UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology

Department of Industrial and Systems Engineering

Postgraduate Guide 2020

www.up.ac.za/ie

Content

Appendices

Introduction

Department of Industrial and Systems Engineering

Industrial Engineering is an extensive field of study since it consists of many diverse scientific disciplines with interfaces to various fields of study from the sciences, engineering and management. If one characteristic of Industrial Engineering has to be isolated then it may be the capability of the Industrial Engineer to integrate the contributions of all the other engineering disciplines into a final, functional and marketable product, at the lowest possible cost, by using system knowledge and understanding.

The Department of Industrial and Systems Engineering at the University of Pretoria is the oldest and biggest Industrial Engineering department in South Africa. The first Industrial Engineers graduated from the University of Pretoria in 1963. Up to 1974 Industrial Engineering was offered as a program in the Department of Mechanical Engineering. In 1975 the Department of Industrial Engineering was established as an independent academic department.

Research Focus Streams

The following are research focus streams within the Department of Industrial and Systems Engineering:

Resource Optimisation (RO)

- Operations research
- Simulation modelling
- Stochastic modelling
- Forecasting

Business Process Optimisation (BPO)

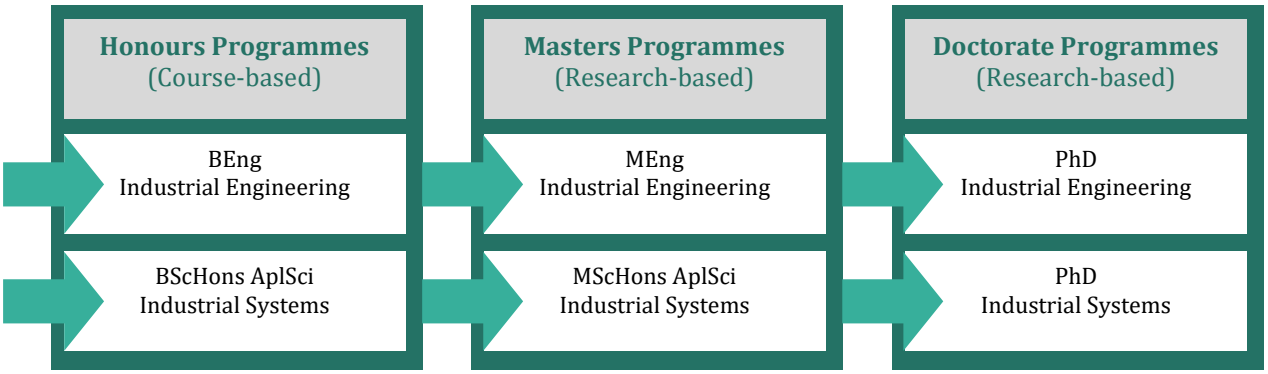
- Enterprise engineering
- Enterprise architecture
- Business process analytics

Supply Chain Engineering (SCE)

- Supply chain management
- Manufacturing planning and control systems
- Supply chain processes
- Supply chain design

Postgraduate Academic Programmes

The core mission of the University is research and instruction which comprises of four distinct phases: Undergraduate, Honours, Masters and Doctorate. Phases two, three and four are dealt with in this guide. The following sources should be consulted in conjunction with this guide:
Yearbooks and Faculty Rules - https://www.up.ac.za/yearbooks/2019/home



Honours Programmes

BEngHons Industrial Engineering (Plan code: 12240012)

A student is required to pass modules to the total value of 128 credits. The minimum duration of study is 1 year. The Programme consists of one compulsory module (32 credits) with any relevant core module as pre-requisite and the remainder of credits either core and/or elective modules. Students are allowed 32 relevant credits from outside the department. Students are advised to select modules in line with their desired research stream.

Course Curriculum (Also see *Note on page 7)

Semester 1		Semester 2	
Compulsory module			
- BCS 780 Industrial & systems engineering research	32 Credits	or - BCS 780 Industrial & systems engineering research	32 Credits
Core modules			
- BLK 781 *(SCE)* Supply chain processes	16 Credits	- BVK 780 *(SCE)* Supply chain design	16 Credits
- BBA 781 *(BPO)* Enterprise engineering	32 Credits	- BOZ 780 *(RO)* Operations research	32 Credits
- BPZ 782 *(SCE)* Manufacturing planning & control systems	32 Credits	- BUY 780 *(RO)* Simulation modelling	32 Credits
Elective modules (IE Dept)			
		- BTH 780 *(BPO)* Reliability engineering	16 Credits
Elective modules (Outside)			
- Elective module/s worth 32 credits allowed			

Minimum Admission Requirements

A BEng degree awarded by the University of Pretoria
or
A relevant four-year bachelor's degree in engineering that the Engineering Council of South-Africa (ECSA) regards acceptable for registration as a candidate engineer and for eventual registration as a professional engineer.

Selection Process

The departmental postgraduate committee reserves the right to make a thorough assessment of the applicant's academic transcript and Curriculum Vitae (CV), to decide if the applicant is suitable for postgraduate studies.

Applications and Registration

Students may Apply Online via the University of Pretoria website - https://www.up.ac.za/online-application
Once a student has been admitted he/she may register for modules. Online registrations open in January 2020.

Closing Dates

South-African citizens: 29 November 2019
International applicants: 30 August 2019

BScHons AplSci Industrial Systems (Plan code: 12243002)

A student is required to pass modules to the total value of 128 credits. The minimum duration of study is 1 year. The Programme consists of two compulsory module (48 credits) with any relevant core module as pre-requisite and the remainder of credits either core and/or elective modules. Students are allowed 16 relevant credits from outside the department. Students are advised to select modules in line with their desired research stream.

Course Curriculum (Also see *Note on page 7)

Semester 1		Semester 2	
Compulsory module			
- BCS 780 Industrial & systems engineering research	32 Credits	or - BCS 780 Industrial & systems engineering research	32 Credits
- BAN 780 Industrial analysis	16 Credits		
Core modules			
- BLK 781 *(SCE)* Supply chain processes	16 Credits	- BVK 780 *(SCE)* Supply chain design	16 Credits
- BBA 781 *(BPO)* Enterprise engineering	32 Credits	- BOZ 780 *(RO)* Operations research	32 Credits
- BPZ 782 *(SCE)* Manufacturing planning & control systems	32 Credits	- BUY 780 (RO) Simulation modelling	32 Credits
Elective modules (IE Dept)			
		- BTH 780 *(BPO)* Reliability engineering	16 Credits
Elective modules (Outside)			
- Elective module/s worth 16 credits allowed			

Minimum Admission Requirements

A three-year BSc degree in Natural Sciences with a weighted average of at least 60%
or
An equivalent degree with a weighted average of at least 60%
or
An appropriate BTech qualification excluding the National Diploma e.g. one offered by a department of industrial engineering at a university of technology in South Africa with a weighted average of at least 75% and no modules failed
or
A four-year engineering-based university degree not recognised by ECSA for registration as a professional engineer

Selection Process

The departmental postgraduate committee reserves the right to make a thorough assessment of the applicant's academic transcript and Curriculum Vitae (CV), to decide if the applicant is suitable for postgraduate studies.

Applications and Registration

Students may Apply Online via the University of Pretoria website - https://www.up.ac.za/online-application
Once a student has been admitted he/she may register for modules. Online registrations open in January 2020.

Closing Dates

South-African citizens: 29 November 2019
International applicants: 30 August 2019

Master's Programmes

A dissertation is required as deliverable. The dissertation must prove the student's ability to undertake scientific research and to report thereon. The minimum duration of study is 1 year.
A dissertation is acceptable if it proves that a student:

- is conversant with the nature and aim of the research,
- has a satisfactory knowledge of the literature concerned and can interpret it,
- has mastered the techniques relevant to his/her research,
- has sound knowledge of both the theory and the practice of scientific methodology,
- is able to evaluate the scientific relevance of his/her findings and
- can structure the report on the research scientifically with accountability.

The student may not have previously submitted the dissertation for graduation purposes at another tertiary institution.

Research Topic

A prospective student should select a research topic in collaboration with the staff of the Department of Industrial and Systems Engineering. Research topics may be chosen within the three research streams and other topics may be considered in consultation with the HoD.

The following are research focus streams within the Department of Industrial and Systems Engineering:

- Business Process Optimisation *(BPO)*
- Resource Optimisation *(RO)*
- Supply Chain Engineering *(SCE)*

Some pre-defined topics may be available on the departmental website:
https://www.up.ac.za/industrial-and-systems-engineering/article/2005687/masters-and-doctorate-research-topics
Please consult with the concerned lecturer as indicated. Students may also provide their own research topic.

Minimum admission requirements

MEng Industrial Engineering
Plan code: 12250012, Module code: BIR 890
A BEng Hons degree awarded by the University of Pretoria with a cumulative weighted average of 65% or An equivalent degree with a cumulative weighted average of 65% The applicant must also meet the admission requirements for the BEng Hons degree.

MSc AplSci Industrial Systems
Plan code: 12253060, Module code: BIR 891
A BSc Hons degree awarded ty the University of Pretoria with a cumulative weighted average of 65% or An equivalent degree with a cumulative weighted average of 65% The applicant must also meet the admission requirements for the BScHons AplSci degree.

Selection process

The departmental postgraduate committee may request evidence of knowledge of research methodology.
The departmental postgraduate committee may require additional honours modules for non-degree purposes where background is insufficient.

The departmental postgraduate committee reserves the right to make a thorough assessment of the applicant's academic transcript and Curriculum Vitae (CV), to decide if the applicant is suitable for postgraduate studies. This assessment may include an oral or written examination.

Applications and research topic submission

Students have to submit their Masters proposal to the department and collaborate with a proposed/selected supervisor. Students may thereafter upon approval, apply and register for the relevant Master's degree. Please also read the Research section on page 6 of this brochure.

Doctorate Programmes

It requires the preparation of a thesis by the student based on his/her own independent and original research as a positive contribution towards the development of science and the existing body of knowledge of the subject. The requirements for the thesis are based on, but not limited to, the requirements for a dissertation, with the important addition of the student's ability to prove that he/she can plan, initiate, and execute independent and original research. The minimum duration of study is 2 years.
The student may not have previously submitted the thesis for graduation purposes at another tertiary institution.

Research Topic

A prospective student should select a research topic in collaboration with the staff of the Department of Industrial and Systems Engineering. Research topics may be chosen within the three research streams and other topics may be considered in consultation with the HoD.

The following are research focus streams within the Department of Industrial and Systems Engineering:

- Business Process Optimisation *(BPO)*
- Resource Optimisation *(RO)*
- Supply Chain Engineering *(SCE)*

Some pre-defined topics may be available on the departmental website:
https://www.up.ac.za/industrial-and-systems-engineering/article/2005687/masters-and-doctorate-research-topics
Please consult with the concerned lecturer as indicated. Students may also provide their own research topic.

Minimum admission requirements

PhD Industrial Engineering
Plan code: 12263002, Module code: BIR 990
A MEng degree awarded by the University of Pretoria. or A research-based master's degree in engineering awarded by another university. The applicant must also meet the admission requirements for the BEng Hons degree.

PhD Industrial Systems
Plan code: 12263132, Module code: BIT 990
An appropriate research-based master's degree. The applicant must also meet the admission requirements for the BScHons AplSci degree.

Selection process

The departmental postgraduate committee may request evidence of knowledge of research methodology, a copy of the master's dissertation and a list of published journal articles (if any).
The departmental postgraduate committee may require additional honours modules for non-degree purposes

where background is insufficient.
The departmental postgraduate committee reserves the right to make a thorough assessment of the applicant's academic transcript and Curriculum Vitae (CV), to decide if the applicant is suitable for postgraduate studies. This assessment may include an oral or written examination.

Applications and research topic submission

Students have to submit their Doctorate proposal to the department and collaborate with a proposed/selected supervisor. Students may thereafter upon approval, apply and register for the relevant Master's degree. Please also read the Research section on page 6 of this brochure.

Research

The following section is applicable mainly to students enrolling for Master's and Doctorate studies.

Proposal document

The document should include a complete project plan that addresses technical deliverables, time scales, and costs. A copy must be submitted to Mrs Hanli Helm at hanli.helm@up.ac.za. The problem/opportunity must be postulated clearly, and details must be furnished of the environment in which the study will be conducted. Sketches, photographs, and diagrams usually make it convenient for an outsider to understand the problem. The scope of the work, as well as the planned approach and the perceived route, is important. Any presentable work that has been completed beforehand (e.g. an overview model or prototype), should be presented as well.

The document may not exceed 10 pages and should address the items as proposed in the following structure:

- Introduction/Background
- Problem statement
  What is the problem/opportunity addressed by the student?
- Purpose and scope of the research
  What does the student wish to achieve?
  What are the boundaries for the research?
  Which specific deliverables will be presented and how will the problem be solved?
- Approach
  Which steps will be taken in the execution of the research?
  Which techniques/resources will be used and how will these be obtained?
  What cost does the research entail, and how will it be covered through the solution's perceived advantages?

Please consult a possible supervisor at the Department for guidance on the proposal document.

Library resources

Students who have already consulted with a supervisor in the department and who have been advised to utilize the University of Pretoria's library resources may apply and register for the following programme and gain access to the library with a student card (issued by the Student Service Centre 'SSC'):

Engineering Postgraduate (Non-degree purposes)
Plan code 12290001
Masters students will be registered for the following module: ZZZ 777
Doctorate students will be registered for the following module: ZZZ 888

Policies, professional and ethical conduct

It is expected of students and lecturers to follow the University's policies and to display professional conduct in all activities related to post graduate studies, including matters such as: class conduct, plagiarism, copyright, referencing and students with special needs apply. Please visit the EBIT Faculty webpage on Research Ethics and

Integrity: (http://www.up.ac.za/en/faculty-of-engineering-built-environment-it/article/15815/faculty-committee-for-research-ethics-integrity). Application forms, Declaration by researcher- and Informed consent forms may be downloaded from the above-mentioned webpage.

Students and lecturers that intend to do research using questionairres or interacting with industries in related ways MUST obtain EBIT ethical clearance before compiling the questionnaires.

General

Fees and funding

Please refer to the "Fees and Funding webpage" (http://www.up.ac.za/fees-and-funding) which gives details regarding tuition fees, scholarships and loans. Student may contact Student Accounts at the Student Service Centre (SSC) for queries on the various fees such as application-, registration- and tuition fees. Contact detail: Tel: 012 420 3111/4111, E-mail: ssc@up.ac.za

ClickUP

ClickUP is the online learning management system of the University of Pretoria that acts as a virtual classroom. All Postgraduate students (including Masters and PhD students) will have access to ClickUP once registered. Students will be able to login via "MyTUKS Login" from the Homepage on the University of Pretoria's website. Students will then be navigated to the "UP Student Portal" where his/her registered modules (ClickUP courses for each subject and the "industrial_postgraduate_2020" departmental ClickUP course) will be listed. Each module has a unique site that contains lecturer details, study guide, course structure, prescribed material, and announcements. It also hosts facilities to conduct online discussions and e-mail communication(s). Since ClickUP is the official means through which lecturers communicate to all students, students must visit ClickUP regularly and ensure that their latest e-mail addresses are registered in ClickUP.

Additional information may be obtained from the Student Help Desk at:

- E-mail: studenthelp@it.up.ac.za
- Tel: +27 12 420 3837

***Note:**

The most recent version of the brochure will be published on the departmental website as stated above. All matters pertaining to the administration of postgraduate activities is the responsibility of the Head of the Department IE ***Although every attempt has been made to ensure that this brochure is correct and up to date at the time of publishing, the Department reserves the right to make any changes without prior notice and without prejudice. Due to the unavailability of lecturing staff, some modules may be discontinued or changed.***

Appendices

Contact Details

Department of Industrial and Systems Engineering

Honours, Masters and PhD enquiries: Curriculum, Class Timetables

Contact person	Mrs Hanli Helm
Office	Engineering II, Room 3-13
Contact details	Tel: +27(0)12 420 5230
	Fax: +27(0)12 362 5103
	E-mail: hanli.helm@up.ac.za
Webpage:	https://www.up.ac.za/industrial-and-systems-engineering
Office hours	Monday - Friday 07:30-16:00

Engineering Student Administration (EBIT)

Honours Programmes: Administration of Applications

Contact person	Ms. Sibongile Mgiba
Office	Engineering I, Room 6-9
Contact details	Tel: +27(0)12 420 5316
	Fax: +27(0)86 544 4640
	E-mail: laurrine.mgiba@up.ac.za

Honours Programmes: Administration and Registration

Contact person	Mr. Roy Mashiloane
Office	Engineering I, Room 6-9
Contact details	Tel: +27(0)12 420 3656
	Fax: +27(0)86 544 4640
	E-mail: roy.mashiloane@up.ac.za

Masters Programmes: Administration, Applications and Registration

Contact person	Ms. Stefanie Steenberg
Office	Engineering I, Room 6-5.1
Contact details	Tel: +27(0)12 420 5315
	Fax: +27(0)86 544 4640
	E-mail: stefanie.steenberg@up.ac.za

Doctorate Programmes: Administration, Applications and Registration

Contact person	Mr. Kenneth Nkanyana
Office	Engineering I, Room 6-8.1
Contact details	Tel: +27(0)12 420 6735
	Fax: +27(0)86 544 4640
	E-mail: kenneth.nkanyana@up.ac.za

Webpage	http://www.up.ac.za/faculty-of-engineering-built-environment-it
Office hours	Monday - Friday 07:30-16:00

Student Service Centre (SSC)

Enquiries on Applications student accounts, fees & funding and Bursaries & Loans

Contact details	Tel: +27(0)12 420 3111
	Fax: +27(0)12 420 4555
	E-mail: ssc@up.ac.za
Webpage	http://www.up.ac.za/enquiry
Office hours	Monday - Friday 08:00 - 16:00

Module Descriptions

BAN 780 Industrial analysis (Compulsory module, BSc Hons) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

***Compulsory only for BSc(Hons) AplSci students. Can be taken as elective module by Engineering students who did not complete an Industrial Engineering undergraduate degree. It CANNOT be taken by students who completed an Industrial Engineering undergraduate degree ***

Module content:
- Descriptive modelling: Engineering Statistics (self study)
- Predictive modelling: Simulation Modelling
- Prescriptive modelling: Operations Research

Note that the Descriptive modelling theme is assessed during the first scheduled class in block-week 1 and counts 50% of the semester mark. Study material for the theme is available on clickUP.

BAN 780 serves as pre-requisite for BDE 780.

BAO 780 Advanced aspects of Operations Research (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Decision makers are frequently faced with complex problem environments. The module introduces two advanced topics in the field of Operations Research that can assist in the development of more relevant decision support models. The first topic deals with multi objectivity and introduces a variety of interventions to incorporate the competing objectives into mathematical programming models. Secondly, the topic of Data Envelopment Analysis (DEA) is introduced, a non-parametric method used to empirically measure the productive efficiency of decision-making units. This linear programming methodology allows the decision maker to measure the productivity in complex environments with multiple inputs and outputs; uncover often-overlooked relationships between in- and outputs; and analyse and quantify the inefficiencies of every unit evaluated.

[1]BAR 780 Solution Algorithms in Operations Research (Core module) Credits: 32

Academic organisation: Industrial and Systems Engineering
*Pre-requisite: BAN 313 or BAN 780
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
When developing decision-support models using optimisation, the computational burden is often so great that exact optimal solutions are not attainable, or not efficiently found, especially in combinatorial and discrete optimisation problems. Often approximate solutions are adequate and can provide superior solutions to the current state-of-practice decision approaches. The module introduces a selection of heuristics and metaheuristics applied to a variety of problems frequently faced by Industrial Engineers. The module also introduces a methodology to test and validate heuristics to ensure robust and reliable application. The module will focus on exact, heuristic and meta-heuristic optimisation algorithms, and introducing research methodologies specifically applicable to the field of operations research.
[1]Students are encouraged to take this module in conjunction with BDE 780 and BOZ 780

BBA 781 Enterprise engineering and research methods (Core module) Credits: 32

Academic organisation: Industrial and Systems Engineering
*Pre-requisite: Information systems design (BID 320)
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module Content:
Enterprise Engineering can be defined as the body of knowledge, principles, and practices to design an enterprise. Due to their complexity and the continuously changing environment, enterprises need new approaches, tools and techniques to deliver innovative products and services to new markets in competitive environments. This module offers an introduction to the engineering design process applied to the enterprise as a system, and present existing approaches for designing, aligning and governing the enterprise. Within the design paradigm, the module also offers research methods (e.g. design research and action research) that are relevant for doing research within the enterprise engineering discipline.

The module covers:
- Background on systems thinking
- Systems design and systems engineering
- Prominent approaches for creating an enterprise engineering capability (e.g. Zachman, The Open Group, Dietz/Hoogervorst).
- Mechanisms and practices associated with different phases of enterprise design (e.g. enterprise modelling, languages, road maps, maturity assessment etc.)
- Research methods and techniques to validate and extend the EE knowledge base
- Case studies
- Change management

* *A prerequisite-knowledge test will be conducted at the start of the semester to evaluate whether the student has sufficient prerequisite knowledge to continue with the module.*

BCI 780 Supply chain information & decision technology (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Information technology is an important enabler of effective supply chain management, typically spanning the extended value chain from suppliers to customers. The timeliness and availability of relevant information are critical when applying supply chain strategies that increase service levels of and reduce cost and lead times. Value-added IT-based services are increasingly used to differentiate and develop relationships with customers.

The objective of the course is:
- To develop a sound understanding of components and priorities
- IT investment to enable supply chain integration and efficiency,
- The impact of business process change on IT implementation and selection of decision support systems
- The value of information
- Leveraging financial information
- Advanced supply chain planning and execution
- Decision support systems
- IT capabilities for supply chain excellence
- Enterprise resource planning
- Systems advanced planning and scheduling systems
- Identification technology
- Integrating supply chain IT

BCS 780 Industrial and systems engineering research (Compulsory module) Credits: 32

Academic organisation: Industrial and Systems Engineering
*Pre-requisites: Within chosen study field – Any one of the following Core modules: BBA 781, BPZ 782, BAR 780, BOZ 780, BUY 780, BGH 780, BLK 781, BVK 780.
Contact time: 24 contact hours per semester
Research percentage: Approximately 40%
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
The module affords an individual student the opportunity of studying a designated area of coherent knowledge under the tutorship of a senior staff member of the Department of Industrial and Systems Engineering. Eligibility, topic and scope of the intended project must be determined in consultation with the proposed supervisor.

BDE 780 Design and analysis of experiments (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
*Pre-requisites: BES 220 or BAN 780 or equivalent as approved by the Head of the Department. Students who have completed another statistical course must apply for acceptance to this module by writing a letter, which demonstrates equivalence of courses.
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
The design of an experiment may be defined as 'the logical construction of an experiment in which the degree of uncertainty with which the inferences are drawn may be well defined'.

The module covers:
- Principles of experimental design (randomisation, replication and blocking, local control)
- One-Factor-Two-level factorial designs
- One-Factor-Multi-level factorial designs
- Completely Randomised Design (CRD) and introduction to ANOVA
- Randomised Complete Block Design (RBD)
- Latin Square Design (LSD)
- Balanced Incomplete Block Design (BIBD)
- Factorial experiments (2nd and 3rd factorial experiments)
- Blocking and confounding in factorial designs
- Overview of fractional factorial designs

BEE 780 Inventory modelling (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
- Theory of Inventory Systems: Inventory models and modelling including time and certainty complexities, linear and non-linear systems and feedback systems
- Review of inventory models: Types and representations (classic, shortage, capacity constraint, time
- Review of important inventory papers, their approaches and their focus
- Modelling and solution techniques: characterisation and assumptions, mathematical modelling, mathematical programming, heuristics, simulation models, Control Theory and other approaches
- State of the art of modelling: current challenges and research trends
- Technological solutions of inventory modelling and management: algorithms and software, integration to MRP, ERP and scheduling modules, integration to WMS modules, and demonstrations

BES 780 Applied engineering statistics (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
This module presents an applied approach to solve real-world engineering problems. The premise of the course is that data analysis, and thus, applied statistics, is an inseparable part of conducting research and solving engineering problems. The module presents the elements of different types of statistical studies as they relate to different industrial settings. The aim of the module is to promote inductive reasoning through the gathering, analysing and interpreting of diverse types of observational data. The outcome of the module is an engineer equipped to select and apply statistical methods appropriate to an industrial setting.

The module covers:
- Contextualisation: different types of industrial processes and research settings, related types of statistical studies and a framework for understanding and applying statistics, principles of probabilistic and rational data gathering
- The use of common and specialised probability distributions (such as the Gamma, Exponential and Weibull distributions) in solving real-life problems, conducting scientific research and analysing stochastic and deterministic processes
- Data transformations: when and how to transform data
- Bridging the gap between technology and statistical analysis: The use of EXCEL in resolving basic and advanced statistical problems

BGH 780 Quality management (Core module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Professionally, engineers are confronted with issues related to product quality and performance or organisational excellence. The intention of this course is to provide an overview of the domain of modern quality management and to equip the student with theory, methodologies and tools and techniques to improve and achieve product quality and performance excellence.

The module covers:
- Contextualisation: the history, guru's, principles, industrial setting and the domain of Quality Management
- Practices of improving and achieving product quality: role in industrial engineering, online and offline quality control practices
- Frameworks of improving organisational excellence: National Quality Awards, ISO 9000 and other frameworks
- Practices of improving performance excellence: quality and competitive advantage, customer and supplier relationships, people empowerment and motivation, quality Leadership and organisational change

BHM 780 Probability models (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
The objective of the module is that students be exposed to probability theory, learn the ability to follow fairly involved theoretical reasoning, continue to learn how to reason mathematically, and solve problems of a more practical nature.

The module covers:

- Probability theory: random variables and random vectors, Sequence of random variables, transformation of probability distributions, stochastic processes: examples of stochastic processes; various types of stochastic processes
- Poisson processes: homogeneous and non-homogeneous stochastic processes with examples
- Renewal processes: renewal functions; ordinary and delayed renewal processes; regenerative stochastic processes
- Discrete-time Markov chains: continuous time Markov chains with focus on examples in reliability, queuing and inventory models

BIS 780 Information systems (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
*Pre-requisites: Information systems design BID 320, Production BPZ 410 – for Industrial Engineering students prior to 2003. Similar course presented by Information Technology
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
To introduce the student with a background in transactional application software development to a variety of aspects in the wider field of information technology. Emphasis is on the functional design of Business Intelligence systems from an Industrial Engineering perspective. The aim is to enable the student to appreciate the scope of management challenges in the integrated environment of business processes, transactional application software, data, IT infrastructure and telecommunications, data warehousing, and the necessary management information needed at various levels in an organization.

The module covers:

- Technology trends
- Context diagram of application software portfolio
- Review of typical transactional information systems
- Role of Business Intelligence and data warehousing
- Business dimensional lifecycle
- Business requirement definition
- Basic elements of the data warehouse
- Extraction, Transformation and Loading processes
- Dimensional modelling (star schema)
- Metadata
- Information delivery

BLC 780 Lean supply chain strategies and systems (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Supply chain executives need to contribute and support long-term strategic objectives by providing a competitive edge through an aligned supply chain strategy. The course addresses the impact of lean principles in supply chain management and practical approach to implementing lean thinking and demand driven supply chains. The course provides a framework for the strategic supply chain decisions, both in designing and managing an efficient extended supply chain. The latest innovations, trends and challenges in agile supply chain strategies and systems are reviewed. Team leadership skills are developed through practical applications, approaches and best practices of lean supply chain design and management. Supply chain leadership perspectives will be provided by executives and managers from industry and team-based simulation games.

The module covers:

- Fundamentals of lean management
- Lean thinking and supply chain (SC) management
- Customer value

- Network design strategies
- Supply chain integration and barriers to integration
- SC performance measurement
- Extended value chain and value stream mapping
- Eliminating waste in the supply chain
- Applying lean principles to supply chain operations
- Inventory positioning approaches
- Operational executive problems
- A3 Performance Management

BLK 781 Supply chain processes (Core module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
A key objective of supply chain management is to develop competiveness and achieve a market advantage through the implementation of cross-functional processes as the mechanism to coordinate internal and external activities. The course aims to create an understanding of the importance of integrating key supply chain business processes and to develop the ability to analyse and implement such processes across functional and corporate silos. Standardised process definitions and practices, including strategic and operational sub-processes and key performance measurements, are considered.

The module covers:
- Customer relationship management process
- Supplier relationship management process
- Customer service management process
- Demand management process
- Order fulfilment process
- Manufacturing flow management (planning & control) process
- Product development and commercialisation process
- Returns management process
- Assessment of Supply Chain Management (SCM) processes
- Implementing and sustaining SCM processes
- Supply chain mapping approaches
- Supply chain performance measurement

BMK 780 Process optimization (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
*Pre-requisites: Module only available to students with a BEng Industrial degree
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Process optimisation is an engineering discipline, which focuses on the tools and techniques used specifically for business process analysis, design, and optimisation. As physics determines the physical behaviour of tangibles, process physics forms the foundation of business process behaviour. Traditionally, operations research techniques are used by Industrial Engineers to optimise business processes, process optimisation provides a more focused approach using techniques such as Social Network Analysis, System Dynamics, image profiling and process mining to uncover analytical models. The outcome of this course is to enable the student to create an integrated, analytical business process behaviour profile. This supports the analysis, design and optimisation of business processes in a Business Engineering lifecycle. Process optimisation requires an understanding of operations research within the business engineer framework. This course requires a full understanding of undergraduate Industrial Engineering modules as well as an postgraduate understanding of resource optimisation and enterprise architecture.

The module covers:
- Standard process physics principles, facts and models
- Process Intelligence
- Adaptive process control and SMART processes
- Robustness and complexity analysis
- Process mining
- Social network analysis

[2]BOZ 780 Operations research (Core module) Credits: 32

Academic organisation: Industrial and Systems Engineering
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Building on undergraduate modules in Operations Research, the module aims to extend the mathematical programming and optimisation capabilities by introducing uncertainty. Many decision makers are confronted with complex environments in which data is not known with certainty, or in which the decision constraints are uncertain. For cases where one knows the shape, or can assume that the uncertainty follows a known probabilistic distribution, stochastic programming can be used. In the module both chance-constrained programming and fixed recourse are introduced. Fuzzy optimisation is introduced for cases where the shape and/or distribution of the uncertainty are not known. The module also addresses the uncertainty when a decision maker is confronted with multiple, competing objectives.
[2]Students are encouraged to take this module in conjunction with BDE 780 and BAR 780

BPZ 782 Manufacturing planning & control systems (Core module) Credits: 32

Academic organisation: Industrial and Systems Engineering
*Pre-requisite: Operations Management and Operations Research (advisable but not mandatorily required)
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Review of MPC, Agile Manufacturing Processes, Models of MPC (Details in the attached document).
Section 1: Review of MPC Theories and Framework
Section 2: Research Framework for Problems in Manufacturing Systems
- Mathematical Model based Problems and their techniques
- Estimation and Hypothesis based Problems and their techniques

Section 3: Introduction to MPC Problems and sample Models
- Forecasting models
- Aggregate planning models
- Lot sizing and disaggregation models
- Finite Scheduling models
- Lean Manufacturing Models
- Basic Distribution and Replenishment Models
- Basic Supply Chain Structural Analysis and Performance Models

Section 4: Agile Panning Problems and Techniques
- Multi-Level Master Scheduling Techniques
- Constraint Scheduling – (TOC theory, applications and optimisation)
- Lean Manufacturing Implementation (from Flow Lean to Process Kaizen)
- Introduction to CONWIP ideology
- Introduction to Demand Driven MRP

BSI 780 Business engineering (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Organisations are complex systems, which consist of people, processes, customers, resources and regulatory environments. Business Engineering (BE) is a discipline which uses an engineering approach towards introducing planned business change into the organisation. This includes formal analysis, design, implementation and maintenance of the holistic business system; requiring a deep understanding and knowledge of the interaction and balance of complex business system elements. The outcome of the course is to enable the student to understand the art and science of engineering complex business systems. Business engineering is the ultimate pinnacle of industrial engineering competency – being able to construct business systems serving complicated organisational value propositions. The course requires a full understanding of undergraduate Industrial Engineering modules as well as a postgraduate understanding of resource optimisation, enterprise architecture, and supply chain engineering.

The module covers:
- BE principles for design, implementation and optimisation of complex business systems
- BE programme process which governs the implementation of holistic business changes
- BE programme and project structures
- BE Tools and techniques used throughout the BE lifecycle for engineering modelling and optimisation.
- Business
- Models and innovation approaches
- Integrated Business planning
- Business Process reference models for strategic, tactical, core and support processes.

BSS 780 Systems Engineering (Elective Module) Credits: 32

Academic organisation: Industrial and Systems Engineering
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Systems engineering is a multi-disciplinary engineering profession that focuses on the conception, design and development, integration, architecture and management of complex systems over their life cycle. It does this by creating, executing and coordinating an interactive platform for all stakeholders viz: clients, consumers, design team/technical crew and management team amongst others. Complexity of systems hinges on diversity, multiplicity and intricacy of intra and inter-connectivity of system entities. This module will commence briefly with some introductory knowledge prior to diverting to intermediate and advanced concepts with specific attention given to case studies, development and application of models and emergence of research opportunities.

The module covers:
Case Based Systems Engineering Management:
- Concept Design: Identifying requirements, Exploring Concepts, Evaluating Concepts, Defining Concepts;
- Engineering Design: Deployment of CORE9 for Systems Architecting and Integrating;
- Post-Development Considerations:
- Production Systems Design, Operations and Logistics in a Systems life cycle;

Systems Engineering Analysis:
- Modelling of Case Study Dynamical Systems,
- Risk Modelling throughout a System's Life Cycle,
- Adaptive and predictive behaviour of systems,
- Optimal Network Selection and Complexity Issues in System Dynamics;

Complexity of Interaction in Systems:
- Internet of things (IoT),
- Relationship of things (RoT),

- Interaction Dynamics,
- Social Engineering,
- System's Performance-failure dynamics
- Human-Machine Systems Interaction and AI Systems

BTH 780 Reliability engineering (Elective module) Credits: 16

Academic organisation: Industrial and Systems Engineering
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
To make students conversant with the concepts, tools and techniques of reliability engineering
The module covers:
- Introduction to reliability engineering
- Reliability mathematics
- Probability plotting
- Reliability prediction for design
- Reliability testing
- Reliability growth
- Maintainability
- Reliability management

BUY 780 Simulation modelling (Core module) Credits: 32

Academic organisation: Industrial and Systems Engineering
*Pre-requisite: BAN 313 or BAN 780
Contact time: 36 contact hours per semester
Period of presentation: Semester 1 or 2
Research percentage: Approximately 40%
Language of instruction: English

Module content:
In recent years the boundaries between different simulation paradigms such as discrete event simulation, system dynamics and agent-based models have become less distinct. Improvements in computational efficiency also allow much richer and complex models to be built. This course introduces agent-based models (ABM) as a class of computational models that deal with autonomous agents and their interactions with other agents, and their surrounding environments. Course content covers basic theoretical foundations of ABM and then focuses on a few specific application areas where ABM is used for decision-making: pedestrian and transport models; production and logistics; as well as biology.

BVK 780 Supply chain design (Core module) Credits: 16

Academic organisation: Industrial and Systems Engineering
*Pre-requisites: BLK 781 Supply chain processes
Contact time: 24 contact hours per semester
Period of presentation: Semester 1 or 2
Language of instruction: English

Module content:
Strategic design of supply chain networks, inventory management and supply chain integration. Framework for strategic alliances and third party logistics. Analysis and application of alternative supply chain reference models as the basis for modelling, analysis and improvement.

The module covers:
- Supply chain network design
- Strategic management of inventory
- Supply chain integration

- Strategic alliances
- Coordinated product and supply chain design
- Supply chain modelling (SCOR, VRM)

The following modules will <u>NOT be offered</u> by the IE department in 2020:

Advanced aspects of operations research	BAO 780	(Elective module)
Solution algorithms in operations research	BAR 780	(Core module)
Supply chain information & decision technology	BCI 780	(Elective module)
Design and analysis of experiments	BDE 780	(Elective module)
Inventory modelling	BEE 780	(Elective module)
Applied engineering statistics	BES 780	(Elective module)
Quality management	BGH 780	(Core module)
Probability models	BHM 780	(Elective module)
Information systems	BIS 780	(Elective module)
Lean supply chain strategies and systems	BLC 780	(Elective module)
Process optimization	BMK 781	(Elective module)
Business engineering	BSI 780	(Elective module)
Systems engineering	BSS 780	(Elective module)

Honours Class Timetable

2020

First Semester 2020																									
Subject	Contact	Time	March (*BW 1)					April (*BW 2)					June (*BW 3)					June (Exam)					Venue:
			9	10	11	12	13	20	21	22	23	24	1	2	3	4	5	22	23	24	25	26	
*Industrial Analysis (BAN 780)	Prof Johan Joubert 012 420 2843 Dr Wilna Bean 012 420 6706	08:00-12:00																					Eng II 3-40 (*BW 1)
		13:00-17:00																					
Supply Chain Processes (BLK 781)	Mr Johan de Villiers 012 492 1001	08:00-12:00																					Eng II 3-40 (*BW 1)
		13:00-17:00																					
Enterprise Engineering (BBA 781)	Prof Marne de Vries 012 420 2038	08:00-12:00																					Eng II 3-40 (*BW 1)
		13:00-17:00																					
Manufacturing Planning & Control Systems (BPZ 782)	Dr Olufemi Adetunji 012 420 5229	08:00-12:00																					Eng II 3-40 (*BW 1)
		13:00-17:00																					

***BCS 780** (Industrial & Systems Engineering Research) **Information Session** Video Recording available at the following link:
http://www.up.ac.za/en/industrial-and-systems-engineering/article/45575/postgraduate

Second Semester 2020																									
Subject	Contact	Time	August (*BW 1)					Sept. / Oct. (*BW 2)					November (*BW 3)					Nov (Exam)					Venue:
			17	18	19	20	21	28	29	30	1	2	2	3	4	5	6	23	24	25	26	27	
Operations Research (BOZ 780)	Dr Wilna Bean 012 420 6706	08:00-12:00																					To be confirmed
		13:00-17:00																					
Simulation Modeling (BUY 780)	Prof Johan Joubert 012 420 2843	08:00-12:00																					To be confirmed
		13:00-17:00																					
Supply Chain Design (BVK 780)	Mr Johan de Villiers 012 492 1001	08:00-12:00																					To be confirmed
		13:00-17:00																					
Reliability Engineering (BTH 780)	Prof Sarma Yadavalli 012 420 2979 Dr Michael Ayomoh 012 420 2832	08:00-12:00																					To be confirmed
		13:00-17:00																					

***BCS 780** (Industrial & Systems Engineering Research) **Information Session** Video Recording available at the following link:
http://www.up.ac.za/en/industrial-and-systems-engineering/article/45575/postgraduate

*'BW' Refers to Block Week

***BCS 780 is compulsory for all Hons students -** please refer to page 11 of the PG Guide for **pre-requisites.**

*BAN 780 is compulsory for all BScHons ApISci students

Class sessions are scheduled from either 08:00 - 12:00 AM or 13:00 - 17:00 PM

Class Sessions

Exams

IMPORTANT NOTES:

1. Please ensure to check for timetable clashes when choosing electives from other Departments, it will not be the obligation of the Department

Last Updated: 2020-03-02

Prof. VSS Yadavalli
Acting Head: Department of Industrial and Systems Engineering