KING SAUD UNIVERSITY
COLLEGE OF ENGINEERING
INDUSTRIAL ENGINEERING DEPARTMENT

BACHELOR OF SCIENCE IN INDUSTRIAL ENGINEERING

ACADEMIC PLAN

1439 H
2018 G

***Approved by*:** Chairman: …… Dean: ……

KING SAUD UNIVERSITY
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B.SC. IN INDUSTRIAL ENGINEERING

1. INTRODUCTION

King Saud University (KSU) objectives and responsibilities are to provide Saudi Arabian society with highly educated intellectuals and professionals. In response to this department for Industrial Engineering (IE) in the college of engineering at KSU has been established in year 1422H (2002G). Earlier, industrial engineering as a program founded in the year 1403H (1983G) under the umbrella of Mechanical Engineering department. Since its establishment, it enhances the role of the industrial engineering professional in the country. IE department is highly concerned with synthesizing, designing, analyzing, operating, and maintaining various integrated production systems and its processes to produce products using distinguished solution techniques and tools. Industrial Engineers play a vital role in all development plans of the country and hold key positions in all governmental and private sectors. They are heavily involved in numerous manufacturing and service industries in Saudi Arabia and abroad.

The mission of the Industrial Engineering program is to offer a high-quality program to educate and graduate industrial engineers who are equipped with the scientific and technical capabilities and tools that allow them to effectively practice and lead the profession.

Industrial engineering program provides the graduates with broad career opportunities, ranging from manufacturing systems to service systems in wide range of organizations in private and government sections. Graduates of the Industrial Engineering program will be able to pursue career in a variety of technical positions, including quality engineering, manufacturing engineering, Strategic, operational and logistical planning, management engineering, Operations Engineering, Safety engineering, Maintenance Engineering, Production Engineering, Cost Engineering, Engineering Project management, Human factors and ergonomics Engineering, and many others. Most them move into supervisory and management roles and many become executive leaders in their chosen industries.

The department of Industrial Engineering offers distinguished undergraduate and graduate (Higher Diploma, Master and doctorate) programs. These programs are continuously updated to keep pace with national and international developments. IE department curriculum is spread into four areas of specializations which are:

* ***Manufacturing Systems Engineering:*** this area is concerned with the design and the analysis of production processes and manufacturing system. It includes many types of sciences, such as, manufacturing technology; factory design; automation of process and system using computers; computer aided design and manufacture; manufacturing system design and operation.
* ***Industrial Operations Systems Engineering and Logistics:*** this area is concerned with studying and analyzing industrial operations, engineering supply chains and planning, controlling and monitoring industrial production. It includes many types of sciences, such as, operations research; Production planning and control; designing and analyzing supply chains; manufacturing cost analysis.
* ***Human Factors Engineering:*** this area is concerned with design and analysis of work and its time according to the required human factors in order to achieve the best

production levels. It includes many types of sciences, such as, human factors analysis; time and motion study.

* ***Quality, Safety and Maintenance Systems Engineering:*** this area is concerned with design and analysis of quality, safety and maintenance systems that are necessary for different production organizations. It includes many types of sciences, such as, maintenance engineering; quality engineering; occupational safety engineering.

The objectives of the undergraduate program are:

Objective 1: Graduates will be able to identify, define and implement effective solutions to real cases in the manufacturing and service systems by applying industrial engineering sciences and tools, contemporary knowledge and cutting-edge technologies.

Objective 2: Graduates will be able to update their professional skills continuously to design integrated production systems of people, machines, information, energy, materials and financial resources.

Objective 3: Graduates will be able to communicate and work effectively and ethically as individuals and as team members.

Objective 4: Graduates will be able to assume leadership roles in their profession and communities.

Based on achieving the above program educational aims, program outcomes are demonstrated and assessed. The outcomes are represented by set of abilities and knowledge that will be gained by the student and that will be reflected in handling his career work. **The Program outcomes are:**

(a) An ability to apply knowledge of mathematics, science, and engineering

(b) An ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) An ability to function on multidisciplinary teams

(e) An ability to identify, formulate, and solve engineering problems

(f) An understanding of professional and ethical responsibility

(g) An ability to communicate effectively

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

2. BACHLEOR OF SCIENCE PROGRAM IN INDUSTRIAL ENGINEERING (165 Credit Hours):

The undergraduate program in Industrial engineering has been designed to offer high quality, up-to-date and internationally recognized education program. It is prepared to contain scientific and technological foundations, integrated knowledge, and skills of the applied engineering and industrial engineering sciences. It also contains the necessary decision-making techniques and tools. And it gives the student the flexibility to pursue careers in variety of manufacturing and service organizations, job functions in consultancy, government and academia.

The undergraduate program in Industrial engineering is based on the knowledge and skills of four main areas of specialization (**manufacturing systems engineering, industrial operations systems engineering, logistics and human factors engineering and quality, safety and maintenance systems engineering**). All the areas are integrated in a program that provides the students with the necessary principles, tools and skills of Industrial Engineering profession that in turns gives the flexibility to pursue careers in variety of manufacturing and service organizations.

2.1. Program Requirements

The duration of the program is five years divided into 10 semesters, with two semesters in the academic year. The Students need to successfully pass **165** credit hours with minimum GPA of **(2.75 of 5)** to complete graduation requirements. This includes the following:

- 32 credit hours of the first common year, where the student develops his language skills, communication skills, computers and basic sciences. Table (2) shows the first common year courses divided into two semesters.
- 8 credit hours of university requirements
  - ✓ Compulsory course (2 credit hours) (Table 3A)
  - ✓ Elective courses: student chooses 3 courses (6 credit hours) (Table 3B).
- 48 credit hours of college requirements for all departments of which:
  - ✓ 40 credit hours are compulsory courses (Table 4A),
  - ✓ 6 credit hours of complementary courses (Table 4B), and
  - ✓ 2 credit hours free course (Table 4c)
- 77 credit hours of departmental requirements of which
  - ✓ 66 credit hours for core courses (Table 5A),
  - ✓ 4 credit hours for graduation capstone design project (Table 5B),
  - ✓ 6 credit hours for elective courses (Table 5C),
  - ✓ 1 credit hour as practical training without grade, given in Table (5D),
  - ✓ An optional elective research course with 0 credit hour, given in Table (5E)

Table (6) gives a typical plan for the B. Sc. in Industrial Engineering.

2.3. Graduation Capstone Design Project Requirements

The design project is divided into two parts (2 credit hours each). The student is eligible to register for senior capstone design project -1 if he completes successfully at least 129 credit hours and successfully passing ALL courses at level 7. Senior capstone design project -2 can be taken during the first and second semesters only (not during summer semester).

2.4. Practical Training Requirements

Students in the department are required to complete a 10 weeks summer training requirement in an area related to Industrial Engineering. Prior to undertaking the practical training program, the student must obtain the approval of the department and he must have completed, successfully, at least 110 credit hours. Students enrolling in the practical training program are not allowed to take simultaneously any course or projects.

Table (1) SUMMARY OF B.S. DEGREE REQUIREMENTS IN INDUSTRIAL ENGINEERING

Requirements	Cr. Hr.	Description
First year	**32**	General Chemistry (4), Differential Calculus (3), Statistics (3), English (12), Writing Skills (2), University Skills (3), IT Skills (3), Entrepreneurship (1), Health and Fitness (1)
University	**8**	Islamic Studies: compulsory (2), Optional (6)
College	**48**	Compulsory (42), Complementary 6)
Department	**76**	Core (66), Project (4), Electives (6)
	1	Practical Training (1) without grade (NP)
	0	Research Project 0 (NP)
Total	**165**	

Table 2 COMMON FIRST YEAR REQUIREMENTS

Level 1			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
ENGS 100	English language	6 (6,9,0)	
MATH 101	Differential Calculus	3 (3,1,0)	
ENT 101	Entrepreneurship	1 (1,0,0)	
CHEM 101	General Chemistry	4 (3,0,2)	
ARAB 100	Writing Skills	2 (2,0,0)	
Total		**16**	

Level 2			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
ENGS 110	English	6 (6,9,0)	
CUR 101	University Skills	3 (3,0,0)	
CT 101	IT skills	3 (0,0,6)	
STAT 101	Introduction to Statistics	3 (2,2,0)	
EPH 101	Health & fitness	1 (1,1,0)	
Total		**16**	

Table (3) UNIVERSITY REQUIREMENTS

Table (3A) COMPALUSORY UNIVERSITY REQUIREMENTS

Course Code	Course Title	Cr. Hr.
IC 107	Ethics of the Profession	2(2,0,0)
	Total	**2**

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Table (3B) OPTIONAL UNIVERSITY REQUIREMENTS (STUDENT SELECT 6 CR. HR. (3 COURSES))

Course Code	Course Title	Cr. Hr.	Nature
IC 100	Studies in Prophet Biography	2(2,0,0)	Elective
IC 101	Origins of Islamic Culture	2(2,0,0)	Elective
IC 102	Family in Islam	2(2,0,0)	Elective
IC 103	The Economic System in Islam	2(2,0,0)	Elective
IC 104	The Political System in Islam	2(2,0,0)	Elective
IC 105	Human Rights	2(2,0,0)	Elective
IC 106	Medical Jurisprudence	2(2,0,0)	Elective
IC 108	Contemporary Issues	2(2,0,0)	Elective
IC 109	Role of Women in Development	2(2,0,0)	Elective
	Total	**6**	

Table (4) COLLEGE REQUIREMENTS

Table (4A) COMPULSORY COURSES

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
MATH 106	Integral Calculus	3 (3, 2, 0)	*MATH 101*
MATH 107	Vectors and Matrices	3 (3, 2 , 0)	*MATH 101*
MATH 203	Differential and Integral Calculus	3 (3, 2, 0)	*MATH 106 MATH 107*
MATH 204	Differential Equations	3 (3, 2, 0)	*MATH 203*
PHYS 103	General Physics (1)	4 (3, 0, 2)	
PHYS 104	General Physics (2)	4 (3, 0, 2)	PHYS 103
ENGL 109	Language & Communication	2 (2, 1,0)	
ENGL 110	Technical Writing	2 (2,1,0)	ENGL 109
GE 104	Basics of Engineering Drawing	3 (2 ,0, 2)	
GE 106	Introduction to engineering Design	3 (2, 1, 2)	GE 104
GE 201	Statics	3 (3, 1, 0)	*MATH 106, MATH 107*
GE 203	Engineering and Environment	2 (2, 0, 0)	*CHEM 101, MATH 101*
GE 402	Engineering Projects Management	3 (3, 1, 0)	
GE 403	Engineering Economy	2 (2, 1, 0)	
Total		**40**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Table (4B) ADDITIONAL COURSES

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
GE 211	Computer Programming with C++	3 (2, 0, 2)	
MATH 244	Linear Algebra	3 (3, 2, 0)	*MATH 107*
	Total	**6**	

Table (4C) COLLEGE FREE COURSE FOR IE PROGRAM (2 CREDIT HOURS)

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisites
xxxxxx	Xxxx (Free Course)	2	
	Total	**2**	

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Table (5) INDUSTRIAL ENGINEERING REQUIREMENTS

Table (5A) CORE COURSES

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
IE 214	Industrial operations Management (1)	3 (3, 2, 0)	STAT 101	
IE 222	Industrial operations Analysis (1)	3 (3, 1, 1)	MATH 107	GE 211
IE 251	Manufacturing materials	3 (2, 2, 2)	PHYS104, CHEM101	
IE 252	Manufacturing processes (1)	3 (3, 2, 1)	IE 251, GE 104	
IE 314	Industrial operations Management (2)	3 (3, 2, 0)	IE 214	
IE 322	Industrial operations Analysis (2)	3 (3, 1, 1)	IE 222, GE211	
IE 333	Design and analysis of Experiments	3 (3, 1, 1)	STAT 101	
IE 337	Automatic Control Systems	3 (3, 1, 1)	MATH 204, GE 211	
IE 339	Quality Engineering	3 (3, 1, 1)	IE 333	IE 352
IE 341	Human Factors Engineering	3 (2, 1, 2)	IE 333	
IE 342	Work Analysis and design	3 (2 ,1 , 2)	IE 352	
IE 352	Manufacturing processes (2)	4 (4, 2, 1)	IE 252	
IE 360	CAD/CAM	3 (2, 1, 2)	GE 104	IE 352
IE 361	Product design and innovation	3 (2, 1, 2)	GE 106, IE 339, IE 360	
IE 405	Manufacturing Economics	3 (3, 1, 0)	IE 342	
IE 420	Industrial Systems Simulation	3 (2, 1, 2)	IE322	
IE 438	Engineering Reliability & Maintenance	3 (3, 1, 1)	IE 314	
IE 449	Safety Engineering	3 (3, 1, 1)	IE341, GE203	
IE 450	Industrial Facility Design	3 (3, 1, 1)	IE 342	
IE 461	Computer Integrated Manufacturing	3 (2, 1, 2)	IE 360, IE 450	
IE 462	Industrial Information Systems	2 (2, 2, 1)	IE 314	
IE 469	Manufacturing Systems	3 (3, 1, 1)	IE 438	IE 450
Total		**66**		

NP= No grade (Pass or Fail)

Table (5B) SENIOR DESIGN PROJECTS

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
IE 496	Graduation Project (1)	2 (2, 0, 0)	Complete successfully 129 credits hours and passing all courses in levels 1-7.
IE 497	Graduation Project (2)	2 (2, 0, 0)	IE 496
Total		**4**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

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Table (5C) INDUSTRIAL ENGINEERING ELECTIVE COURSES (STUDENT SELECTS 6 CR. HR. (2 COURSES))

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
IE 480	Production Systems Operations	3 (3, 1, 0)	IE 314	
IE 481	Supply chain and Logistics	3 (3, 1, 0)	IE 314	
IE 482	Decision Analysis	3 (3, 1, 0)	IE 322	
IE 483	Engineering Analytics	3 (3, 1, 0)	IE 322	
IE 484	Advanced Quality Engineering	3 (3, 1, 1)	IE 339	
IE 485	Advanced Safety Engineering	3 (3, 1, 1)	IE 449	
IE 486	Ergonomics design	3 (3, 1, 1)	IE341, IE 342	
IE 487	Advanced Manufacturing Technologies	3 (3, 1, 1)	IE 352	
IE 488	Additive Manufacturing Technologies	3 (3, 1, 1)	IE 352, IE 360	
IE 489	Manufacturing System Modeling	3 (3, 1, 1)		IE 469
IE 490	Maintenance Engineering	3 (3, 1, 1)	IE 438	
IE 491	Engineering Reliability	3 (3, 1, 0)	IE 438	
	Total	**6**		

Table (5D) INDUSTRIAL ENGINEERING PRACTICAL TRAINING COURSE (1 CREDIT HOUR)

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
IE 999	Practical Training	1 (NP)	Successful Completion of 110 credit hours	
	Total	**1**		

Table (5E) INDUSTRIAL ENGINEERING ELECTIVE COURSES WITHOUT EARNED HOURS

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
IE 998	Research Project	0 (NP)	Successful completion of 129 cr. hr.	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab; NP=No grade (Pass or Fail)

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Table 6 RECOMMENDED SEMESTER SCHEDULE - INDUSTRIAL ENGINEERING PROGRAM

Level (1)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
ENGS 100	English language	6 (6,9,0)		
MATH 101	Differential Calculus	3 (3,1,0)		
ENT 101	Entrepreneurship	1 (1,0,0)		
CHEM 101	General Chemistry	4 (3,0,2)		
ARAB 100	Writing Skills	2 (2,0,0)		
Total		**16**		

Level (2)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
ENGS 110	English	6 (6,9,0)		
CUR 101	University Skills	3 (3,0,0)		
CT 101	IT skills	3 (0,0,6)		
STAT 101	Introduction to Statistics	3 (2,2,0)		
EPH 101	Health & fitness	1 (1,1,0)		
Total		**16**		

Level (3)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
IC 1xx	Optional IC course	2(2,0,0)		
PHYS 103	General Physics (1)	4(3,0,2)		
MATH 106	Integral Calculus	3(3,2,0)	*MATH 101*	
MATH 107	Vectors & Matrices	3(3,2,0)	*MATH 101*	
ENGL 109	Language & Communication	2(2,1,0)		
GE 104	Basics of Engineering Drawing	3(2,0,2)		
Total		**17**		

Level (4)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
PHYS 104	General Physics (2)	4(3,0,2)	PHYS 103	
ENGL 110	Technical Writing	2(2,1,0)	*ENGL 109*	
MATH 203	Differential and Integral Calculus	3(3,2,0)	*MATH 106 MATH 107*	
GE 106	Introduction to Engineering Design	3(2,1,2)	*GE 104*	
GE 201	Statics	3(3,1,0)	*MATH 106 MATH 107*	
GE 203	Engineering and Environment	2(2,0,0)	*CHEM 101 MATH 101*	
Total		**17**		

Level (5)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
GE 211	Computer programming in C++	3(2,0,2)		
MATH 204	Differential Equations	3(3,2,0)	MATH203	
MATH 244	Linear Algebra	3(3,2,0)	MATH 107	
IE 214	Industrial operation Management (1)	3(3,2,0)	STAT 101	
IE 222	Industrial Operations Analysis (1)	3(3,1,1)	MATH107	GE211
IE 251	Manufacturing Materials	3(2,2,2)	PHYS104, CHEM101	
Total		**18**		

Level (6)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
IE 314	Industrial operation Management (2)	3(3,2,0)	IE214	
IE 322	Industrial Operations Analysis (2)	3(3,1,1)	IE222, GE211	
IE 333	Design & analysis of Experiments	3(3,1,1)	STAT 101	
IE 337	Automatic Control Systems	3(3,1,1)	MATH204, GE211	
IE 252	Manufacturing processes (1)	3(3,2,1)	IE251, GE104	
IC 107	Ethics of the Profession	2(2,0,0)		
Total		**17**		

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Level (7)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
IC xxx	Elective Islamic course	2(2,0,0)		
GE 403	Engineering Economy	2(2,1,0)		
IE 339	Quality Engineering	3(3,1,1)	IE333	IE352
IE 341	Human Factors Engineering	3(2,1,2)	IE333	
IE 352	Manufacturing processes (2)	4(4,2,1)	IE252	
IE 360	CAD/CAM	3(2,1,2)	GE104	IE352
Total		**17**		

Level (8)				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
GE 402	Engineering Projects Management	3(3,1,0)		
IE 420	Industrial Systems Simulation	3(2,1,2)	IE322	
IE 438	Engineering Reliability & Maintenance	3(3,1,1)	IE314	
IE 342	Work Analysis & Design	3(2,1,2)	IE352	
IE 449	Safety Engineering	3(3,1,1)	IE341, GE203	
IE 361	Product Design and Innovation	3(2,1,2)	GE106 IE339, IE360	
Total		**18**		

Level 9				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
IE 405	Manufacturing Economics	3(3,1,0)	IE342	
IE 450	Industrial Facility Design	3(3,1,1)	IE342	
IE 462	Industrial Information Systems	2(2,1,1)	IE314	
IE 469	Manufacturing Systems	3(3,1,1)	IE438	IE450
IE ***	Elective	3		
IE 496	Graduation Project (1)	2(2,0,0)	Complete successfully 129 credits hours and passing all courses in levels 1-7.	
Total		**16**		

Level 10				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
***	Free Course	2		
IC ***	Elective Islamic Course	2(2,0,0)		
IE 461	Computer Integrated manufacturing	3(2,1,2)	IE360, IE450	
IE ***	Elective	3		
IE 497	Graduation Project (2)	2(2,0,0)	IE 496	
IE 999	Practical Training	1 (NP)	Successful completion of 110 credit hrs.	
IE 998	Research Project	0 (NP)	Complete successfully 129 credits hours	
Total		**13**		

* PROGRAM IS PRECEDED BY A 2-LEVEL PREPARATORY YEAR
** CO-REQUISITE
NP: No grade (Pass or Fail)
(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

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3. COURSES DESCRIPTION

3.1 First Common Year

ENGS 101 - English Language **6(6,9,0)**

This initial stage of the course is designed to give the students a strong foundation in the language, improving their command of English as well as improving their vocabulary, reading, writing and communication skills. In the process of improving these skills, students will also develop their confidence in the language and also their presentation skills. These all contribute to the life skills of the student and help to prepare them for their future studies and careers beyond KSU. As the course progresses, and students reach a higher level of English, the focus will switch to the academic side of the language. This will involve preparing students for the style of language they will need for their future studies.

Pre-requisites: None.

ENGS 110 – Academic English Language **6(6,9,0)**

The final assessment for the course is the highly regarded International English Language Testing System (IELTS), which is used as a qualifying test for students wishing to attend university in many countries including the UK and Australia. Specialist material will be used to prepare students for this test with the aim of reaching an IELTS score of 5.0 by the end of the year.

Pre-requisites: None.

Math 101 - Differential Calculus **3(3,1,0)**

Limits and Continuity: The Concept of Limit, Computation of Limits, Continuity and its Consequences, Limits Involving Infinity, Formal Definition of the Limit. Differentiation: The Concept of Derivative, Computation of Derivatives (The Power Rule, Higher Order Derivatives, and Acceleration), the Product and Quotient Rules, The Chain Rule, Derivatives of Exponential and Logarithmic Functions, Implicit Differentiation and Inverse Trigonometric Functions, the Mean Value Theorem. Applications of Differentiation: Indeterminate Forms and L'Hopital's rule, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity and the Second Derivative Test, Optimization, Related Rates.

Pre-requisites: None.

STAT 101 – Introduction to Statistics **3(2,2,0)**

Probability and probability distribution - Mathematical expectations of random variables. Discrete and continuous distributions. Sampling distributions - Estimation, testing of hypothesis - Regression and correlation.

Pre-requisites: *None*.

CHEM 101 - General Chemistry **4(3,0,2)**

Stoichiometry: SI Units, chemical formulas, the mole, methods of expressing concentration, Calculations based on chemical equations. Gases: laws, kinetic theory, deviation and van der Waals equation. Thermochemistry: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics. Solutions: Type of solutions and laws related , colligative properties. Chemical kinetics: Law of reaction rate, reaction order, factors affecting the rates. Chemical Equilibrium: Relation between Kc & Kp, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions. Atomic Structure: emission spectrum, Bohr's theory de Broglre's hypothesis, quantum numbers, electronic configuration of elements, consequences of the periodic table.

Pre-requisites: *None*.

CT 101 - IT Skills **3(0,0,6)**

Basic Concepts of Information Technology, Using a computer and Managing Files, Word Processing, Spreadsheets, Databases, Presentation.

Pre-requisites: None.

CUR 101 - University Skills **3(3,0,0)**

Learning skills**:** Self-management for learning, Learning tools, Reading strategies, Second language learning skills, Test administration. Thinking skills: Theory Of Inventive Problem Solving (TRIZ), Rounding Thinking, Expanding perception, Creative thinking. Research skills: Problem determining, Search for information strategies, Sites of sources, access this information, Using thin formation, Information construction, Information evaluation.

Pre-requisites: None.

ARAB 100 - Writing Skill **2(2,0,0)**

Applications in reading and speaking skills, the adverb of time and the adverb of place, accusative, exclamation, punctuations, computer-based writing, dictionaries and E-dictionaries, applications to reading and writing skills, accusative of cause or reason, denotative of state (circumstantial accusative or accusative of the state or condition), writing a paragraph and essay, apposition (adjective/ corroboration/ substitute/ explanatory apposition), relations, and writing formal and informal letters.

Pre-requisite: ---

EPH 101 - Health and Fitness **1(1,1,0)**

Subjects about general health and body and brain fitness.

Pre-requisites: None.

ENT 101 - Entrepreneurship **1(1,0,0)**

Pre-requisites: None.

3.2 University Requirements

IC 100- Studies in Prophet Biography	**2(2,0,0)**
IC 101- Origins of Islamic Culture	**2(2,0,0)**
IC 102 Family in Islam	**2(2,0,0)**
IC 103 The Economic System in Islam	**2(2,0,0)**
IC 104 The Political System in Islam	**2(2,0,0)**
IC 105 Human rights	**2(2,0,0)**
IC 106 Medical Jurisprudence	**2((2,0,0)**
IC 107 ethic of the profession	**2(2,0,0)**
IC 108 Contemporary Issues	**2(2,0,0)**
IC 109 Role of Women in Development	**2(2,0,0)**

3.3 College Requirements

MATH 106 - Integral Calculus **3(3,2,0)**

The definite integral, fundamental theorem of calculus, the indefinite integral, change of variable, numerical integration. Area, volume of revolution, work, arc length. Differentiation and integration of inverse trigonometric functions. The logarithmic, exponential, hyperbolic and inverse hyperbolic functions. Techniques of integration: substitution, by parts, trigonometric substitutions, partial fractions, miscellaneous substitutions. Indeterminate forms, improper integrals. Polar coordinates.

Pre-requisite: ***MATH 101*****.**

MATH 107 – Vectors and Matrices **3(3,2,0)**

Vectors in two and three dimensions, scalar and vector products, equations of lines and planes in space, surfaces, cylindrical and spherical coordinates. Vector valued functions, their limits, continuity, derivatives and integrals. Motion of a particle in space, tangential and normal components of acceleration. Functions in two or three variables, their limits, continuity, partial derivatives, differentials, chain rule, directional derivatives, tangent planes and normal lines to surfaces. Extrema of functions of several variables, Lagrange multipliers. Systems of linear equations, matrices, determinants, inverse of a matrix, Cramer's rule.

Pre-requisite: ***MATH 101*****.**

MATH 203 - Differential and Integral Calculus **3(3,2,0)**

Infinite series, convergence and divergence of infinite series, integral test, ratio test, root test and comparison test. Conditional convergence and absolute convergence, alternating series test. Power series, Taylor and Maclaurin series. Double integral and its applications to area, volume, moments and centre of mass. Double integrals in polar coordinates. Triple integral in rectangular, cylindrical and spherical coordinates and applications to volume moment and centre of mass. Vector fields, line integrals, surface integrals, Green's theorem, the divergence theorem, Stoke' theorem.

Pre-requisite: ***MATH 106*** **and** ***MATH 107*****.**

MATH 204 - Differential Equations **3(3,2,0)**

Various types of first order equations and their applications. Linear equations of higher order. Systems of linear equations with constant coefficients, reduction of order. Power series methods for solving second order equations with polynomial coefficients. Fourier series, Fourier series for even and odd functions. Complex Fourier series. The Fourier integral.

Pre-requisite: ***MATH 203*****.**

MATH 244 – Linear Algebra **3(3,2,0)**

Matrices and their operations. Types of matrices. Elementary transformations. Determinants, elementary properties. Inverse of a matrix. Linear systems of equations. Vector spaces, linear independence, finite dimensional spaces, linear subspaces. Inner product spaces. Linear transformations, kernel and image of a liner transformation. Eigen values and Eigen vectors of a matrix and of a linear operator.

Prerequisite: ***MATH 107*****.**

PHYS 103 - General Physics (1) **4(3,0,2)**

Introduction (Vectors), Motion in one dimension with constant acceleration, Motion in two dimension with application to projectile motion and circular motion, Newton's Laws of Motion, Work and Energy, Potential Energy and conservation of Energy, Linear Momentum and Collisions, Rotation of rigid object about a fix axis**.**

Pre-requisites: ***None*****.**

Approved by**:** Chairman: …… Dean: ……

PHYS 104 - General Physics (2) **4(3,0,2)**

Electricity and Magnetism: Coulomb's law, electric fields, Gauss' Law, electric potential, potential energy, capacitance and dielectric, currents and resistance, electrical energy and power, direct current circuits, Kirchhoffs rules, magnetic fields, motion of charged particle in a magnetic field, sources of the magnetic field, Ampere's law, Faraday's law of induction, self-inductance, energy in a magnetic field, mutual inductance, alternating current circuits, the RLC series circuit, power in an A.C. circuit, resonance in RLC services circuit.

Pre-requisites: ***PHYS 103***

ENGL 109 – Language & Communication **2(2,1,0)**

The course includes *English for Specific Purpose* (ESP) units that cover terminology and expressions, in various engineering disciplines. The course is designed to improve the communication and reading skills of engineering students. It equips the student with essential linguistic expertise for his engineering study and prospective professional career

Pre-requisites: ***None*****.**

ENGL 110 – Technical Writing **2(2,1,0)**

The course is intended to enhance technical writing skills. It equips students with writing basics and techniques required for constructing clear and persuasive presentation of their ideas, on various forms including reports, presentations, worksheets, CVs' and memos. The course highlights effective writing features including: focus, organization, support & elaboration, style, and conventions. It emphasizes on observing ethical norms in writing.

Pre-requisites: ENGL *109*

GE 104 - Basics of Engineering Drawing **3(2,0,2)**

The course includes the drawing of Orthographic and isometric projections. Other topics include scaling, sectioning, dimensioning and blue print reading. The course is taught using free hand, AutoCAD and AutoDesk Inventor**.**

Pre-requisites: ***None*****.**

GE 106 – Introduction to Engineering Design **3(2,1,2)**

Engineering profession, jobs, and disciplines; Elements of engineering analysis; Introduction to engineering design and team formulation; Engineering problem definition; Engineering system Architecture and physical function decomposition; human factor, environment, and safety issues in design; Generation of alternative concepts; Evaluation of alternatives and selection of a concept, Design defense, performance evaluation, and reporting; Engineering ethics

Pre-requisites: GE 104

GE 201 - Static **3(3,1,0)**.

Force systems; vector analysis, moments and couples in 2D and 3D. Equilibrium of force systems. Analysis of structures; plane trusses and frames. Distributed force system; centroids and composite bodies. Area moments of inertia. Analysis of beams. Friction.

Pre-requisite: ***MATH 106*** **and** ***MATH 107*****.**

GE 203 – Engineering and Environment **2(2,0,0)**

This course introduces the impact of engineering and industrial activities on the environment. The lectures cover basics of ecosystems, environmental balance, types of pollution, and types, sources, and limits of pollutants; in addition to fundamentals of Environmental Impact

Assessment (EIA). Pollution control technologies and examples of pollution from various engineering and industrial sectors are also covered
Pre-requisite: *CHEM101* and *MATH 101*.

GE 211 - Computer Programming in "C++" **3(2,0,2)**
Introduction to computers and C++ programming. Compilers and numbers systems. Program structures, comments, and printing. Formatting output, Escape sequence, and program debugging. Variables, arithmetic operators, and expressions. Access of input/output files. Program control using: if-else statement, switch commands, for loops, and while loops. User-defined functions. One and two dimensional Arrays. Multidimensional arrays. Strings and Pointers. Engineering Applications.
Pre-requisites: *None*.

GE 402 – Engineering Project Management **3(3,1,0)**
Introduces techniques that provide rational solutions to a range of project management decisions encountered in engineering projects. Students are expected to gain a detailed understanding of some; of the techniques, tools and processes available and their application in starting, planning, managing and finishing engineering projects; The course covers project management fundamentals including projects life cycle, project planning and scheduling techniques, cash flow forecasting, performance evaluations, estimating and cost control; project organizations; Introduction to risk management.
Pre-requisites:

GE 403 - Engineering Economy **2(2,1,0)**
This course is being offered to the students who enroll in the College of Engineering to give them fundamental knowledge and understandings on Cost concepts, Time value of money operations. Measuring the worth of investments, Comparison of alternatives, Depreciation, and Economic analysis of public projects.
Pre-requisites: *None*.

3.4 Industrial Engineering Courses

IE 214: Industrial Operations Management (1) 3(3,2,0)
Introduction to operation management, evolution of operations management, productivity challenge, new trends in operstions management; Demand forecasting, staregic importance of forecasting, forecasting approaches, monitoring and control of forecast, forecasting in service sector; Capacity planning, bottelneck analysis & theory of constariants and break even analysis; Supply chain, teqniques for evaluating supply chain, managing bulwhip effect, supplier selection and transportation mode analysis; Management of Inventory, invetory models for independent demand, probabilistic inventory models and safety stock.
Pre-requisite: STAT 101

IE 222: Industrial Operations Analysis (1) 3(3,1,1)
Introduction to mathematical programming and optimization; Characteristics of linear programs; Modeling of various industrial programs as linear programs; Graphical solutions; Introduction to the theory of simplex methods; Big M method, Unbounded and infeasible solutions; Sensitivity analysis and introduction to the duality theory; Transportation and assignment problems and solution techniques; Shortest path, Minimum spanning tree, and maximum flow problems; Goal Programming.
Pre-requisite: MATH 107
Co-requisite: GE211

IE 251: Manufacturing Materials 3(2,2,2)
Engineering materials properties testing and processing parameters; Material compositions and structures; physical and mechanical properties of materials; Ferrous materials; Heat treatment; Non-Ferrous alloys; Ceramics, Polymers, Composites; introduction to Nano materials; Material selection.
Pre-requisite: PHYS 104, CHEM 101

IE 252: Manufacturing processes (1) 3(3,2,1)
Engineering materials processing parameters that influence design considerations, product quality and production costs; Definition of stress, strain and mechanical properties of materials applied to metal forming processes; sheet metal forming, processes (deep drawing, stretch shearing and bending) ; bulk forming processes (forging, rolling , extrusion and wire drawing); basic casting techniques; Welding processes
Pre-requisite: IE251, GE104

IE 314: Industrial Operations Management (2) 3(3,2,0)
Aggregate sales and operations planning, aggregate planning approaches, revenue management, using software for aggregate palnning; Short term scheduling, forward and backward scheduling, scheduling process focused facilities, finite capacity scheduling; production line balancing; Business analytics models, decision making tools.
Pre-requisite: IE 214

IE 322: Industrial Operations Analysis (2) 3(3,1,1)
Deterministic dynamic programming; Forward and backward procedures; Integer programming; Branch and Bound methods; Nonlinear programming; Single and multi variable unconstrained optimization; KKT conditions and quadratic programming; Markov chains; Queuing Theory.
Pre-requisite: IE 222

IE 333: Design and Analysis of Experiments 3(3,1,1)
Introduction to design of experiments and its applications in industry; Hypothesis testing; Analysis of variance; Residual analysis; Block design; Randomized complete and incomplete designs; Two and multi factor factorial design; Introduction to response surface methodology.
Pre-requisite: STAT 101

IE 337: Automatic Control Systems 3(3,1,1)
Process control fundamentals; Control theory principles; Modeling analogy; Digital control using programmable logic controller and computer.
Pre-requisite: MATH 204, GE 211

IE 339: Quality Engineering 3(3,1,1)
An understanding of the basic concepts of quality; An appreciation of the functions served by a quality management system; the ability to design quality into products so as to satisfy both internal and external customer; The study of frequency distributions and probability models in quality control; Preparation and use various control charts; Construction of different sampling plans; Quality improvement Methods and analysis of quality costs; Application of computer in the above areas.
Pre-requisite: IE 333, **Co-requisite: IE 352**

IE 341: Human Factors Engineering 3(2,1,2)
Introduction to human factors; Human-Machine Systems; Information theory; Human Capabilities, environmental and thermal factors; Display and control Design, Hand Tools and Devices, Workplace Design, Physical Work and Manual Materials Handling and Speech Communications.
Pre-requisites: IE 333

IE 342: Work Analysis and Design 3(2,1,2)
Introduction to work analysis and design; Methods engineering: Study of the basic work measurement techniques; Applications and limitations of the stop-watch time study, pre-determined motion time systems.
Pre-requisite: IE 352

IE 352: Manufacturing Processes (2) 4(4,2,1)
Dimensional and geometric tolerances, Tool materials and geometry; Cutting tools assembly techniques; Cutting mechanics; Material removal operations; Effects of cutting variables on machining operations; Optimization of cutting variables for machining operations; Non-traditional machining; Process planning.
Pre-requisite: IE 252

IE 360: CAD/CAM 3 (2,1,2)
Introduction to CAD/CAM Systems, Components of CAD/CAM Systems, Geometric Modeling Systems, Geometric Transformations, Representation and Manipulation of Curves, Geometric Projections, Data Exchange between CAD/CAM Systems, Finite Element Modeling and Analysis, Introduction to Numerical Control (NC), Analysis of NC positioning system, Manual Part Programming.
Pre-requisite: GE 104
Ce-requisite: IE 352

IE 361: Product Design and Innovation 3(2,1,2)
Introduction to manage innovation; product development stages; Customer needs; Product specification; Quality function deployment; Product structure and components; Function Analysis; Value engineering principles; principle of reverse engineering; Idea generation; Theory of inventive problem solving (TIPS-TRIZ); Design for manufacturing and assembly (DFMA); Principles of robust design; Implementing prototype metrologies; product development and Entrepreneurship; product development project.
Pre-requisite: GE 106, IE 339, IE 360

IE 405: Manufacturing Economics 3(3,1,0)
Introduction to manufacturing economics; Labor cost analysis; Materials cost analysis; Overhead cost calculations; Operation cost estimating, product cost estimating, and product pricing, Costing and Entrepreneurship.
Pre-requisite: IE 342

IE 420 Industrial Systems Simulation 3(2,1,2)
Introduction to the concept of simulation including modeling and simulation languages; Appropriate inputs to a simulation model, and random number generation; Analysis of the output from a simulation model; Validation of the simulation model.
Pre-requisite: IE 322

IE 438: Engineering Reliability and Maintenance 3(3,1,1)
Introduction to the concept of reliability**;** Failure distributions; Reliability characteristics**;** Estimation of system reliability both for the independent and dependent cases; Maintenance workload analysis and calculations; Capacity planning of maintenance resources; Maintenance works scheduling; Maintenance audit and the measurement of maintenance works performance; Computerized maintenance management systems (CMMS).
Pre-requisite: IE 314

IE 449: Safety Engineering 3(3,1,1)
Introduction to regulations and standards; Industrial hazard avoidance concepts and techniques; Plant safety applications; Management and its safety responsibilities; Analytical trees and fault tree analysis; Risk assessment; Emergency planning.
Pre-requisites: IE 341, GE203

IE 450: Industrial Facility Design 3(3,1,1)
Facility design stages of Industrial factory; Product analysis; Production analysis (product-process relation, industrial decisions, production-layout relation, process design and planning charts process); Capacity analysis (actual quantities, number of production units and labors, assembly line balancing); material handling analysis; Area allocation and space analysis; Flow analysis; Plant layout and plan; Computerized facility layout and allocations.
Pre-requisite: IE 342

IE 461: Computer Integrated Manufacturing 3(2,1,2)
Introduction and manufacturing systems; Industrial Robots; Material handling systems; Automated storage and retrieval system; Automated identification and data capture; Industrial Networks and Communication Systems; Industrial Information Systems; Computer Aided Process Planning; Inspection principles and technologies.
Pre-requisite: IE 360, IE 450

IE 462: Industrial Information Systems 2(2,2,1)
Analysis, design and implementation of industrial information systems with special focus placed on manufacturing systems and environments; Information systems development life cycle, information systems requirements determination; Data modeling; Structured analysis and functional architecture design ; Object-oriented analysis and design; E-business and web-based database.
Pre-requisite: IE 314

IE 469: Manufacturing Systems 3(3,1,1*)*
Definition and classification of manufacturing systems; Manufacturing automation fundamentals; Manufacturing Metrics and Economics; Single-Station Manufacturing Cells; Modeling of Manufacturing Systems: Analytical Models, IDEF0, IDEF1X, Petri Nets; Automated Production and Assembly Lines; Group Technology and Cellular Manufacturing; and Flexible Manufacturing Systems (FMS).
Pre-requisite: IE 438;
Co- requisite: IE 450

IE 496: Graduation Project (1) 2 (2,0,0)
Senior student select a project applying learned tools and knowledge to understand the process and elements of a large, interdisciplinary engineering project design through experience. The course is carried out by: Choosing the topic; Establishing the project; reviewing background; Preparing for/or preliminary conducting of the experiments; Collecting the field data and developing the mathematical model if applicable; Writing the first two chapters along with any preliminary findings.
Pre-requisite: passing levels 1 to 7 and 129 Cr. Hr.

IE 497: Graduation Project (2) 2 (2,0,0)
This course is continuation of part I of the project and the following tasks are carried out: Running and finalizing the experimental program or the mathematical/computer model; Analyzing the results and findings and drawing the conclusions; Writing the complete project report; Presenting and defending the project.
Pre-requisite: IE 496

IE 999: Practical Training 1(NP)
The student should gain an industrial training in the field at any governmental and or private industry for sixty days.
Pre-requisite: 110 Cr. Hr.

IE Elective Courses

IE 480: Production Systems Operation 3 (3, 1, 0)
Business plans to production operation systems, strategies to reach targets, production operations system's contribution to competitiveness, balancing production operations system and strategies. Production system operations performance, world-class successful production operations systems, productivity and efficiency what should be measured? Overall equipment effectiveness. Advance production system operations dynamic, bottleneck rates, internal benchmarking, and labor constrained production operation system. Just in time and lean manufacturing, implementing just in time, pull production operation system, Kanban, comparison of Conwip with Kanban and material requirement planning, production scheduling in pull environment. Advance aggregate and work force planning, product mix planning.

Modern views of capacity management, forcing cycle time compliance, factory physics approach, capacity allocation and production line balancing. Production systems operation development in the future, key areas and success factors, future production from an international perspective.
Pre-requisite: IE 314

IE 481: Supply chain and Logistics 3 (3, 1, 0)
Reviewing supply chain and logistics; design of the supply chain network; Analysis and design of domestic and international logistics systems; Application of supply chain and logistics decision-making tools and skills; Application of analytical tools useful for logistic systems for a better competitive advantage; Analysis of the characteristics of logistics system elements and their interrelationships within a company.
Pre-requisite: IE 314

IE 482: Decision Analysis 3 (3, 1, 0)
This course provides an overview of modelling techniques and methods used in decision analysis, including utility models, decision trees, and Bayesian models. Elicitation techniques for model building are emphasized. Practical applications through real-world model building are described and conducted.
Pre-requisite: IE 322

IE 483 : Engineering Analytics 3 (3, 1, 0)
Students explore all three areas of Analytics, namely Predictive Analytics, Descriptive Analytics, and Prescriptive Analytics. The Predictive Analytics covers advanced forecasting techniques such as regression methods and neural networks. Descriptive Analytics deals with data mining techniques such as clustering and classifications. Prescriptive Analytics consists in applying heuristic methods to solve hard optimization problems, including Constructive Heuristics, Improvement Heuristics, and Metaheuristics.
Pre-requisite: IE 322

IE 484 : Advanced Quality Engineering 3 (3, 1, 1)
This course provides students with the analytical and quality management tools necessary skills to solve manufacturing quality problems and implement effective quality management systems. Topics include overview of quality management methodologies, total quality management (TQM), the Six Sigma (DMAIC) problem solving methodology, Kaizen methodology, 5S methodology, failure mode and effects analysis (FMEA), quality function deployment (QFD), measurement system analysis (MSA), Taguchi quality engineering approach.
Pre-requisite: IE 339

IE 485 : Advanced Safety Engineering 3 (3, 1, 1)
Course covering hazard identification and risk analysis, safe system design, safety analysis techniques, system hazard analysis, and safety cases. Techniques covered include: Hazard and Operability Studies (HAZOP) and Computer Hazard and Operability Studies (CHAZOP), Functional Failure Analysis (FFA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Failure Modes and Effects Analysis (FMEA) and Failure Modes Effects and Criticality Analysis (FMECA), and Goal Structured Notation (GSN), and others.
Pre-requisite: IE 449

IE 486 : Ergonomics design **3 (3, 1, 1)**
This course covers mainly theories/methods that influence the assessment of physical, social, and psychological human factors. Development of user needs with application to designed products that interact with human body. In addition, application of design to meet human needs. Design of fabricated products, tools/machines, software/hardware interfaces, art/culture, living environments, and complex sociotechnical systems.
Pre-requisite: IE 341, IE342

IE 487 : Advanced Manufacturing Technologies **3 (3, 1, 1)**
Manufacturing with lasers: overview of laser manufacturing processes, laser cutting, laser hardening, laser welding of metals; Manufacturing with additive processes: overview of additive manufacturing processes, binder jetting, directed energy deposition, material extrusion, ultrasonic lamination technology, hybrid additive process; Manufacturing Micro parts and micro features: micro manufacturing overview, micro mechanical drilling, micro milling, micro electrical discharge machining, electrochemical discharge machining.
Pre-requisite: IE 352

IE 488 : Additive Manufacturing Technologies **3 (3, 1, 1)**
Basic Principles of additive manufacturing, Technologies of Additive Manufacturing, Generalized process chain, additive manufacturing processes, Direct write technologies, guideline of process selection, Software issues for additive manufacturing, Direct digital manufacturing, Applications for Additive Manufacture.
Pre-requisite: IE 352, IE 360

IE 489 : Manufacturing System Modeling **3 (3, 1, 1)**
Definition and classification of factory models; Process time variability; Multi stage single product factory models; Multiple product factory models; Models of various forms of batching; Serial limited Buffer models; Simulations techniques in manufacturing
Co- requisite: IE 469

IE-490 Maintenance Engineering **3 (3, 1, 1)**
Maintenance functions, Preventive Maintenance, Concepts, Modelling, and Analysis, Maintenance Work Measurement, Maintenance Material Control, Maintenance Operations and Control, Maintenance Quality Control, Reliability-Centered Maintenance, Total Productive Maintenance, and Intelligent Maintenance
Co- requisite: IE 438

IE491 Reliability Engineering **3 (3, 1, 0)**
Introduction to reliability, Reliability measures, and Probability models. Reliability of state-independent system. State-independent systems. Stress-strength model. Design for reliability. Maintainability and Design for Maintainability. Data Collection and Empirical Methods. Reliability testing. Identifying Failure and Repair Distributions. Statistical Tests
Co- requisite: IE 438

IE 998: Research Project **0 (NP)**
This course is concerned with development of research skills of students. The course provides the student with definition of ethics of scientific research, the principles of conducting and writing research proposal, research methodologies, research reports, and presentation of research results.
Pre-requisite: Successful completion of 129 credit hours.

***Approved by*:** Chairman: …… Dean: ……