

**'EMA2602  
RRM2602**

May/June 2017

**ENGINEERING MANAGEMENT II (MODULE B)**

Duration 2 Hours

100 Marks

**EXAMINERS**

FIRST

SECOND

EXTERNAL

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**Use of a non-programmable pocket calculator is permissible****Closed book examination****This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue**

This examination paper consists of 13 pages (including this page)

Answer all the questions in the answer book

**QUESTION 1**

This question consists of multiple-choice questions. Answer them in your answer book. Read through the instructions below

**Instructions:**

- (i) Suppose a question reads as follows.

Which of the following statements is/are **correct**?

- a) Good employment relations will usually result in improved employee productivity
- b) Good employment relations will usually result in reduced absenteeism
- c) One of the main functions of a trade union is to negotiate better wages and working conditions on behalf of its members

- [1] a
- [2] a and c
- [3] a, b and c
- [4] b and c
- [5] c

In this case, all three of the statements (a, b and c) are correct and, therefore, you would write [3] in your answer book next to the number of the question

- (ii) Write down only one of the options (1 to 5) for each question.
- (iii) You will receive two marks for a correct answer. No marks will be deducted for incorrect answers.
- (iv) Question 1 consists of 10 questions and is marked out of 20.
- (v) **Write your answers to the questions in your answer book. Write down the number of the question and, next to it, the number of the option you have selected, for example:**

- 1.1 [5]
- 1.2 [4]
- 1.3 [3]

PLEASE TURN OVER

**QUESTION 1 (Multiple-choice questions)**Employment relations and labour legislation

1 1 Read the following three statements

- a) The Basic Conditions of Employment Act applies to employees and employers in the minerals industry
- b) In terms of the Basic Conditions of Employment Act (BCEA) an employer must give employees who work continuously for at least five hours a meal interval of at least 20 minutes
- c) In terms of the BCEA work performed after 18 00 and before 06 00 the next day is classified as night work

Which of the above statements is/are **correct**?

(2)

- [1] a
- [2] a and c
- [3] a, b and c
- [4] b and c
- [5] None of the options (1, 2, 3 or 4) is correct

1 2 Read the following three statements

- a) An employee who works on a public holiday must receive 1,5 times the ordinary wage for that day
- b) An employee is entitled to 14 consecutive days' annual leave per leave cycle
- c) An employer is not required to pay an employee while she is on maternity leave

Which of the above statements is/are **correct**?

(2)

- [1] a
- [2] a and c
- [3] a, b and c
- [4] b and c
- [5] None of the above options (1, 2, 3, or 4) are correct

1 3 Read the following three statements

- a) When an employee is dismissed owing to operational requirements, the employer must pay the employee at least two weeks' salary for each year of continuous service
- b) In terms of the Basic Conditions of Employment Act it is a criminal offence to employ a child who is under 15 years of age

PLEASE TURN OVER

- c) Independent contractors are covered by the Labour Relations Act but not by the Basic Conditions of Employment Act.

Which of the above statements is/are **correct**? (2)

- [1] a
- [2] a and c
- [3] a, b and c
- [4] b and c
- [5] None of the options (1, 2, 3 or 4) is correct

1 4 Read the following three statements

- a) The UIF provides benefits and security for unemployed people
- b) Employers who employ 10 or more workers must appoint safety representatives
- c) The Compensation for Occupational Injuries and Diseases Act applies to employees who were involved in an accident while being transported to and from work free of charge by the employer

Which of the above statements is/are **correct**? (2)

- [1] a
- [2] a and c
- [3] a, b and c
- [4] b and c
- [5] None of the options (1, 2, 3 or 4) is correct

#### Engineering contracts and law

1 5 Which **one** of the following statements is **correct**? (2)

If a party to a contract indicates that he/she does **not** intend to perform in terms of the contract, there is a breach of contract in the form of

- [1] *mora debitoris*
- [2] repudiation
- [3] positive malperformance
- [4] prevention of performance

1 6 Read the following three statements

- a) *Mora creditoris* means "delay of the creditor".
- b) An offer lapses or expires when a counter-offer is made
- c) In terms of a contract, a debtor is a person who has a duty to perform

PLEASE TURN OVER

Which of the above statements is/are **correct**?

(2)

- [1] b and c
- [2] a and c
- [3] a and b
- [4] a, b and c
- [5] None of the options (1, 2, 3 or 4) is correct

Total quality management (TQM)

1 7 Read the following three statements

- a) The prevention of future quality problems is a key responsibility of new product development teams
- b) Quality function deployment is a formal method for transforming customer requirements into technical requirements
- c) For a process to be at Six Sigma it must have fewer than 3,4 defects per one thousand opportunities for error

Which of the above statements is/are **correct**?

(2)

- [1] a and b
- [2] a and c
- [3] a, b and c
- [4] a
- [5] None of the options (1, 2, 3 or 4) is correct

The engineer, user of information systems

1 8 Read the following three statements

- a) E-commerce is about the buying, selling, marketing and servicing of products and services across a variety of networks
- b) "Bricks and clicks" is a hybrid business model whereby companies use both traditional and e-business
- c) One of the reasons why internet security is not good is because the WWW project was started by Tim Berners-Lee at CERN as a means to share research and ideas with employees and researchers around the world. He probably did not consider hackers when the project was initiated

Which of the above statements is/are **correct**?

(2)

- [1] b and c

PLEASE TURN OVER

- [2] a and b
- [3] a, b and c
- [4] b
- [5] None of the options (1, 2, 3 or 4) is correct

Managing technology and innovation

1 9 Read the following three statements

- a) The appropriability problem deals with the problem of how innovators can protect their innovations and enjoy the benefits of the money that can be generated from such intellectual property
- b) Patenting is the only mechanism for protecting intellectual property
- c) Tacit knowledge is the knowledge embedded in the people and the processes in the company that is difficult to codify and to transfer to others

Which of the above statements is/are **correct**? (2)

- [1] a, b and c
- [2] b and c
- [3] a
- [4] a and c
- [5] None of the options (1, 2, 3 or 4) is correct

Entrepreneurship

1 10 Read the following three statements

- a) Innovation and creativity are key drivers for the entrepreneur
- b) The complaints of family, friends and colleagues regarding products and poor service can be a source of business ideas
- c) Trade fairs and exhibitions are potential sources of business ideas

Which of the above statements is/are **correct**? (2)

- [1] a
- [2] b and c
- [3] a and c
- [4] a, b and c
- [5] None of the options (1, 2, 3 or 4) is correct

[20]

PLEASE TURN OVER

**QUESTION 2 (Employment relations and labour legislation)**

- 2 1 Employees, employers and the state are the three groups of participants (role players) in the employment relations system. Briefly outline their functions and roles (3)
- 2 2 Explain the difference between a strike and a lock-out (4)
- 2 3 One of the female miners at a mine has been sexually harassed underground. How should this situation be managed in terms of the mine's disciplinary code and hearing procedure? The alleged male perpetrator has been identified (10)
- [17]**

**QUESTION 3 (Engineering contract and law)**

- 3 1 Explain what a contract is and when an agreement can be considered a contract (i.e. the requirements of a contract) (7)
- 3 2 Define "duress" and state what the consequences of duress could be when drawing up a contract (2)
- 3 3 Briefly explain what a mistake is with regard to a contract (2)
- 3 4 Match each of the following terms of contract with its correct definition. In your answer book, write down the number of each term and, next to it, the letter representing the correct option, e.g. 1. j (6)

1 Condition	a Determines a specific time or period within which a contract will either become operative or be dissolved
2 Time clause	b A contractual term whereby a contracting party assumes absolute liability for proper performance
3 Supposition	c A clause that entitles a contracting party to summarily cancel the contract due to the other's breach
4 Warranty	d A clause that states that the party who commits breach of contract must render a specified performance to the aggrieved party
5 Cancellation clause	e A contractual term that renders the operation of a contract dependent on an event that has already taken place

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6 Penalty clause	f A contractual term that renders the operation and consequences of a contract dependent on the occurrence or non-occurrence of a specific uncertain future event
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[17]

**QUESTION 4 (Total quality management)**

Please read through the following case study

**Case study: Granite Rock Company**

Granite Rock Company is a 111-year-old, family-owned company based in Watsonville, California, USA. It produces rock, sand, gravel aggregates, ready-mix concrete and asphalt for sale to commercial and residential builders and highway construction companies. The company also retails building materials made by other manufacturers and runs a highway paving operation. It employs 700 people, distributed among branch offices, several quarries and 15 batch plants.

Granite Rock operates in a competitive marketplace in which customers demand high quality and most competitors are owned by multinational construction material companies with considerable financial backing. Because the products Granite Rock sells are commodities, it is difficult to differentiate one supplier from another and customers typically buy from the lowest bidder. One factor that separates Granite Rock from its tough competition is quality. Since 1980, Granite Rock has increased its market share significantly. Productivity also has increased, with revenue earned per employee rising to about 30 % above the national industry average. Most of the improvement has been realised since 1985, when Granite Rock started its Total Quality Programme. The programme stresses satisfying two types of customers: the contractor, who normally makes purchasing decisions, and the end-point customer, who ultimately pays for the buildings or roads made with Granite Rock materials. By emphasising the hidden costs associated with slow service and sub-standard construction materials, such as rework and premature deterioration, the company is convincing a growing number of contractors of the value of using its high-quality materials and unmatched service. As a result of its investments in computer-controlled processing equipment and widespread use of statistical process control, Granite Rock can assure customers that its materials exceed specifications. Also, customers can be confident about on-time delivery. Granite Rock's record for delivering concrete on time, a key determinant of customer satisfaction, rose from less than 70% in 1988 to 98,5% in 2010. Charts for each product line help assess Granite Rock's performance relative to competitors on key product and service characteristics, ranked according to customer priorities. The company's objective is to obtain a 10% lead over its nearest competitor for each performance indicator. Coordination across divisions is fostered by 10

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Corporate Quality Teams that oversee and help align improvement efforts across the entire organisation. Although senior executives chair committees, members include managers, salaried professional and technical workers, and hourly union employees. Teams carry out quality improvement projects and many day-to-day activities and operations. In 1991, nearly all workers took part in at least one of the company's 100-plus quality teams. As part of Granite Rock's effort to reduce process variability and to increase product reliability, many employees are trained in statistical process control, cause-and-effect analysis and other total quality management (TQM) and problem-solving methods. This workforce capability helps the company exploit the advantages afforded by investments in computer-controlled processing equipment. Its newest batch plant features a computer-controlled process for mixing batches of concrete, enabling real-time monitoring of key process indicators. The electronically controlled system with which Granite Rock helped a supplier design the reliability of several key processes has reached the Six Sigma level. Applying statistical process control to all product lines has helped the company reduce variable costs and produce materials that exceed customer specifications and industry- and government-set standards. Granite Rock's concrete products, for example, consistently exceed the industry performance specifications by a considerable amount. A primary reason why Granite Rock is so successful at meeting customer needs is that the company takes great pains to find out what customers want, what they like about Granite Rock and what needs improving. Each time customers do business with Granite Rock, the company asks them to fill out "quick response" cards that give them the opportunity to comment on the service and products they received that day. Every year since 1987, the company has conducted an annual survey that allows customers to compare the company with its competitors. Every three to five years, more detailed surveys are conducted.

Customer complaints are handled through product/service discrepancy reports that require analysis of the problem and identification of the root cause. Ultimate customer satisfaction is assured through a system where customers can choose not to pay for a product or service that does not meet expectations. Costs incurred in resolving complaints are equivalent to 0.2 % of sales, compared with the industry average of 2 %. In 1992, Granite Rock won the prestigious Malcolm Baldrige National Quality Award, and most recently in 2011, the company won the National Asphalt Pavement Association's Quality in Construction Award.

(Source. 3rd edition of *Management for engineers, technologists and scientists*, pp 162–163)

#### Required

Discuss the TQM principles used by the Granite Rock Company. Describe how the company is applying them. Also choose an organisation of your choice and describe what it is doing to improve

PLEASE TURN OVER

the quality of its products and services. Explain what can still be done to improve the quality of products and services of this company still further

[12]

#### **QUESTION 5 (The engineer, user of information systems)**

- 5 1 Explain why a business should gather data and information (2)
- 5 2 Briefly explain how information technology and information systems can be used to improve services, competitiveness and efficiency (4)
- 5 3 Briefly discuss the purpose of a decision support system (2)
- 5 4 In its Global Risks Report 2016 the World Economic Forum (WEF) identified a number of risks. It found that the risk of large-scale cyberattacks continues to be considered a high impact/high likelihood risk. Briefly explain why the WEF came to this conclusion (4)

[12]

#### **QUESTION 6 (Managing technology and innovation)**

##### **Mini case study: The evolution of human body scanning technology**

##### Background information

In the second half of the 1800s, many entrepreneurs who obtained the rights to claims (small pieces of land) started to mine diamonds in Kimberley, South Africa. Many of these claims were next to one another on a kimberlite pipe that had been formed when molten magma and diamonds were pushed from deeper down to the earth's surface. Each claim was usually mined by small teams of workers. At times the diggings of adjacent claims were at different depths, giving rise to safety and other practical problems. This is probably one of the reasons why claim holders were willing to sell their claims to larger companies such as De Beers, who combined the small claims to mine kimberlite pipes on a large scale.

One problem that the large companies experienced was that of diamond theft. Rather than handing diamonds to their supervisors, some miners and mine workers sold diamonds to diamond traders for their own benefit. The large companies introduced searches of employees after each shift as a result of this, but these employees became more innovative in hiding diamonds by, for example, hiding them in the soles of their shoes. The situation escalated further, strip searches were

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introduced, resulting in the first strike by white diamond miners in 1883 and the swallowing of diamonds by some employees (Bezuidenhout 2016 17) It is clear that a better, more dignified method was required to search employees

In 1895 X-rays were discovered by Wilhelm Roentgen while he was working with a cathode ray tube in his laboratory It took a number of years after this discovery before X-ray machines were developed and adopted by the medical profession By the 1930s X-ray machines were central to hospital diagnosis ([www.sciencemuseum.org.uk](http://www.sciencemuseum.org.uk))

Please read the short article below

**Article - SA company designing, manufacturing 'unrivalled' digital X-ray scanner**

South African medical engineering group Lodox Systems will release the fourth version of its digital X-ray screening technology, dubbed the Xmplar-dr, which the company says is "unrivalled" as the world's only high-speed full-body digital scanning device

Originally developed in the 1990s as a security device to prevent the theft of diamonds by workers at mining giant De Beers' operations, the scanner was later adapted for use in medical trauma management to provide an almost instant diagnostic image of a patient's injuries

Earlier versions of the scanner, which is fully locally designed and manufactured, are currently in operation at over 40 healthcare institutions worldwide, including at the Chris Hani Baragwanath hospital, in Soweto, and Inselspital Bern, in Switzerland

Lodox CEO Pieter de Beer explained that the exceptional feature of the Xmplar-dr is that it takes only 13 seconds to produce an accurate full-body overview of injuries and foreign bodies in a patient, as opposed to a conventional X-ray machine, which requires several minutes and various individual X-rays to compile a full-body image

The technology employs a proprietary linear X-ray beam, which produces fewer harmful scattered X-ray photons than a conventional wide-beam system, while generating an inherently higher image quality and resolution

In addition, the device emits a radiation dose of 0.12 milligray - up to ten times less radiation than a conventional X-ray system

"No other device can provide clinicians with such a fast and accurate picture of a patient's entire body, in combination with such a low radiation dose, which means that the device can be used

PLEASE TURN OVER

directly in emergency rooms, without the need for a separate X-ray unit," he told *Engineering News Online*

He added that in forensic pathology environments, the Lodox technology provides a user-friendly, high-speed method of assessing a subject's entire body, in multiple planes, to assist with pathology location, and is particularly useful in determining the location of bullets in gunshot victims

This eliminates the need to move the subject to obtain the required view from several angles

"In trauma settings, the scanner also permits easy access to the patient to allow monitoring and resuscitation to take place in conjunction with the scanning process, which is impossible with a conventional X-ray process," said De Beer

While the group's primary healthcare markets were the medical trauma, medico-legal and medico-forensic sectors, applications for the scanner beyond these disciplines were being investigated, including its use in paediatric and bariatric medicine

Commenting on the value of the scanner, De Beer said Lodox instituted varied pricing structures for the local public healthcare market, the local private healthcare market and the international healthcare sector

"As a subsidiary of development financier, the Industrial Development Corporation, which is our 95% shareholder, we want to keep the machine as cost effective as possible so that it is accessible for the South African public healthcare sector. As such, the local selling price to public hospitals is around R4-million, while the cost increases to up to R5-million for the international market," he commented

Currently producing around 24 scanners a year, the group said it aimed to have a scanner in all local tertiary hospitals, as well as most district hospitals, in the next two to three years

"We expect to sell between 14 and 16 machines in the next year and to align current production capacity with demand in the year thereafter," said De Beer

The Lodox Xmplar-dr scanner was featured on season nine, episode 18 of US medical drama series *Grey's Anatomy*

(Source: *Engineering News Online*)

Required

PLEASE TURN OVER

- i) List the different stages of the linear “science push” model of the innovation process (5)
- ii) Apply the linear science push model of innovation to the development and commercialisation of the Lodox Xmplar-dr scanner where possible. Mention some of the criticisms against the linear model. Explain if the development and commercialisation of the Lodox Xmplar-dr scanner conform fully to the linear model of the innovation process. You may develop your own model to explain the nature of the innovation process as illustrated in this or other case studies (10)

### References

Bezuidenhout, A. 2016. Stryd met diep wortels. *Beeld* 6 December 17

Greve, N. 2013. SA company designing, manufacturing ‘unrivalled’ digital X-ray scanner. Available at <http://www.engineeringnews.co.za/article/sa-company-designing-manufacturing-unrivalled-digital-x-ray-scanner-2013-06-10> (accessed on 13/01/2017)

[15]

### QUESTION 7 (Entrepreneurship)

Match each concept on the left of the table with its definition, example or closest related issue on the right of the table below. In your answer book, write down the number of each term and, next to it, the letter representing the correct option, e.g. 1 j.

[10]

1 Sole trader	a An entrepreneur who works for a corporation
2 Entrepreneur	b KFC
3 Intrapreneur	c Defines how the entrepreneur/management intends to capitalise on a business opportunity
4 Source of a business idea	d Business losses can be deducted from owners' personal income
5 Example of a franchise	e A person who spots a gap in the market and conceptualises and evaluates a business idea to fill that gap
6 Business plan	f The complaints of family, friends and colleagues regarding products and poor service
7 Partnership	g Suited to knowledge-based, professional organisations

Total 100