactions and side effects.	
Course Outline	Concepts of Systems and System Dynamics, Open and Feedback Systems, Modes of Behavior of Dynamic Systems, Systems Thinking and Modelling, Systems Thinking Methodology, Dynamic Hypothesis, Causal Loop Diagram, Stock–Flow Diagram, Model Validation, Sensitivity Analysis and Policy Analysis, Participatory Systems Thinking, Differential Equation Model and Stock–Flow Diagram, Simulation and Policy Analysis, Causal Loop Diagrams, Stock and Flow Diagram, Parameter Estimation and Sensitivity Analysis, Tests for Confidence Building, Scenario Planning and Modelling.	
Recommended Books	1. System Dynamics Methods: A Quick Introduction by Craig W. Kirkwood, 2006. 2. System Dynamics: Modelling and Simulation, 2017 by Bilash Kanti Bala et al. Springer, 2017 3. A Guide to Learning System Dynamics by MIT, 2020.	

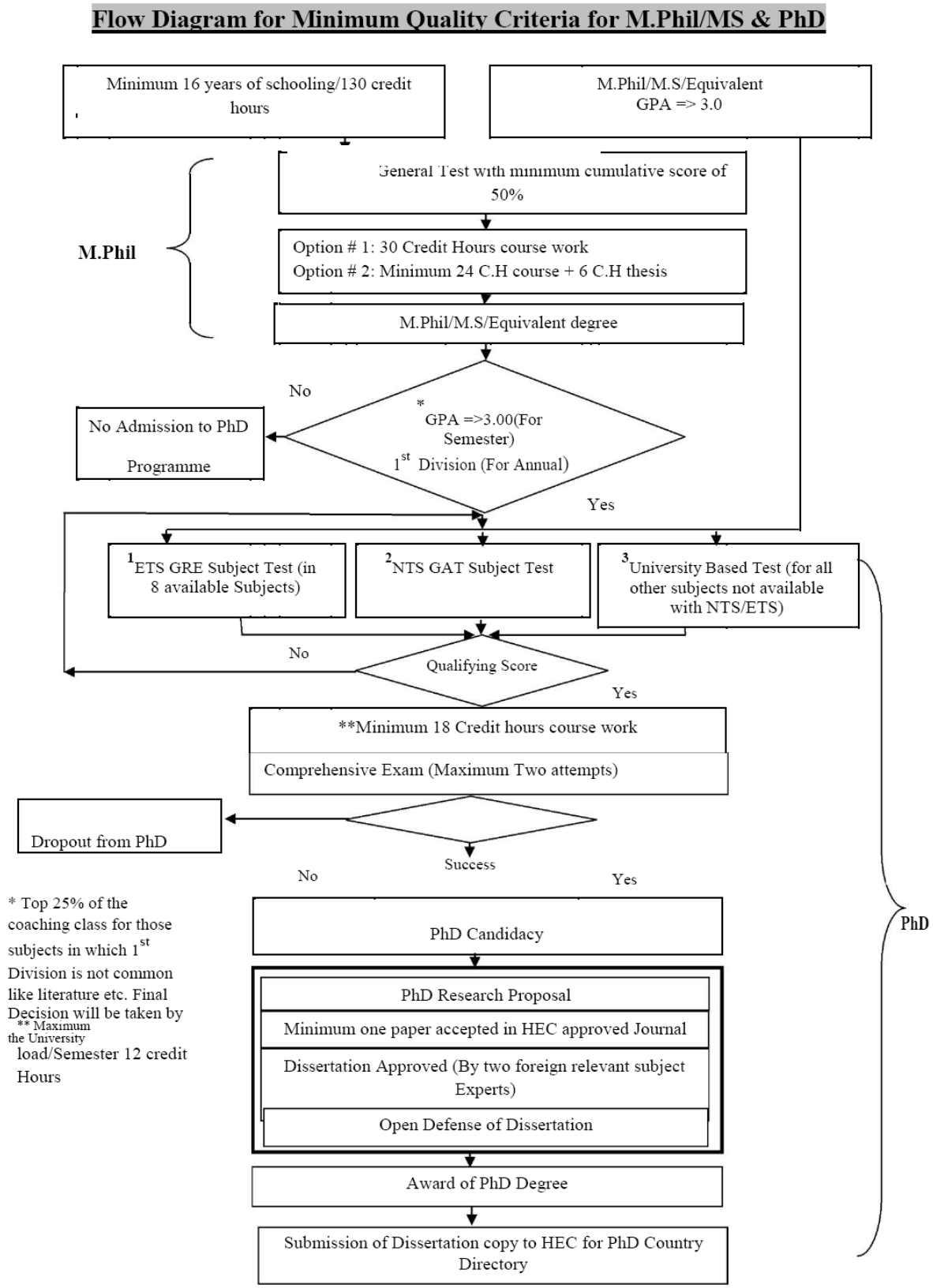
EM 812	RESEARCH PROPOSAL DEVELOPMENT TECHNIQUES	3 CREDIT HRS
Pre-Requisite	NIL	
Course Objectives	Finding an original research gap is one of the most difficult and the biggest challenge for any doctoral student. Every PhD student have to go through this rigorous and taxing task for several months before he/she successfully finds the topic. This course intends to help and guide the student through this journey by providing practical tips and process. The students have to conduct an extensive literature review – another one of the most difficult task during their doctoral studies – however, this process can be made systematic; which is another objective of this course. The third objective of the course is to familiarize and guide the students with the structure and elements of the research proposal.	

Course Outline	What are the chapters/elements of the dissertation? Developing the Problem Statement for Proposal/dissertation. Writing Purpose Statements, Research Questions, and Hypotheses. Writing the Review of Literature for Study. What Is a Literature Review? Different Orientations to a Literature Review. Choosing a Review Topic and Formulating a Research Question, Locating and Organizing Research Sources, Selecting, Analyzing, and Keeping Notes of Sources, Evaluating Research Articles, Structuring and Organizing the Literature Review, Developing Arguments and Supporting Claims, Synthesizing and Interpreting the Literature. Understanding research designs for quantitative, qualitative and mixed-methods studies.
Recommended Books	1. Writing the Literature Review By Sara Efrat Efron, Ruth Ravid, 2019. The Guilford Press 2. Thesis Writing for Master's and Ph.D. Program by Subhash Chandra Parija & Vikram Kate eds, 2018. Springer 3. Writing Literature Reviews: A Guide for Students of the Social and Behavioral Sciences By Jose L. Galvan, Melisa C. Galvan, 2017. Routledge 4. Writing a Proposal for Your Dissertation by Steven R. Terrell, 2016 . The Guilford Press **Reference Books:** 1. The Literature Review: A Step-by-Step Guide for Students by Diana Ridley, 2nd ed. 2012. Sage Publications 2. Researching and writing dissertations: a complete guide for business and management students by Roy Horn 2nd ed, 2012. CIPD - Kogan Page 3. How to Survive Your PhD: The Insider's Guide to Avoiding Mistakes, Choosing the Right Program, Working with Professors, and Just How a Person Actually Writes a 200-Page Paper by Jason Karp, 2009. Sourcebooks Publishers.

EM 813	**SPECIAL TOPICS IN ENGINEERING MANAGEMENT**	**3 CREDIT HRS**
Pre-Requisite	Nil	
Course Objectives	The purpose of this course is to introduce the students to the emerging concepts in Engineering Management.	
Course Outline	Will be provided at the start of the course	
Recommended Books	Will be suggested as per requirements	

EM 899	**RESEARCH THESIS**	**36 CREDIT HRS**
Pre-Requisite	**18 CREDIT HRS OF COURSE WORK**	
Course Objectives		
Course Outline		

6.7. Flow Diagram for HEC Minimum Criteria for MS and PhD



Note: These are minimum HEC requirements and universities may make them more stringent.