King Fahd University of Petroleum & Minerals
College of Environmental Design
Construction Engineering & Management Department

Master of Engineering Management in Engineering Management Graduate Program

Program mission

The EM program is committed to educate and strengthen the engineering management graduates' knowledge and leadership to enable them to assume positions of increasing technical and managerial responsibility. The department is dedicated to graduating engineering managers who excel in building novel and creative engineering solutions and have an impregnable ethical sentiments and keen interest towards society benefits and prosperity. This is achieved by offering an education that is based on a strong engineering core, complemented by studies in business, systems and management which contributes to the national economy

Program Educational Objectives (PEO's)

Within few years after graduation, our graduates will be able to:

1. Integrate their academic preparation with engineering management practice, innovation and technology development.
2. Pursue or seek professional certification in Engineering Management or related field.
3. Advance in their professional careers and attain leadership roles in their respective organizations.
4. Match career advancement opportunities by applying the EM principles learned to real world situations, and demonstrate the ability to understand, analyze, and improve company practices.

The program objectives are aligned with the university and college mission as it covers all points addressed by the KFUPM mission. Objective 1 covers the knowledge and ethical commitment for society. Innovation and creativity are addressed in objective 2. Leadership of graduates is emphasized in objective 3. Contribution to employers and society is addressed in objective 4.

Students Outcomes (SO's)

The followings are the student learning outcomes:

1. An ability to identify, formulate, and solve complex engineering management problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. An ability to conduct applied research in Engineering Management by utilizing appropriate research methods

Two matrices are discussed, the first highlights the interface between Student Learning Outcomes to Program objectives (table 7).

Table 1: matrix relating student learning outcomes to program objectives

STUDENT LEARNING OUTCOMES	**PROGRAM OBJECTIVES**			
	PEO 1	PEO 2	PEO 3	PEO 4
SO 1			✓	✓
SO 2		✓	✓	
SO 3	✓	✓		✓

SO 4	✓		✓	
SO 5	✓		✓	
SO 6	✓	✓	✓	
SO 7		✓	✓	
SO 8	✓	✓	✓	

List of Courses

The Master of Engineering in engineering Management requirement is **thirty three (33)** credit hours. The course work is structured as follows:

EM core courses List 1 (24 credit hours):

1. CRP 505 Statistical Analysis in Planning
2. ACCT 509 Financial Reporting and Analysis
3. EM 510 Advanced Engineering Economics
4. EM 515[5] Quality Management
5. EM 520 Quantitative methods in EM
6. EM 530[3] Decision Analysis
7. EM 550 Engineering Project Management
8. EM 599 Research Seminar
9. EM 600 Master of Engineering Report

[3] Students could take ISE527 Decision Making in lieu of EM 530
[5] Students could take CEM 515 Project Quality Management in lieu of EM 515

MGT elective course (3 credit hours)

The student should select **three (3)** credit hours from the following MGT courses.

1. MGT 512 Leadership and Organizational Behavior

2. MGT 511 Organizational Theory Design

EM elective courses (6 credit hours):

The student should select **six (6)** credit hours from the following courses.

1. EM 560 Manufacturing System and Supply Chain Design
2. EM 570 Maintenance and reliability Systems
3. EM 571 Health Care Management
4. EM 572 Safety and loss prevention Engineering
5. EM 590 Special topics in engineering Management
6. ISE, KFUPM business school, and CEM courses may also be taken as an elective subject to the restrictions below i.e. the following courses can't be taken as elective

   OM 511 Management Science
   ISE 501 Deterministic Operations Research
   ISE 502 Probabilistic Modeling in ISE
   CEM 530 Construction Engineering
   CEM 514 Modelling Construction Operations
   CEM 516 Project Risk Management

7. One relevant graduate course can be taken from the college of engineering or the college of petroleum engineering & geosciences with the consent of graduate advisor.Table 8 shows the program list of courses

Table 2: Summary of the MEM

Master of Engineering (Non thesis-33 Credits)	**Credits**
EM 510: Advanced Engineering Economics	**3**
EM 515: Quality Management	**3**
EM 520: Quantitative Methods in EM	**3**
EM 530: Decision Analysis	**3**
EM 550: Engineering Project Management	**3**
CRP 505: Statistical Analysis in Planning	**3**
MGT 512: Leadership and Organizational Behavior or **MGT 511** Organizational Theory Design	**3**
ACCT 509: Financial Reporting and Analysis	**3**

ELECTIVE I (EM 5XX, MGT 5XX, MKT 5XX, ACCT 5XX , FIN 5XX, MIS 5XX, ECON 5XX, OM 5XX, MBA 5XX, CEM 5XX, ISE 5XX)	**3**
ELECTIVE II* (EM 5XX, MGT 5XX, MKT 5XX, ACCT 5XX , FIN 5XX, MIS 5XX, ECON 5XX, OM 5XX, MBA 5XX, CEM 5XX, ISE 5XX)	**3**
EM 599: Research Seminar	**0**
EM 600: Master of Engineering Report	**3**
	33

*One relevant graduate course can be taken from the college of engineering or the college of petroleum engineering & geosciences with the consent of graduate advisor.

Course Descriptions

CRP 505 Statistical Analysis in Planning (3-0-3)

Probability, statistics, and decision theory and their applications in city planning. Basic probability concepts, data classification and summarization. Statistical sampling, hypothesis testing, goodness of fit, regression analysis, analysis of variance, contingency tables, and elementary Bayesian decision making. Use of Computer statistical packages.

Prerequisite: Graduate Standing

EM 510 Advanced Engineering Economics (3-0-3)

Monetary interest computations principles and methods. It also studies the effect of inflation, depreciation and taxes, cost accounting and estimation, risk, uncertainty and sensitivity analysis, capital budgeting, advanced asset replacement analysis. Advanced topics in engineering economics include: overcome multiple IRR solutions difficulty for non-simple cash flows, real options analysis and cash flow transform techniques. The use of computers spreadsheets is emphasized through periodic assignments and real life case studies.

Prerequisite: Graduate Standing - Student cannot get credit for this course and CEM 518”

EM 520 Quantitative Methods in Engineering Management (3-0-3)

Linear Programming: Concepts and Solution Techniques, Transportation and Assignment Models, Goal Programming Model, Inventory Management Models, Queuing Theory, Event based Simulation, and Markov chains. Computer applications including spreadsheets and programing tools are also presented through real life case studies.

Prerequisite*:* Graduate Standing - Student cannot get credit for this course and OM 511 or ISE 501

EM 515 Quality Management (3-0-3)

Quality management principles and history, total quality management, quality control, quality improvement tools, assurance and reliability in design and production. Quality engineering tools are also emphasized including: experimental engineering design and analysis, measurement system analysis in engineering, engineering process modelling, product and process optimization in engineering, engineering regression, response surface methodology in engineering, robust engineering parameter design, Six Sigma methods, and exploration of methods of building and sustaining quality organizations.

This Course is Equivalent to CEM 515

Prerequisite: Graduate Standing

EM 530 Decision Analysis (3-0-3)

Covers the theory and practice of decision analysis and risk assessment. Covers decision theory, game theory, utility and risk attitude, probability assessment, multi-criterion decision making models, Value of information in decision making, decision trees and influence diagrams, building decision support systems, and Monte Carlo Simulation technique. Describes practical applications through real-world engineering /project management decision analysis applications. Computer applications.

Prerequisite: CRP 505

EM 550 Engineering Project Management (3-0-3)

Covers the elements of project management critical to the success of engineering projects: project management framework, strategic management and project selection, project organization, human aspects of project management, conflicts and negotiations, scope management, time management, cost management, risk management, contracts and procurement, project termination, the project management office, and modern developments in project management, including: PMI, PRINCE 2, and ISO 21500.

Integrates and clarifies the principles and tools through case studies from a variety of disciplines.

Prerequisite: Graduate Standing-
Student cannot get credit for this course and CEM 540

EM – 560 Manufacturing System and Supply Chain Design (3-0-3)

The course will help to develop the managerial insights for the manufacturing planning and control systems, Just in Time (JIT), Advanced JIT (JIT-II), Capacity Planning, Production Activity Control, demand and inventory management, vendor management inventory (VMI), bullwhip effect, MRP and MRP II, Distribution Requirement planning, MPC frontiers (MPC system schematic, beyond the schematic, Optimized production technology (OPT), MPC for process industries), ERP manufacturing systems. The manufacturing strategies: Lean, Agile and virtual manufacturing.

Prerequisite: graduate standing.

EM 570 Maintenance and reliability Systems (3-0-3)

This course examines the effect of different maintenance strategies such as scheduled maintenance, preventive maintenance, and Reliability centered maintenance (RCM), and RBI. It assess maintainability measures and system availability indicators, Total Productive Maintenance (TPM), reliability improvement tools: fault trees, failure mode and effect analysis and root cause analysis.

Prerequisite: graduate standing.

EM – 571 Health Care Management (3-0-3)

This course include the management and improvement of health care systems. The course will orient the students about health care systems components: Queuing theory applications in the Health care, Health care delivery systems, process quality and statistical models, human factors and patient systems, clinical process improvement, process workflow and staff scheduling.

Co-requisite: EM 520

EM – 572 Safety and loss prevention Engineering (3-0-3)

This course is an introduction to the principles of safety engineering applied to industrial situations. Job safety analysis, reduction of accident rates, protective equipment, safety rules and regulations, environmental hazards, health hazards, and ergonomic hazards are covered. Safety and loss prevention. Major process hazards. Hazard identification, assessment and prevention. Personal safety in industrial environment. Fire explosion and toxic release. Safety systems.

Prerequisite: Graduate standing.

EM 590 Special Topics in Engineering Management (3-0-3)

Advanced topics are selected from the major areas of Engineering Management to provide the student with recent developments.

Prerequisite: Graduate Standing

EM 599 Research Seminar (1-0-0)

This course is designed to give the student an overview of research in the engineering management specialty and in the department, familiarity with the research methodology, journals and professional societies in the discipline.

Grades are pass or fail.

Prerequisite: Graduate Standing

EM 600 Master of Engineering Report (0-0-3)

Research study that deals with analysis and/or design of significant problem or case study related to the field of Engineering Management prepared under the supervision of an Engineering Management faculty. The project report should follow formal report format including introduction, literature review, research methodology, collection and analysis of

data, conclusions and recommendations, list of references and appendices of important information.

Co-requisite: EM 599

A mapping relating courses to student learning outcomes

Table 9 relates the courses to Program outcomes

Table 3 Matrix of outcome analysis that relates learning outcomes (new courses are highlighted)

PROGRAM COURSES	Students Outcomes					
	SO 1	SO 2	SO 3	SO 4	SO 5	SO 6
ACCT 509		✓		✓		
CRP 505		✓				
EM 510	✓	✓		✓		✓
EM 520	✓	✓				
MGT 512\ MGT 511	✓	✓	✓	✓		
EM 515	✓	✓		✓		
EM 530			✓		✓	✓
EM 550			✓	✓	✓	✓
EM 599			✓		✓	✓
EM 600	✓	✓	✓	✓	✓	✓

Courses details

Course Number	EM 510
Course Title	Advanced Engineering Economics
LT-LB-CR	3-0-3
Course Main Objectives	1. Evaluate the cash flows based on basic economic measures: present worth, annual equivalence, and future worth. 2. Find the effective interest rate for a cash flow based on the payment and interest compounding periods don't match. 3. Finding the discounted unit rate and its applications in energy pricing (Levelized cost of Energy) 4. Different depreciations rules based on the GAAP. (straight line, declined balance, usage based, declined balance switching to straight line) 5. Calculate the taxations and find after taxation cash flows. 6. Calculate Assets depreciation based on the MACRS model. 7. Evaluating the effect of inflation on the economic equivalence analysis. 8. Find the rate of return for non-simple cash flow (multiple IRR's). 9. Find the external rate of return (or Modified IRR) 10. Find IRR based on analytical solution. 11. Find IRR based on Incremental Analysis 12. Find BCR and PI based on Incremental analysis 13. Find equity based on CAPM model 14. Find WACC based on CAPM and debt costs 15. Formulate the investment problem as a Linear Programming Model 16. Find the optimal time to replace an asset 17. Do the marginal analysis to select between old and new assets 18. Find the optimal time to replace an asset under finite time constraint 19. Provide economic sensitivity analysis to cash flows (one at a time parameter, multiple parameters, break even sensitivity analysis) 20. Simulate economic measured in cash flow analysis. 21. Calculate economic equivalence based on principles of Real Options 22. Calculate economic equivalence based on Transformation techniques (Laplace transform, Z transform)
Catalogue Description	
Prerequisites	Graduate Standing
Suggested	1. Canada, JR, Sullivan WG, Kulonda, D J and White, JA, Capital

References	Investment Analysis for Engineering And Management, 3rd edition, Prentice Hall (2005), plus Handouts. 2. Park, Chan S, Fundamentals of Engineering Economics, 3rd Ed, Prentice Hall (2013) 3. Park Chan, and G P Sharp Bette, Advanced Engineering Economics, John Wiley & Sons (1990)

Course Number	EM 515
Course Title	Quality Management
LT-LB-CR	3-0-3
Course Main Objectives	The outcomes expected from EM 515 are: 1. Understand the quality concepts. 2. The ability to design and assure quality system. 3. The ability to implement quality system. 4. The ability to improve quality system.
Catalogue Description	
Prerequisites	Graduate Standing
Suggested References	Foster, S. Thomas, Quality Management: Integrating the Supply Chain, 6th Ed., Pearson (2016)

Course Number	EM 520
Course Title	Quantitative methods in Engineering Management
LT-LB-CR	3-0-3
Course Main Objectives	After successfully completing the course, the students will be able to understand: 1. The concept and technique of linear programming formulation. 2. Duality and sensitivity analysis in linear programming. 3. The solution of the Simplex Method of Linear Programming. 4. The formulation, solution of Transportation and Assignment Methods. 5. The concepts and solution of inventory Management Models. 6. Queuing Models and Construction Applications. 7. Monte Carlo and discrete event Simulation. 8. Markov chain analysis
Catalogue Description	
Prerequisites	Graduate Standing- Student cannot get credit for this course and OM 511 or ISE 501
Suggested References	1. Barry Render, Ralph Stair, Michael Hanna, Quantitative Analysis for Management, 11th Edition, Prentice Hall, (2012) 2. Bazaraa, M., Jarvis, J. and Sherali, H., Linear Programming and Network Flows, 3rd Ed., John Wiley & Sons, Inc. (2013). 3. Taha, H., Operations Research, 8th Ed, Pearson Prentice Hall (2007) 4. Journal papers covering special topics will be selected by the instructor.

Course Number	EM 530
Course Title	Decision Analysis
LT-LB-CR	3-0-3
Course Main Objectives	To equip students with methodologies and techniques appropriate for formulating and solving decision problems. The techniques will be demonstrated using applications in service and manufacturing industries. After taking this course, students should be able to: 1. Formulate and structure decision problems under certainty, uncertainty, and risk. 2. Define and propose ways to measure risk and uncertainty. 3. Apply classical decision criteria. 4. Develop utility functions and use them in decision making. 5. Evaluate the value of perfect and imperfect information. 6. Apply Bayesian decision-making approach to decision problems. 7. Formulate multi-criteria decision problems and use a proper approach for such problems
Catalogue Description	
Prerequisites	CRP 505
Suggested References	1. Clemen, R.T. and Reilly, T. , **Making Hard Decisions with Decision Tools**, Duxbury Press, 2014, plus Handouts. 2. Milan Zeleny, Multiple Criteria Decision Making, Wiley, 1982. 3. Render, Stair and, Hanna, Quantitative Analysis for Management, 3rd edition, Pearson, 2009. 4. Derek W. Bunn, Applied Decision Analysis.

Course Number	EM 550
Course Title	Engineering Project Management
LT-LB-CR	3-0-3
Course Main Objectives	The aim of this course is to provide the key concepts and foundation knowledge in project management, and to describe, clarify, and formalize project management so that you can apply new knowledge and skills in your professional endeavors. On completion of this course, you should be able: 1. Demonstrate the understanding of the framework and process/life cycle of project management as a discipline, from initiation to completion, including planning, monitoring, control and termination 2. Apply all key functional areas, including project organization structure, within a project context, indicating the interconnection and integration of all the functions critical to achieve project success. 3. Recognize the strategic importance of projects and particularly the role of the project manager 4. Develop a project management plan

Catalogue Description	
Prerequisites	Advanced EM Standing- Student cannot get credit for this course and CEM 540
Suggested References	Meredith and Mantel (2011) **Project Management: A Managerial Approach**, 8th Edition, John Wiley & Son, New York

Course Number	EM 570
Course Title	Maintenance and Reliability Systems
LT-LB-CR	3-0-3
Course Main Objectives	The objectives of this course are: 1. To develop your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system; 2. To empower you with the skills to manage a manufacturing system to achieve continuous system availability for production; 3. To equip you with essential system diagnosis techniques so that you can identify and take appropriate actions on error symptoms and causes of failures. On completion, you will be able to: 1. Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment; 2. Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies; 3. Manage the manufacturing organisation with highest possible availability.
Catalogue Description	
Prerequisite:	Graduate standing.
Suggested References	Lad, B. K., Shrivastava, D., & Kulkarni, M. S. (2016). Machine tool reliability. John Wiley & Sons.

Course Number	EM 572
Course Title	Safety and loss prevention Engineering
LT-LB-CR	3-0-3
Course Main Objectives	1. Discuss the provisions of the federal Process Safety Management (PSM) regulations and describe how they are applied at typical industries in the area. 2. Identify the toxic effects of chemicals encountered in the industrial environment; and discuss how engineering controls are

	used to eliminate these hazards. 3. Discuss the physical characteristics of materials which make them flammable or explosive; and describe the controls that are used in the industrial setting to counter these hazards. 4. State the causes of over-pressurization in equipment and systems in the industrial environment; and describe the operation and use of devices to prevent its occurrence. 5. Describe how each of the formal Process Hazard Analysis (PHA) techniques discussed in class is used and list the advantages and disadvantages of each technique. 6. Complete a research project, based on an actual case history, which demonstrates mastery of the principles learned in the class.
Catalogue Description	
Prerequisites	Graduate Standing
Suggested References	1. Roger L. Brauel, "Safety and Health for Engineers, 2nd Edition, Wiley, 2006. 2. D. A. Crowl and J.F. Louvar "Chemical Process Safety", 3rdedition 2011, Prentice Hall.

Course Number	EM 560
Course Title	Manufacturing System and Supply Chain Design
LT-LB-CR	3-0-3
Course Main Objectives	The objective of this course is to define and enhance manufacturing systems from the perspective of: 1. Demand, Preferential pricing and lead times management 2. Product life cycle management 3. Logistics and Inventory control
Catalogue Description	
Prerequisite:	Graduate standing.
Suggested References	1. Thomas E.. Vollmann, William L.. Berry, & Whybark, D. C. (1997). Manufacturing planning and control systems. Mcgraw Hill, 4th edition. 2. Vajpayee, S. K. (1995). Principles of computer-integrated manufacturing. Prentice-Hall, Inc..

Course Number	EM 571
Course Title	Health Care Management
LT-LB-CR	3-0-3
Course Main Objectives	After successfully completing the course, the students will be able to understand:

	1. The techniques of forecasting to predict future of healthcare systems. 2. Decision theory tools to solve healthcare problems. 3. Healthcare facilities location. 4. Healthcare resources scheduling and staffing. 5. Healthcare supply chain. 6. The concepts and solution of healthcare inventory systems. 7. Quality control in healthcare organizations. 8. Simulation of healthcare systems.
Catalogue Description	
Co-requisites	EM 520
Suggested References	Ozcan, Y. A. (2005). Quantitative methods in health care management: techniques and applications (Vol. 4). John Wiley & Sons. Daniel B. Mclaughlin, Julie M. Hays (2008). Healthcare Operations Management. Health Administration Press, Chicago AUPHA Press, Washington, DC.

1.1 Degree requirements

Table 11 shows the details of the Degree Requirements.

Table 4: Course requirements for the MEM

Category	Total Credit hours in this category	
Core	Lectures	21
	Research Seminar	0
	MR*	3
Elective	9	
Total	33	

*Master of engineering report

1.2 Degree Plan

Part-time student may finish the degree requirements in two and half years. Classes are held twice a week from Saturday to Tuesday from 5:20 PM till 9:35 PM. Each course meets twice a week with each class spanning for one hour fifteen minutes. The degree plans for the master of engineering in Engineering Management is shown in Table 12.

Table 5: M. E. Degree Plan for Engineering Management Program

Course No.	Title	LT	LB	CR	
First Semester					
CRP 505	Statistical analysis in planning	3	0	3	
EM 515	Quality Management	3	0	3	
EM 510	Advanced Engineering Economics	3	0	3	**9**
Second Semester					
EM 520	Quantitative methods in EM	3	0	3	
ACCT 509	Financial Reporting and Analysis	3	0	3	**6**
Third Semester					
MGT 5XX	MGT 512: Leadership and Organizational Behavior or MGT 511: Organizational Theory and Design	3	0	3	
EM 530[4]	Decision Analysis	3	0	3	**6**
Fourth Semester					
EM 599	Research Seminar	1	0	0	
EM 550	Engineering Project Management	3	0	3	
EM/CEM/ISE/MGT/ MKT/ACCT/FIN/ECON/OM MIS/MBA 5XX	Elective I[5]	3	0	3	6
Fifth Semester					
EM 600	Master of Engineering report	0	0	3	
EM/CEM/ISE/MGT/ MKT/ACCT/FIN/ECON/OM/ MIS/MBA 5XX	Elective II	3	0	3	**6**
		Total			**33**

[4] Students could take ISE527 Decision Making in lieu of EM 530

[5] Student may opt to take one course from college of engineering and applied engineering related to their background